Hawaii Range Complex

Supplement to the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement (DEIS/OEIS)

February 2008

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HAWAII RANGE COMPLEX
SUPPLEMENT TO THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT/
OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

FEBRUARY 2008

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COVER SHEET
SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT/ OVERSEAS ENVIRONMENTAL IMPACT STATEMENT
HAWAII RANGE COMPLEX (HRC)

Lead Agency for the EIS: U.S. Department of the Navy

Title of the Proposed Action: Hawaii Range Complex

Affected Jurisdiction: Kauai, Honolulu, Maui, and Hawaii Counties

Designation: Supplement to the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/OEIS)

Abstract

This Supplement to the DEIS/OEIS for the Hawaii Range Complex (HRC) that was filed by the U.S. Department of the Navy (Navy) with the U.S. Environmental Protection Agency in July 2007 has been prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code § 4321 et seq.); the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] §§ 1500-1508); Navy Procedures for Implementing NEPA (32 CFR § 775); and Executive Order 12114, Environmental Effects Abroad of Major Federal Actions. In the July 2007 DEIS/OEIS Revision 1 (hereinafter referred to as the DEIS/OEIS), the Navy identified the need to support and conduct current, emerging, and future training and research, development, test, and evaluation (RDT&E) activities in the HRC. The three alternatives—the No-action Alternative, Alternative 1, and Alternative 2—were analyzed in the DEIS/OEIS. The No-action Alternative stands as no change from current levels of training usage and includes HRC training, support, and RDT&E activities, Major Exercises, and maintenance of the technical and logistical facilities that support these events and exercises, and the monitoring of marine mammals. Alternative 1 includes all ongoing training associated with the No-action Alternative, an increased tempo and frequency of such training and new training, enhanced and future RDT&E activities, enhancements to optimize HRC capabilities, and Major Exercises. Alternative 2 would include all of the training described in Alternative 1 at an increased tempo and frequency, enhancement of RDT&E activities, future RDT&E activities, and additional Major Exercises, such as supporting three Strike Groups training at the same time. A newly proposed alternative, Alternative 3, would include all training and RDT&E activities described in Alternative 2 with reduced mid-frequency and high-frequency active (MFA/HFA) sonar hours (i.e., MFA/HFA sonar hours at the same level as proposed for the No-action Alternative). Alternative 3 is the Navy's preferred alternative.

As described in the DEIS/OEIS, a dose function approach was used to evaluate marine mammal behavioral responses to MFA/HFA sonar in the HRC. The Navy and National Marine Fisheries Service (NMFS) modified the analytical methodology following the publication of the DEIS/OEIS, resulting in the development of a risk function (formerly the dose function). The risk function estimates the probability of behavioral responses that NMFS would classify as harassment for the purposes of the Marine Mammal Protection Act (MMPA) resulting from exposure to specific received levels of MFA sonar. The risk function is a mathematical function adapted from a solution in Feller (1968) as defined in the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar Final OEIS/EIS and relied on in the Supplemental SURTASS LFA Sonar EIS with input parameters modified by NMFS for MFA sonar for mysticetes (baleen whales), odontocetes (toothed whales, dolphins, and porpoises), and pinnipeds (seals, sea lions, and fur seals) and for HFA sonar. The analysis in this Supplement to the DEIS/OEIS also considers more accurate numbers of sonar operating hours from the Navy's Sonar Positional Reporting System and includes post modeling analysis to reduce overestimation of effects that were previously documented in the DEIS/OEIS.

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Executive Summary

EXECUTIVE SUMMARY

Introduction

In July 2007, the U.S. Department of the Navy (Navy) published the Hawaii Range Complex (HRC) Draft Environmental Impact Statement/Overseas Environmental Impact Statement, Revision 1 (hereinafter referred to as the DEIS/OEIS) (U.S. Department of the Navy, 2007c) which identified and addressed potential environmental impacts associated with sustainable range usage and enhancements within the Navy's HRC. The HRC DEIS/OEIS analyzed alternatives being considered to support and conduct current and emerging training and research, development, test, and evaluation (RDT&E) activities in the HRC and upgrade or modernize range complex capabilities to enhance and sustain Navy training and RDT&E. One critical analysis in the DEIS/OEIS concerned potential impacts to marine mammals from Navy acoustic sources. This Supplement to the DEIS/OEIS supplements that July 2007 analysis, narrowly focusing on the following three areas:

- Modifications to the analytical methodology used to evaluate the effects of MFA sonar on marine mammals;
- Changes to the amount and types of sonar allocated to each of the alternatives; and,
- Development of a new alternative.

Like the DEIS/OEIS, the primary acoustic concern of this Supplement to the DEIS/OEIS is on the potential effects of the use of mid-frequency active (MFA) sonar. Effects from high-frequency active (HFA) sonar as analyzed in this Supplement pertain to the use of the MK-48 torpedo and remain unchanged from the assessment that is presented in the DEIS/OEIS.

Given the changes to the DEIS/OEIS, the Navy determined that preparation of a Supplement to the DEIS/OEIS was appropriate. The preparation and circulation of this Supplement will allow the public to undertake a full and complete review and have the opportunity to comment on the proposed risk function methodology, changes in amount and types of sonar proposed for use, and the assessment of a new alternative. However, it is important to recognize that this Supplement to the DEIS/OEIS is not a stand-alone document. Therefore, the HRC DEIS/OEIS should be reviewed for information on the overall HRC training and RDT&E proposal.

The Supplement to the DEIS/OEIS will be distributed for public review, and public hearings will be announced. Comments received during the public review period, including comment received during the public hearings held on the Supplement to the DEIS/OEIS, as well as all comments received on the DEIS/OEIS, will be incorporated into the HRC Final EIS/OEIS.

Each of the differences between the DEIS/OEIS and the Supplement to the DEIS/OEIS is summarized below.

Modifications to the Analytical Methodology

The first difference between the DEIS/OEIS and the Supplement to the DEIS/OEIS concerns modifications to the analytical methodology used to evaluate marine mammal behavior responses to MFA sonar in the HRC. The DEIS/OEIS relies on the use of a dose function analytical approach in this regard. Following publication of the DEIS/OEIS, the Navy continued working with the National Marine Fisheries Service (NMFS) to define a mathematically representative curve and applicable model input parameters that would be more appropriate than that used in the DEIS/OEIS. Based on NMFS' guidance (National Marine Fisheries Service, 2008), the Navy is implementing a mathematical function adapted from a solution in Feller (1968) as defined in the Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar Final OEIS/EIS (U.S. Department of the Navy, 2001), and relied on in the Supplemental SURTASS LFA Sonar EIS (U.S. Department of the Navy, 2007a) to assess the MFA sonar risk for behavioral harassment, with input parameters modified by NMFS for MFA sonar for mysticetes (baleen whales), odontocetes (toothed whales), and pinnipeds (monk seals) for purposes of the HRC analysis.

Following application of the risk function, this Supplement to the DEIS/OEIS includes further post acoustic modeling analysis of the results of the acoustic model to provide a more accurate assessment of potential effects. This further analysis addresses the presence of land masses, the actual acoustic footprint when multiple ships are training together, and the NMFS defined refresh rate of 24 hours, which represents the amount of time in which individual marine mammals can be counted as harassed no more than once.

Changes to the Amount and Type of Sonar

The second difference between the DEIS/OEIS and this Supplement to the DEIS/OEIS concerns the amount and type of sonar that is analyzed. Sonar hours for this Supplement are based on the Sonar Positional Reporting System (SPORTS). SPORTS is a database tool that was established by Commander, U.S. Fleet Forces Command in March 2006 to determine geographic locations of sonar use. All commands employing MFA sonar and sonobuoys have been required to populate the SPORTS database by reporting MFA sonar use on a daily basis. After publication of the DEIS/OEIS, the Navy determined that SPORTS could also be a useful tool in refining the estimated sonar hour usage originally collected and analyzed in the DEIS/OEIS. Accordingly, SPORTS data was used in this Supplement to the DEIS/OEIS to assist in determining the amount of MFA sonar use for each alternative for purposes of modeling potential effects to marine mammals. As previously noted, estimates of HFA sonar use (MK-48) remain unchanged from that presented in the DEIS/OEIS.

The MFA acoustic sources assessed in this Supplement to the DEIS/OEIS are the same as those described in the DEIS/OEIS. For modeling purposes, however, the sonar hours attributed to the AN/SQS 56, dipping sonar, and submarine sonar are now included in the analysis using the parameters for those systems. The resultant changes in sonar hours for modeling are presented below (Tables ES-1 to ES-3).

Table ES-1. Summary of Sonar Hour Changes for the No-action Alternative

DEIS/OEIS Hours/Events Modeled		Supplement to the DEIS/OEIS Hours/ Events Modeled	
DEIS/OEIS Totals		**Supplement to the DEIS/OEIS Totals**	
Source	**Modeled**	**Source**	**Modeled**
53	3,495 hours	53	1,284 hours
		56	383 hours
Dipping	912 dips	Dipping	1,010 dips
Sonobuoy	2,540 buoys	Sonobuoy	2,423 buoys
MK-48	313 runs	MK-48	313 runs
		Submarine	200 hours

Table ES-2. Summary of Sonar Hour Changes for Alternative 1

DEIS/OEIS Hours/Events Modeled		Supplement to the DEIS/OEIS Hours/ Events Modeled	
DEIS/OEIS Totals		**Supplement to the DEIS/OEIS Totals**	
Source	**Modeled**	**Source**	**Modeled**
53	4,027 hours	53	1,788 hours
		56	551 hours
Dipping	1,248 dips	Dipping	1,517 dips
Sonobuoy	3,020 buoys	Sonobuoy	3,127 buoys
MK-48	317 runs	MK-48	317 runs
		Submarine	200 hours

Table ES-3. Summary of Sonar Hour Changes for Alternative 2

DEIS/OEIS Hours/Events Modeled		Supplement to the DEIS/OEIS Hours/ Events Modeled	
DEIS/OEIS Totals		**Supplement to the DEIS/OEIS Totals**	
Source	**Modeled**	**Source**	**Modeled**
53	5,179 hours	53	2,496 hours
		56	787 hours
Dipping	1,488 dips	Dipping	1,763 dips
Sonobuoy	3,542 buoys	Sonobuoy	3,528 buoys
MK-48	374 runs	MK-48	374 runs
		Submarine	200 hours

Development of a New Alternative (Alternative 3—Preferred)

The third difference between the DEIS/OEIS and the Supplement to the DEIS/OEIS is the Navy's proposal to add an alternative. Alternative 3 consists of all Alternative 2 activities with reduced MFA sonar hours. The MFA sonar hours analyzed under Alternative 3 would be at the same level as identified for No-action Alternative (Table ES-1). All non-antisubmarine warfare training and RDT&E activities identified for Alternative 2 would be implemented under Alternative 3. The Navy has selected Alternative 3 as its preferred alternative. This alternative would allow the Navy to meet its future non-antisubmarine training and RDT&E mission objectives and avoid increases in potential effects to marine mammals above historic levels of antisubmarine warfare (ASW) training in the HRC.

Summary of MFA Sonar Exposures to Marine Mammals for Each Alternative

Table ES-4 lists sonar exposures by exercise type and sonar source for each alternative. Based on modeling results and analysis under the No-action Alternative, 40,457 marine mammals will exhibit behavioral responses NMFS will classify as harassment (Level B) under the Marine Mammal Protection Act (MMPA). Based on modeling results and analysis under Alternative 1, 47,979 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. Based on modeling results and analysis under Alternative 2, 67,437 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. In addition, under Alternative 2, one humpback whale would be exposed to MFA/HFA sonar resulting in Level A harassment (as defined under the MMPA). Under Alternative 3, estimated harassment of marine mammals would be the same as those described under the No-action Alternative. The Navy has initiated consultation with NMFS in accordance with the MMPA previously on the DEIS/OEIS Alternative 2 (the previously preferred alternative). The Navy remains in consultation with NMFS, and requests that they consider this new preferred alternative for purposes of MMPA consultation.

The Navy finds harassment resulting from the proposed use of MFA/HFA sonar may affect endangered blue whale, North Pacific right whale, fin whale, sei whale, humpback whale, sperm whale, and Hawaiian monk seals. The Navy has initiated consultation with NMFS in accordance with Section 7 of the Endangered Species Act (ESA) previously on the DEIS/OEIS Alternative 2 (the previously preferred alternative). The Navy remains in consultation with NMFS, and requests that they consider this new preferred alternative for purposes of ESA consultation.

Table ES-4. Sonar Exposures by Exercise Type and Sonar Source for Each Alternative

No-action Totals

Source	Modeled	PTS	TTS	Risk Function
53	1,284 hours	0.25	503	28,049
56	383 hours	0.04	72	2,369
Dipping	1,010 dips	0.00	0	164
Sonobuoy	2,423 buoys	0.00	0	728
MK-48	313 runs	0.01	19	521
Submarine	200 hours	0.00	0	8,010
	Total	0.30	594	39,863

Alternative 1 Totals

Source	Modeled	PTS	TTS	Risk Function
53	1,788 hours	0.25	641	34,367
56	551 hours	0.04	94	2,963
Dipping	1,517 dips	0.00	0	163
Sonobuoy	3,127 buoys	0.00	0	1,173
MK-48	317 runs	0.01	19	527
Submarine	200 hours	0.00	0	8,010
	Total	0.30	754	47,225

Alternative 2 Totals

Source	Modeled	PTS	TTS	Risk Function
53	2,496 hours	0.42	943	51,611
56	787 hours	0.07	143	4,560
Dipping	1,763 dips	0.00	0	193
Sonobuoy	3,528 buoys	0.00	0	1,314
MK-48	374 runs	0.01	24	639
Submarine	200 hours	0.00	0	8,010
	Total	0.50	1,110	66,327

Alternative 3 Totals

Source	Modeled	PTS	TTS	Risk Function
53	1,284 hours	0.25	503	28,049
56	383 hours	0.04	72	2,369
Dipping	1,010 dips	0.00	0	164
Sonobuoy	2,423 buoys	0.00	0	728
MK-48	313 runs	0.01	19	521
Submarine	200 hours	0.00	0	8,010
	Total	0.30	594	39,863

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1.0 Introduction

1.0 INTRODUCTION

Overview

In July 2007, the U.S. Department of the Navy (Navy) published the Hawaii Range Complex (HRC) Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DEIS/OEIS), which identified and addressed potential environmental impacts associated with sustainable range usage and enhancements within the Navy's HRC. The HRC DEIS/OEIS (hereinafter referred to as the DEIS/OEIS) analyzed alternatives that would: (1) support and conduct current and emerging training, and research, development, test, and evaluation (RDT&E) activities in the HRC; and (2) upgrade or modernize range complex capabilities to enhance and sustain Navy training and RDT&E. Public hearings on the DEIS/OEIS were held in August 2007, and extensive oral and written public comments were received and considered on many resource issues during the public comment period. It is important, however, to recognize that this Supplement to the DEIS/OEIS is not a stand-alone document; therefore, the HRC DEIS/OEIS should be reviewed for information on the overall HRC training and RDT&E proposal.

The DEIS/OEIS analyzed potential impacts to marine mammals from Navy actions that involve the use of acoustic sources. Since the publication of the DEIS/OEIS, the Navy, in coordination with the National Marine Fisheries Service (NMFS), has conducted a re-evaluation of this analysis. This re-evaluation and consequent proposed changes to the DEIS/OEIS led the Navy to determine that the preparation of a Supplement to the DEIS/OEIS is appropriate. Guidance from the Council on Environmental Quality provides that a Supplement to a DEIS/OEIS may be prepared by an action proponent when there are significant new circumstances or information relating to environmental concerns and bearing on the Proposed Action or its impacts (40 Code of Federal Regulations [CFR] § 1502.9(c)(1)(ii)). An agency may also supplement a DEIS/OEIS if it determines that it will better fulfill the purposes of the National Environmental Policy Act (NEPA) (40 CFR § 1509(c)(2)).

Accordingly, this document has been prepared to supplement the analysis contained in the DEIS/OEIS and narrowly focuses on the following three areas:

- Modifications to the analytical methodology used to evaluate the effects of mid-frequency active (MFA) sonar on marine mammals;
- Changes to the amount and types of sonar allocated to each of the alternatives; and,
- Development of a new alternative.

Like the DEIS/OEIS, the primary acoustic concern of this Supplement to the DEIS/OEIS is on the potential effects of the use of MFA sonar. Effects from high-frequency active (HFA) sonar as analyzed in this Supplement to the DEIS/OEIS pertains to the use of the MK-48 torpedo and remains unchanged from the assessment that is presented in the DEIS/OEIS.

The first difference between the DEIS/OEIS and the Supplement to the DEIS/OEIS concerns modifications to the analytical methodology used to evaluate marine mammal behavior responses to MFA sonar in the HRC. These modifications are two-fold: (1) a change in the mathematical function used to quantify behavioral harassment; and (2) the addition of post acoustic model analysis.

Modifications to the Analytical Methodology

The DEIS/OEIS relies on the use of a dose function analytical approach in this regard. Following publication of the DEIS/OEIS, the Navy continued working with NMFS to define a more appropriate mathematically representative curve and applicable model input parameters than was used in the DEIS/OEIS. In this effort to define the mathematical function and applicable input parameters that best quantify behavioral harassment from military readiness activities the Navy and NMFS considered several different methodologies. This development process resulted in the identification of two possible methodologies that could relate acoustic "doses" (i.e., MFA sonar exposures) to the probability of significant behavioral responses. As the regulating agency, NMFS presented the two methodologies to six scientists (marine mammalogists and an acoustician) (both within and outside the federal government) for an independent review. Two scientists, including one from the NMFS Office of Science and Technology, synthesized the reviews from the six scientists and made a recommendation to the NMFS Office of Protected Resources.

Based on this recommendation, while recognizing the limitations of the underlying data as well as past NMFS rulings (Surveillance Towed Array Sensor System Low Frequency Active Low Frequency Active [SURTASS LFA] Sonar Final EIS, and at the same time acknowledging the Supplemental SURTASS LFA Sonar EIS), the NMFS Office of Protected Resources selected for Navy use a mathematical function adapted from a solution in Feller (1968). This function is considered to be appropriate for application to instances with limited data (Feller, 1968), which is the situation with respect to the state of the science for assessing the effects on MFA and HFA sonar on the behavior of marine mammals. Moreover, this same mathematical function was used by the Navy in its Final OEIS/EIS for the SURTASS LFA Sonar (U.S. Department of the Navy, 2001) and relied on in the analysis performed in the Supplemental SURTASS LFA Sonar EIS (U.S. Department of the Navy, 2007a). Accordingly, the Navy is applying the risk function (no longer referred to as the dose function) to estimate the number of species that would experience harassment when exposed to specific received levels of MFA/HFA sonar in this Supplement to the DEIS/OEIS. Furthermore, NMFS has modified the model input parameters for MFA sonar effects on mysticetes, odontocetes, and pinnipeds.

Navy Post Acoustic Modeling Analysis

Following application of the risk function, this Supplement to the DEIS/OEIS includes further analysis of the results of the acoustic model to reduce the potential for the overestimation of MFA sonar hours and provide a more accurate assessment of potential effects. These corrections were necessary because the original DEIS/OEIS modeling resulted in an overestimation for the following reasons:

- Acoustic footprints for sonar sources did not account for land masses.
- Acoustic footprints for sonar sources were added independently and, therefore, did not account for overlap with other sonar systems used during the same time period. As a consequence, the area of the total acoustic footprint was larger than the actual acoustic footprint associated with multiple ships operating together.

- Acoustic modeling did not account for the NMFS defined refresh rate of 24 hours. This time period represents the amount of time in which individual marine mammals can be harassed no more than once.

Changes to the Amount and Types of Sonar

The second difference between the DEIS/OEIS and this Supplement to the DEIS/OEIS concerns the amount and type of sonar that is analyzed. Sonar hours for this Supplement are based on data available from the Sonar Positional Reporting System (SPORTS). SPORTS is a database tool that was established by Commander, U.S. Fleet Forces Command in March 2006 to determine geographic locations of sonar use. All commands employing MFA sonar and sonobuoys have been required to populate the SPORTS database by reporting MFA sonar use on a daily basis. After publication of the DEIS/OEIS, the Navy determined that SPORTS could also be a useful tool in refining the estimated sonar quantification originally collected and analyzed for the DEIS/OEIS. Accordingly, SPORTS data is used in this Supplement to the DEIS/OEIS to assist in determining the amount of MFA sonar use hours for each alternative for purposes of modeling potential effects to marine mammals. Estimates of HFA sonar use (MK-48 torpedo) remain unchanged from the DEIS/OEIS. The resultant changes in sonar hours for modeling are presented below (Tables 1-1 to 1-3).

Development of a New Alternative 3 (Alternative 3—Preferred)

The third difference between the DEIS/OEIS and the Supplement to the DEIS/OEIS is the Navy's proposal to add an alternative. Alternative 3 consists of all Alternative 2 activities with reduced MFA sonar hours. The MFA sonar hours analyzed under Alternative 3 would be at the same level as identified for No-action Alternative (Table 1-1). All non-antisubmarine warfare (ASW) training and RDT&E activities identified for Alternative 2 would be implemented under Alternative 3.

Scope and Content of the Supplement to the HRC DEIS/OEIS

The focus of this Supplement to the DEIS/OEIS is the open ocean and offshore areas of the HRC. The focus of the document is the risk function modeling approach used to evaluate marine mammal behavioral response to MFA sonar training within the HRC using more refined numbers of sonar use.

Changes to the Proposed Action and Alternatives presented in the HRC DEIS/OEIS are described in Chapter 2.0 of this Supplement. These changes are a result of the Navy's reassessment of requirements for ASW training in the HRC. Chapter 3.0 of this Supplement describes and evaluates marine mammal behavioral response to MFA sonar training in the HRC using the risk function approach.

Table 1-1. Sonar Hour Changes for the No-action Alternative

DEIS/OEIS Hours/Events Modeled			**Supplement to the DEIS/OEIS Hours/Events Modeled**		
TRACKEX					
	Source	**Modeled**			
	53	1,440 hours	**Other ASW (TRACKEX/TORPEX)**		
	Dipping	NA		**Source**	**Modeled**
	Sonobuoy	962 buoys		53	360 hours
				56	75 hours
TORPEX				Dipping	110 dips
	Source	**Modeled**		Sonobuoy	1,278 buoys
	53	356 hours		MK-48	309 runs
	Dipping	NA		Submarine	200 hours
	Sonobuoy	330 buoys			
	MK-48	309 runs			
RIMPAC			**RIMPAC**		
	Source	**Modeled**		**Source**	**Modeled**
	53	532 hours		53	399 hours
				56	133 hours
	Dipping	336 dips		Dipping	400 dips
	Sonobuoy	480 buoys		Sonobuoy	497 buoys
	MK-48	4 runs		MK-48	4 runs
USWEX (6 Exercises)			**USWEX (5 Exercises)**		
	Source	**Modeled**		**Source**	**Modeled**
	53	1,167 hours		53	525 hours
				56	175 hours
	Dipping	576 dips		Dipping	500 dips
	Sonobuoy	768 buoys		Sonobuoy	648 buoys
DEIS/OEIS Totals			**Supplement to the DEIS/OEIS Totals**		
	Source	**Modeled**		**Source**	**Modeled**
	53	3,495 hours		53	1,284 hours
				56	383 hours
	Dipping	912 dips		Dipping	1,010 dips
	Sonobuoy	2,540 buoys		Sonobuoy	2,423 buoys
	MK-48	313 runs		MK-48	313 runs
				Submarine	200 hours

Table 1-2. Sonar Hour Changes for Alternative 1

DEIS/OEIS Hours/Events Modeled		Supplement to the DEIS/OEIS Hours/Events Modeled	
TRACKEX			
Source	**Modeled**	**Other ASW (TRACKEX/TORPEX)**	
53	1,440 hours	**Source**	**Modeled**
Dipping	NA	53	360 hours
Sonobuoy	962 buoys	56	75 hours
TORPEX		Dipping	117 dips
Source	**Modeled**	Sonobuoy	1,355 buoys
53	356 hours	MK-48	309 runs
Dipping	NA	Submarine	200 hours
Sonobuoy	330 buoys		
MK-48	309 runs		
RIMPAC (2 Carrier)		**RIMPAC (2 Carrier)**	
Source	**Modeled**	**Source**	**Modeled**
53	1,064 hours	53	798 hours
		56	266 hours
Dipping	672 dips	Dipping	800 dips
Sonobuoy	960 buoys	Sonobuoy	994 buoys
MK-48	8 runs	MK-48	8 runs
USWEX (6 Exercises)		**USWEX (6 Exercises)**	
Source	**Modeled**	**Source**	**Modeled**
53	1,167 hours	53	630 hours
		56	210 hours
Dipping	576 dips	Dipping	600 dips
Sonobuoy	768 buoys	Sonobuoy	778 buoys
DEIS/OEIS Totals		**Supplement to the DEIS/OEIS Totals**	
Source	**Modeled**	**Source**	**Modeled**
53	4,027 hours	53	1,788 hours
		56	551 hours
Dipping	1,248 dips	Dipping	1,517 dips
Sonobuoy	3,020 buoys	Sonobuoy	3,127 buoys
MK-48	317 runs	MK-48	317 runs
		Submarine	200 hours

Table 1-3. Sonar Hour Changes for Alternative 2

DEIS/OEIS Hours/Events Modeled			Supplement to the DEIS/OEIS Hours/Events Modeled		
TRACKEX					
	Source	**Modeled**			
	53	1,590 hours	**Other ASW (TRACKEX/TORPEX)**		
	Dipping	NA		**Source**	**Modeled**
	Sonobuoy	1,061 buoys		53	360 hours
				56	75 hours
TORPEX				Dipping	123 dips
	Source	**Modeled**		Sonobuoy	1,431 buoys
	53	414 hours		MK-48	365 runs
	Dipping	NA		Submarine	200 hours
	Sonobuoy	428 buoys			
	MK-48	365 runs			
RIMPAC (2 Carrier)			**RIMPAC (2 Carrier)**		
	Source	**Modeled**		**Source**	**Modeled**
	53	1,064 hours		53	798 hours
				56	266 hours
	Dipping	672 dips		Dipping	800 dips
	Sonobuoy	960 buoys		Sonobuoy	994 buoys
	MK-48	8 runs		MK-48	8 runs
USWEX (6 Exercises)			**USWEX (6 Exercises)**		
	Source	**Modeled**		**Source**	**Modeled**
	53	1,167 hours		53	630 hours
				56	210 hours
	Dipping	576 dips		Dipping	600 dips
	Sonobuoy	768 buoys		Sonobuoy	778 buoys
Multiple Strike Group			**Multiple Strike Group**		
	Source	**Modeled**		**Source**	**Modeled**
	53	944 hours		53	708 hours
				56	236 hours
	Dipping	240 dips		Dipping	240 dips
	Sonobuoy	325 buoys		Sonobuoy	325 buoys
	MK-48	1 run		MK-48	1 run
DEIS/OEIS Totals			**Supplement to the DEIS/OEIS Totals**		
	Source	**Modeled**		**Source**	**Modeled**
	53	5,179 hours		53	2,496 hours
				56	787 hours
	Dipping	1,488 dips		Dipping	1,763 dips
	Sonobuoy	3,542 buoys		Sonobuoy	3,528 buoys
	MK-48	374 runs		MK-48	374 runs
				Submarine	200 hours

2.0 Description of the Proposed Action and Alternatives

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Since the release of the July 2007 Hawaii Range Complex (HRC) Draft Environmental Impact Statement/Overseas Environmental Impact Statement, Revision 1 (DEIS/OEIS) (U.S. Department of the Navy, 2007c), the Proposed Action and Alternatives have undergone several changes. This chapter describes the changes to alternatives presented in the DEIS/OEIS for the sonar sources listed below, plus a new alternative. For a description of the complete Proposed Action and original Alternatives, refer to Chapter 2.0 in the DEIS/OEIS.

- Surface ship sonar (AN/SQS-53 and AN/SQS-56)
- Helicopter dipping sonar (AN/AQS-22)
- Aircraft deployed sonobuoys (AN/SSQ-62)
- Submarine sonar (BQQ-10, BQQ-5, BSY-1)
- MK-48 torpedo

2.1 NO-ACTION ALTERNATIVE

The only change to the No-action Alternative is the amount and type of mid-frequency active (MFA) sonar used during antisubmarine warfare (ASW) training. Estimates of high frequency active (HFA) sonar use remain unchanged from the DEIS/OEIS. In the DEIS/OEIS, the AN/SQS 56 sonar was modeled as AN/SQS 53 and dipping sonar use in other HRC ASW training was not included in the modeling. Submarine sonar was previously considered not likely to have a measurable effect on marine mammals and was not modeled in the DEIS/OEIS. Since the preparation of the DEIS/OEIS, the Navy has lowered the threshold criteria for which effects are evaluated resulting in a requirement to model submarine sonar. For the No-action Alternative, Table 2.1-1 lists MFA/HFA sonar use analyzed in this Supplement to the DEIS/OEIS. Sonar usage is based on the Sonar Positional Reporting System (SPORTS) data and operator input.

Table 2.1-1. Sonar Usage for the No-action Alternative

Supplement to the DEIS/OEIS Hours/Events Modeled		
Other HRC ASW Training		
	Source	**Modeled**
	53	360 hours
	56	75 hours
	Dipping	110 dips
	Sonobuoy	1,278 buoys
	MK-48	309 runs
	Submarine	200 hours
RIMPAC		
	Source	**Modeled**
	53	399 hours
	56	133 hours
	Dipping	400 dips
	Sonobuoy	497 buoys
	MK-48	4 runs
USWEX (5 Exercises)		
	Source	**Modeled**
	53	525 hours
	56	175 hours
	Dipping	500 dips
	Sonobuoy	648 buoys
No-action Alternative Totals		
	Source	**Modeled**
	53	1,284 hours
	56	383 hours
	Dipping	1,010 dips
	Sonobuoy	2,423 buoys
	MK-48	313 runs
	Submarine	200 hours

2.2 ALTERNATIVE 1

The only change to Alternative 1 is the amount and type of MFA sonar used during ASW training, as described under the No-action Alternative. Estimates of HFA sonar use remain unchanged from the DEIS/OEIS. For Alternative 1, Table 2.2-1 lists MFA/HFA sonar usage analyzed in this Supplement to the DEIS/OEIS. Sonar usage is based on SPORTS data and operator input.

Table 2.2-1. Sonar Usage for Alternative 1

Supplement to the DEIS/OEIS Hours/ Events Modeled		
Other HRC ASW Training		
	Source	**Modeled**
	53	360 hours
	56	75 hours
	Dipping	117 dips
	Sonobuoy	1,355 buoys
	MK-48	309 runs
	Submarine	200 hours
RIMPAC (2 Carrier)		
	Source	**Modeled**
	53	798 hours
	56	266 hours
	Dipping	800 dips
	Sonobuoy	994 buoys
	MK-48	8 runs
USWEX (6 Exercises)		
	Source	**Modeled**
	53	630 hours
	56	210 hours
	Dipping	600 dips
	Sonobuoy	778 buoys
Alternative 1 Totals		
	Source	**Modeled**
	53	1,788 hours
	56	551 hours
	Dipping	1,517 dips
	Sonobuoy	3,127 buoys
	MK-48	317 runs
	Submarine	200 hours

2.3 ALTERNATIVE 2

The only change to Alternative 2 is the amount and type of MFA sonar used during ASW training, as described under the No-action Alternative. Estimates of HFA sonar use remain unchanged from the DEIS/OEIS. For Alternative 2, Table 2.3-1 lists MFA/HFA sonar usage analyzed in this Supplement to the DEIS/OEIS. Sonar usage is based on SPORTS data and operator input.

Table 2.3-1. Sonar Usage for Alternative 2

Supplement to the DEIS/OEIS Hours/ Events Modeled		
Other HRC ASW Training		
	Source	**Modeled**
	53	360 hours
	56	75 hours
	Dipping	123 dips
	Sonobuoy	1,431 buoys
	MK-48	365 runs
	Submarine	200 hours
RIMPAC (2 Carrier)		
	Source	**Modeled**
	53	798 hours
	56	266 hours
	Dipping	800 dips
	Sonobuoy	994 buoys
	MK-48	8 runs
USWEX (6 Exercises)		
	Source	**Modeled**
	53	630 hours
	56	210 hours
	Dipping	600 dips
	Sonobuoy	778 buoys
Multiple Strike Group		
	Source	**Modeled**
	53	708 hours
	56	236 hours
	Dipping	240 dips
	Sonobuoy	325 buoys
	MK-48	1 run
Alternative 2 Totals		
	Source	**Modeled**
	53	2,496 hours
	56	787 hours
	Dipping	1,763 dips
	Sonobuoy	3,528 buoys
	MK-48	374 runs
	Submarine	200 hours

2.4 ALTERNATIVE 3 (PREFERRED)

Alternative 3, a newly proposed alternative, consists of the MFA/HFA sonar usage analyzed under the No-action Alternative plus all non-ASW training and research, development, test, and evaluation (RDT&E) activities from Alternative 2 (as described in the DEIS/OEIS). For Alternative 3, Table 2.4-1 lists MFA/HFA sonar usage analyzed in this Supplement to the DEIS/OEIS. Sonar usage is based on SPORTS data and operator input. Sonar hours for Alternative 3 and effects associated with ASW training would be identical to that presented under the No-action Alternative. Alternative 3 is the preferred alternative because it allows the Navy to meet its future non-ASW training and RDT&E mission objectives and avoid increases in potential effects to marine mammals above historic levels of ASW training in the HRC**.**

Table 2.4-1. Sonar Usage for Alternative 3

Supplement to the DEIS/OEIS Hours/ Events Modeled		
Other HRC ASW Training		
	Source	**Modeled**
	53	360 hours
	56	75 hours
	Dipping	110 dips
	Sonobuoy	1,278 buoys
	MK-48	309 runs
	Submarine	200 hours
RIMPAC		
	Source	**Modeled**
	53	399 hours
	56	133 hours
	Dipping	400 dips
	Sonobuoy	497 buoys
	MK-48	4 runs
USWEX (5 Exercises)		
	Source	**Modeled**
	53	525 hours
	56	175 hours
	Dipping	500 dips
	Sonobuoy	648 buoys
Alternative 3 Totals		
	Source	**Modeled**
	53	1,284 hours
	56	383 hours
	Dipping	1,010 dips
	Sonobuoy	2,423 buoys
	MK-48	313 runs
	Submarine	200 hours

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3.0 Environmental Consequences

3.0 ENVIRONMENTAL CONSEQUENCES

The affected environment is unchanged from that presented in the Hawaii Range Complex (HRC) Draft Environmental Impact Statement/Overseas Environmental Impact Statement, Revision 1 (DEIS/OEIS) (U.S. Department of the Navy, 2007c).

3.1 MODIFICATION TO THE ANALYTICAL METHODOLOGY

3.1.1 BACKGROUND

Based on available evidence, marine animals are likely to exhibit any of a suite of potential behavioral responses or combinations of behavioral responses upon exposure to sonar transmissions. Potential behavioral responses include, but are not limited to: avoiding exposure or continued exposure; behavioral disturbance (including distress or disruption of social or foraging activity); habituation to the sound; becoming sensitized to the sound; or not responding to the sound.

Existing studies of behavioral effects of human-made sounds in marine environments remain inconclusive, partly because many of those studies have lacked adequate controls, applied only to certain kinds of exposures (which are often different from the exposures being analyzed in the study), and had limited ability to detect behavioral changes that may be significant to the biology of the animals that were being observed. These studies are further complicated by the wide variety of behavioral responses marine mammals exhibit and the fact that those responses can vary significantly by species, individuals, and the context of an exposure. In some circumstances, some individuals will continue normal behavioral activities in the presence of high levels of human-made noise. In other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson et al., 1995; Wartzok et al., 2003). These differences within and between individuals appear to result from a complex interaction of experience, motivation, and learning that are difficult to quantify and predict.

It is possible that some marine mammal behavioral reactions to anthropogenic sound may result in strandings. Several “mass stranding” events—strandings that involve two or more individuals of the same species (excluding a single cow-calf pair)—that have occurred over the past two decades have been associated with naval operations, seismic surveys, and other anthropogenic activities that introduced sound into the marine environment. Sonar exposure has been identified as a contributing cause or factor in five specific mass stranding events: Greece in 1996; the Bahamas in March 2000; Madeira, Portugal in 2000; the Canary Islands in 2002, and Spain in 2006 (Advisory Committee Report on Acoustic Impacts on Marine Mammals, 2006).

In these circumstances, exposure to acoustic energy has been considered an indirect cause of the death of marine mammals (Cox et al., 2006). Based on studies of lesions in beaked whales that have stranded in the Canary Islands and Bahamas associated with exposure to naval exercises that involved sonar, several investigators have hypothesized that there are two potential physiological mechanisms that might explain why marine mammals stranded: tissue damage resulting from resonance effects (Ketten, 2005) and tissue damage resulting from “gas and fat embolic syndrome” (Fernandez et al., 2005; Jepson et al., 2003; 2005). It is also likely that stranding is a behavioral response to a sound under certain contextual conditions and that the subsequently observed physiological effects of the strandings (e.g., overheating, decomposition, or internal hemorrhaging from being on shore) were the result of the stranding versus exposure to sonar (Cox et al., 2006). Please refer to the DEIS/OEIS for a detailed discussion on Marine Mammal Protection Act (MMPA) Level B harassment.

3.1.2 DEVELOPMENT OF THE RISK FUNCTION

In Section 4.1.2.4.9 of the DEIS/OEIS, the Navy presented a dose methodology to assess the probability of Level B behavioral harassment from the effects of mid-frequency active (MFA) and high-frequency active (HFA) sonar on marine mammals. Following publication of the DEIS/OEIS the Navy continued working with the National Marine Fisheries Service (NMFS) to refine the mathematically representative curve previously used, along with applicable input parameters with the purpose of increasing the accuracy of the Navy’s assessment. As the regulating and cooperating agency, NMFS presented two methodologies to six scientists (marine mammalogists and acousticians from within and outside the federal government) for an independent review (National Marine Fisheries Service, 2008). Two scientists, including one from the NMFS Office of Science and Technology, then synthesized the reviews from the six scientists and developed a recommendation.

One of the methodologies was a normal curve fit to a “mean of means” calculated from the mean of: (1) the estimated mean received level produced by the reconstruction of the USS SHOUP event of May 2003 in which killer whales were exposed to MFA sonar (U.S. Department of the Navy, 2004); (2) the mean of the five maximum received levels at which Nowacek et al. (2004) observed significantly different responses of right whales to an alert stimuli; and (3) the mean of the lowest received levels from the 3 kilohertz (kHz) data that the SPAWAR Systems Center (SSC) classified as altered behavior from Finneran and Schlundt (2004).

The second methodology was a derivation of a mathematical function used for assessing the percentage of a marine mammal population experiencing the risk of harassment under the MMPA associated with the Navy’s use of the Surveillance Towed Array Sensor System Low-Frequency Active (SURTASS LFA) sonar (U.S. Department of the Navy, 2001). This function is appropriate for application to instances with limited data (Feller, 1968), and this methodology is subsequently identified as “the risk function” in this document.

The NMFS Office of Protected Resources made the decision to use the risk function and applicable input parameters to estimate the risk of behavioral harassment associated with exposure to MFA sonar. This determination was based on the recommendation of the two NMFS scientists; consideration of the independent reviews from six scientists; the fact the underlying data; and NMFS MMPA regulations affecting the Navy’s use of SURTASS LFA sonar (Federal Register [FR] 67:48145-48154, 2002; FR 72: 46846-46893, 2007).

3.1.3 METHODOLOGY FOR APPLYING RISK FUNCTION

To assess the potential effects on marine mammals associated with active sonar used during training activities, the Navy together with NMFS, as a first step, investigated a series of mathematical models and methodologies that estimate the number of times individuals of the different species of marine mammals might be exposed to MFA sonar at different received levels. The Navy effects analyses assumed that the potential consequences of exposure to MFA sonar on individual animals would be a function of the received sound pressure level (decibels re 1 micropascal [dB re 1 µPa]). These analyses assume that MFA sonar poses no risk, that is, does not constitute harassment to marine mammals if they are exposed to sound pressure levels from the MFA sonar below a certain basement value.

The second step of the assessment procedure requires the Navy and NMFS to identify how marine mammals are likely to respond when they are exposed to active sonar. Marine mammals can experience a variety of responses to sound including sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral responses, social responses that might result in reducing the fitness of individual marine mammals and social responses that would not result in reducing the fitness of individual marine mammals.

Previously, the Navy and NMFS have used acoustic thresholds to identify the number of marine mammals that might experience hearing losses (temporary or permanent) or behavioral harassment upon being exposed to MFA sonar (see Figure 3.1.3-1 left panel). These acoustic thresholds have been represented by either sound exposure level (related to sound energy, abbreviated as SEL), sound pressure level (abbreviated as SPL), or other metrics such as peak pressure level and acoustic impulse (not considered for sonar in this Supplement to the DEIS/OEIS). The general approach has been to apply these threshold functions so that a marine mammal is counted as behaviorally harassed or experiencing hearing loss when exposed to received sound levels above a certain threshold and not counted as behaviorally harassed or experiencing hearing loss when exposed to received levels below that threshold. For example, previous Navy EISs, environmental assessments, MMPA take authorization requests, and the MMPA incidental harassment authorization (IHA) for the Navy's 2006 Rim-of-the Pacific (RIMPAC) Major Exercise (FR 71.38710-38712, 2006) used 173 decibel re 1 micropascal squared-second (dB re 1 μPa^2-s) as the energy threshold level (i.e., SEL) for Level B behavioral harassment for cetaceans. If the transmitted sonar accumulated energy received by a whale was above 195 dB re 1 μPa^2-s, then the animal was considered to have experienced a temporary loss in the sensitivity of its hearing. If the received accumulated energy level was below 195 dB re 1 μPa^2-s, then the animal was not treated as having experienced a temporary loss in the sensitivity of its hearing.

The left panel in Figure 3.1.3-1 illustrates a typical step-function or threshold that might also relate a sonar exposure to the probability of a response. As this figure illustrates, past Navy/NMFS acoustic thresholds assumed that every marine mammal above a particular received level (for example, to the right of the red vertical line in the figure) would exhibit identical responses to a sonar exposure. This assumed that the responses of marine mammals would not be affected by differences in acoustic conditions; differences between species and populations, differences in gender, age, reproductive status, or social behavior; or the prior experience of the individuals.

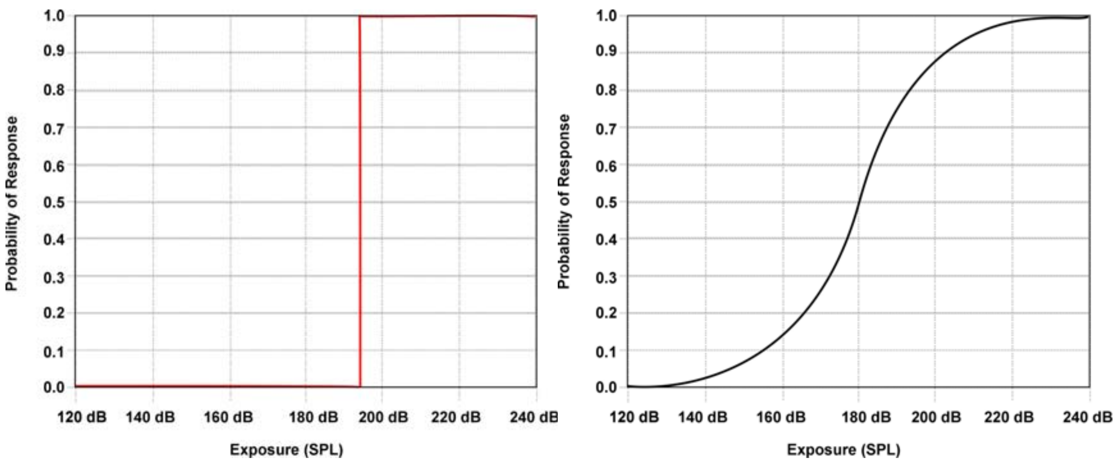

Figure 3.1.3-1. The left panel illustrates a typical step function with the probability of a response on the y-axis and received exposure on the x-axis. The right panel illustrates a typical risk continuum-function using the same axes. SPL is "Sound Pressure Level" in decibels referenced to 1 micropascal root mean square (1 μPa rms).

Both the Navy and NMFS agree that the studies of marine mammals in the wild and in experimental settings do not support these assumptions—different species of marine mammals and different individuals of the same species respond differently to sonar exposure. Additionally, there are specific geographic/bathymetric conditions that dictate the response of marine mammals to sonar that suggest that different populations may respond differently to sonar exposure. Further, studies of animal physiology suggest that gender, age, reproductive status, and social behavior, among other variables, probably affect how marine mammals respond to sonar exposures. (Wartzok et al., 2003; Southall et al., 2007)

Over the past several years, the Navy and NMFS have worked on developing an MFA sonar acoustic risk function to replace the acoustic thresholds used in the past to estimate the probability of marine mammals being behaviorally harassed by received levels of MFA sonar. The Navy and NMFS will continue to use acoustic thresholds to estimate temporary or permanent threshold shifts using SEL as the appropriate metric. Unlike acoustic thresholds, acoustic risk continuum functions (which are also called "exposure-response functions," "dose-response functions," or "stress-response functions" in other risk assessment contexts) assume that the probability of a response depends first on the "dose" (in this case, the received level of sound) and that the probability of a response increases as the "dose" increases. It is important to note that the probabilities associated with acoustic risk functions do not represent an individual's probability of responding. Rather, the probabilities identify the proportion of an exposed population that is likely to respond to an exposure.

The right panel in Figure 3.1.3-1 illustrates a typical acoustic risk function that might relate an exposure, as received sound pressure level in decibels referenced to 1 micropascal (1 μPa), to the probability of a response. As the exposure receive level increases in this figure, the probability of a response increases as well but the relationship between an exposure and a response is "linear" only in the center of the curve (that is, unit increases in exposure would produce unit increases in the probability of a response only in the center of a risk function curve). In the "tails" of an acoustic risk function curve, unit increases in exposure produce smaller increases in the probability of a response. Based on observations of various animals, including humans, the relationship represented by an acoustic risk function is a more robust predictor of the probable behavioral responses of marine mammals to sonar and other acoustic sources.

The Navy and NMFS have previously used the acoustic risk function to estimate the probable responses of marine mammals to acoustic exposures for other training and research programs. Examples of previous application include the Navy Final EISs on the SURTASS LFA sonar (U.S. Department of the Navy, 2001); the North Pacific Acoustic Laboratory experiments conducted off the Island of Kauai (Office of Naval Research, 2001), and the Supplemental EIS for SURTASS LFA sonar (U.S. Department of the Navy, 2007a).

The Navy and NMFS used two metrics to estimate the number of marine mammals that could be subject to Level B harassment (behavioral harassment and temporary threshold shift [TTS]) as defined by the MMPA, during training exercises. The agencies used acoustic risk functions with the metric of received sound pressure level (dB re 1 μPa) to estimate the number of marine mammals that might be at risk for MMPA Level B behavioral harassment as a result of being exposed to MFA sonar. The agencies will continue to use acoustic thresholds ("step-functions") with the metric of sound exposure level (dB re 1 μPa^2-s) to estimate the number of marine mammals that might be "taken" through sensory impairment (i.e., Level A – permanent threshold shift [PTS] and Level B – TTS) as a result of being exposed to MFA sonar.

Although the Navy has not used acoustic risk functions in previous MFA sonar assessments of the potential effects of MFA sonar on marine mammals, risk functions are not new concepts for risk assessments. Common elements are contained in the process used for developing criteria for air, water, radiation, and ambient noise and for assessing the effects of sources of air, water, and noise pollution. The Environmental Protection Agency uses dose-functions to develop water quality criteria and to regulate pesticide applications (U.S. Environmental Protection Agency, 1998); the Nuclear Regulatory Commission uses dose-functions to estimate the consequences of radiation exposures (see Nuclear Regulatory Commission, 1997 and 10 Code of Federal Regulations 20.1201); the Centers for Disease Control and Prevention and the Food and Drug Administration use dose-functions as part of their assessment methods (for example, see Centers for Disease Control and Prevention, 2003, U.S. Food and Drug Administration and others, 2001); and the Occupational Safety and Health Administration uses dose-functions to assess the potential effects of noise and chemicals in occupational environments on the health of people working in those environments (for examples, see FR 61:56746-56856, 1996; FR 71:10099-10385, 2006).

Risk Function Adapted from Feller (1968)

The particular acoustic risk function developed by the Navy and NMFS estimates the probability of behavioral responses that NMFS would classify as harassment for the purposes of the MMPA given exposure to specific received levels of MFA sonar. The mathematical function is derived from a solution in Feller (1968) as defined in the SURTASS LFA Sonar Final OEIS/EIS (U.S. Department of the Navy, 2001), and relied on in the Supplemental SURTASS LFA Sonar EIS (U.S. Department of the Navy, 2007a) for the probability of MFA sonar risk for MMPA Level B behavioral harassment with input parameters modified by NMFS for MFA sonar for mysticetes, odontocetes, and pinnipeds.

In order to represent a probability of risk, the function should have a value near zero at very low exposures, and a value near one for very high exposures. One class of functions that satisfies this criterion is cumulative probability distributions, a type of cumulative distribution function. In selecting a particular functional expression for risk, several criteria were identified:

- The function must use parameters to focus discussion on areas of uncertainty;
- The function should contain a limited number of parameters;
- The function should be capable of accurately fitting experimental data; and
- The function should be reasonably convenient for algebraic manipulations.

As described in U.S. Department of the Navy (2001), the mathematical function below is adapted from a solution in Feller (1968).

$$R = \frac{1 - \left(\frac{L-B}{K}\right)^{-A}}{1 - \left(\frac{L-B}{K}\right)^{-2A}}$$

Where: R = risk (0 – 1.0);
L = Received Level (RL) in dB;
B = basement RL in dB; (120 dB);
K = the RL increment above basement in dB at which there is 50 percent risk;
A = risk transition sharpness parameter (10) (explained in 3.1.5.3).

In order to use this function, the values of the three parameters (<u>B</u>, <u>K</u>, and <u>A</u>) need to be established. As further explained in Section 3.1.4, the values used in this Supplement to the DEIS/OEIS analysis are based on three sources of data: TTS experiments conducted at SSC and documented in Finneran, et al. (2001, 2003, and 2005; Finneran and Schlundt, 2004); reconstruction of sound fields produced by the USS SHOUP associated with the behavioral responses of killer whales observed in Haro Strait and documented in Department of Commerce (National Marine Fisheries Service, 2005); U.S. Department of the Navy (2004); and Fromm (2004a, 2004b); and observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components documented in Nowacek et al. (2004). The input parameters, as defined by NMFS, are based on very limited data that represent the best available science at this time.

3.1.4 DATA SOURCES USED FOR RISK FUNCTION

There is widespread consensus that cetacean response to MFA sound signals needs to be better defined using controlled experiments. Navy is contributing to an ongoing behavioral response study in the Bahamas that is anticipated to provide some initial information on beaked whales, the species identified as the most sensitive to MFA sonar. NMFS is leading this international effort with scientists from various academic institutions and research organizations to conduct studies on how marine mammals respond to underwater sound exposures.

Until additional data is available, NMFS and the Navy have determined that the following three data sets are most applicable for the direct use in developing risk function parameters for

MFA/HFA sonar. These data sets represent the only known data that specifically relate altered behavioral responses to exposure to MFA sound sources.

<u>Data from SSC's Controlled Experiments</u>: Most of the observations of the behavioral responses of toothed whales resulted from a series of controlled experiments on bottlenose dolphins and beluga whales conducted by researchers at SSC's facility in San Diego, California (Finneran et al., 2001, 2003, 2005; Finneran and Schlundt 2004; Schlundt et al., 2000). In experimental trials with marine mammals trained to perform tasks when prompted, scientists evaluated whether the marine mammals performed these tasks when exposed to mid-frequency tones. Altered behavior during experimental trials usually involved refusal of animals to return to the site of the sound stimulus. This refusal included what appeared to be deliberate attempts to avoid a sound exposure or to avoid the location of the exposure site during subsequent tests. (Schlundt et al., 2000, Finneran et al., 2002) Bottlenose dolphins exposed to 1-sec intense tones exhibited short-term changes in behavior above received sound levels of 178 to 193 dB re 1 micropascal (μPa) root mean square (rms), and beluga whales did so at received levels of 180 to 196 dB and above. Test animals sometimes vocalized after an exposure to impulsive sound from a seismic watergun (Finneran et al., 2002). In some instances, animals exhibited aggressive behavior toward the test apparatus (Ridgway et al., 1997; Schlundt et al., 2000).

1. Finneran and Schlundt (2004) examined behavioral observations recorded by the trainers or test coordinators during the Schlundt et al. (2000) and Finneran et al. (2001, 2003, 2005) experiments featuring 1-second (sec) tones. These included observations from 193 exposure sessions (fatiguing stimulus level > 141 dB re 1μPa) conducted by Schlundt et al. (2000) and 21 exposure sessions conducted by Finneran et al. (2001, 2003, 2005). The observations were made during exposures to sound sources at 0.4 kHz, 3 kHz, 10 kHz, 20 kHz, and 75 kHz. The TTS experiments that supported Finneran and Schlundt (2004) are further explained below:

    a. Schlundt et al. (2000) provided a detailed summary of the behavioral responses of trained marine mammals during TTS tests conducted at SSC San Diego with 1-sec tones. Schlundt et al. (2000) reported eight individual TTS experiments. Fatiguing stimuli durations were 1-sec; exposure frequencies were 0.4 kHz, 3 kHz, 10 kHz, 20 kHz and 75 kHz. The experiments were conducted in San Diego Bay. Because of the variable ambient noise in the bay, low-level broadband masking noise was used to keep hearing thresholds consistent despite fluctuations in the ambient noise. Schlundt et al. (2000) reported that "behavioral alterations," or deviations from the behaviors the animals being tested had been trained to exhibit, occurred as the animals were exposed to increasing fatiguing stimulus levels.

    b. Finneran et al. (2001, 2003, 2005) conducted TTS experiments using tones at 3 kHz. The test method was similar to that of Schlundt et al. (2000) except the tests were conducted in a pool with very low ambient noise level (below 50 dB re 1 μPa/hertz [Hz]), and no masking noise was used. Two separate experiments were conducted using 1-sec tones. In the first, fatiguing sound levels were increased from 160 to 201 dB SPL. In the second experiment, fatiguing sound levels between 180 and 200 dB re 1 μPa were randomly presented.

Data from Studies of Baleen (Mysticetes) Whale Responses: The only mysticete data available resulted from a field experiments in which baleen whales (mysticetes) were exposed to a range frequency sound sources from 120 Hz to 4500 Hz.(Nowacek et al. 2004). An alert stimulus, with a mid-frequency component, was the only portion of the study used to support the risk function input parameters.

2. Nowacek et al. (2004) documented observations of the behavioral response of North Atlantic right whales exposed to alert stimuli containing mid-frequency components. To assess risk factors involved in ship strikes, a multi-sensor acoustic tag was used to measure the responses of whales to passing ships and experimentally tested their responses to controlled sound exposures, which included recordings of ship noise, the social sounds of conspecifics and a signal designed to alert the whales. The alert signal was 18-minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high (2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. The purposes of the alert signal were (a) to provoke an action from the whales via the auditory system with disharmonic signals that cover the whales estimated hearing range; (b) to maximize the signal to noise ratio (obtain the largest difference between background noise) and c) to provide localization cues for the whale. Five out of six whales reacted to the signal designed to elicit such behavior. Maximum received levels ranged from 133 to 148 dB re 1μPa.

Observations of Killer Whales in Haro Strait in the Wild: In May 2003, killer whales (*Orcinus orca*) were observed exhibiting behavioral responses while the USS SHOUP was engaged in MFA sonar operations in the Haro Strait in the vicinity of Puget Sound, Washington. Although these observations were made in an uncontrolled environment, the sound field that may have been associated with the sonar operations had to be estimated, and the behavioral observations were reported for groups of whales, not individual whales, the observations associated with the USS SHOUP provide the only data set available of the behavioral responses of wild, non-captive animal upon exposure to the AN/SQS-53 MFA sonar.

3. U.S. Department of Commerce (National Marine Fisheries, 2005); U.S. Department of the Navy (2004); Fromm (2004a, 2004b) documented reconstruction of sound fields produced by the USS SHOUP associated with the behavioral response of killer whales observed in Haro Strait. Observations from this reconstruction included an approximate closest approach time which was correlated to a reconstructed estimate of received level at an approximate whale location (which ranged from 150 to 180 dB), with a mean value of 169.3 dB.

3.1.4.1 LIMITATIONS OF THE RISK FUNCTION DATA SOURCES

There are significant limitations and challenges to any risk function derived to estimate the probability of marine mammal behavioral responses; these are largely attributable to sparse data. Ultimately there should be multiple functions for different marine mammal taxonomic groups, but the current data are insufficient to support them. The goal is unquestionably that risk functions be based on empirical measurement.

The risk function presented here is based on three data sets that NMFS and Navy have determined are the best available science at this time. The Navy and NMFS acknowledge each of these data sets has limitations. However, this risk function, if informed by the limited available data relevant to the MFA sonar application, has the advantages of simplicity and the fact that there is precedent for its application and foundation in marine mammal research.

While NMFS considers all data sets as being weighted equally in the development of the risk function, the Navy believes the SSC San Diego data is the most rigorous and applicable for the following reasons:

- The data represents the only source of information where the researchers had complete control over and ability to quantify the noise exposure conditions.
- The altered behaviors were identifiable due to long term observations of the animals.
- The fatiguing noise consisted of tonal exposures with limited frequencies contained in the MFA sonar bandwidth.

However, the Navy and NMFS do agree that the following are limitations associated with the three data sets used as the basis of the risk function:

- The three data sets represent the responses of only four species: trained bottlenose dolphins and beluga whales, North Atlantic right whales in the wild and killer whales in the wild.
- None of the three data sets represent experiments designed for behavioral observations of animals exposed to MFA sonar.
- The behavioral responses of marine mammals that were observed in the wild are based solely on an estimated received level of sound exposure; they do not take into consideration (due to minimal or no supporting data):
  - Potential relationships between acoustic exposures and specific behavioral activities (e.g., feeding, reproduction, changes in diving behavior, etc.), variables such as bathymetry, or acoustic waveguides; or
  - Differences in individuals, populations, or species, or the prior experiences, reproductive state, hearing sensitivity, or age of the marine mammal.

<u>SSC San Diego Trained Bottlenose Dolphins and Beluga Data Set:</u>

- The animals were trained animals in captivity; therefore, they may be more or less sensitive than cetaceans found in the wild (Domjan, 1998).
- The tests were designed to measure TTS, not behavior.
- Because the tests were designed to measure TTS, the animals were exposed to much higher levels of sound than the baseline risk function (only two of the total 193 observations were at levels below 160 dB re 1 μPa^2-s).
- The animals were not exposed in the open ocean but in a shallow bay or pool.

<u>North Atlantic Right Whales in the Wild Data Set:</u>

- The observations of behavioral response were from exposure to alert stimuli that contained mid-frequency components but was not similar to a MFA sonar ping. The alert signal was 18 minutes of exposure consisting of three 2-minute signals played sequentially three times over. The three signals had a 60 percent duty cycle and consisted of: (1) alternating 1-sec pure tones at 500 Hz and 850 Hz; (2) a 2-sec logarithmic down-sweep from 4,500 Hz to 500 Hz; and (3) a pair of low (1,500 Hz)-high

(2,000 Hz) sine wave tones amplitude modulated at 120 Hz and each 1-sec long. This 18-minute alert stimuli is in contrast to the average 1-sec ping every 30 sec in a comparatively very narrow frequency band used by military sonar.

- The purpose of the alert signal was, in part, to provoke an action from the whales through an auditory stimulus.

Killer Whales in the Wild Data Set:

- The observations of behavioral harassment were complicated by the fact that there were other sources of harassment in the vicinity (other vessels and their interaction with the animals during the observation).
- The observations were anecdotal and inconsistent. There were no controls during the observation period, with no way to assess the relative magnitude of the any observed response as opposed to baseline conditions.

3.1.5 INPUT PARAMETERS FOR THE RISK FUNCTION

The values of B, K, and A need to be specified in order to utilize the risk function defined in Section 3.1.1. The risk continuum function approximates the dose-response function in a manner analogous to pharmacological risk assessment (U.S. Department of the Navy, 2001, Appendix A). In this case, the risk function is combined with the distribution of sound exposure levels to estimate aggregate impact on an exposed population.

3.1.5.1 BASEMENT VALUE FOR RISK—THE B PARAMETER

The B parameter defines the basement value for risk, below which the risk is so low that calculations are impractical. This 120 dB level is taken as the estimate received level (RL) below which the risk of significant change in a biologically important behavior approaches zero for the MFA sonar risk assessment. This level is based on a broad overview of the levels at which multiple species have been reported responding to a variety of sound sources, both mid-frequency and other, was recommended by the scientists, and has been used in other publications. The Navy recognizes that for actual risk of changes in behavior to be zero, the signal-to-noise ratio of the animal must also be zero. However, the present convention of ending the risk calculation at 120 dB for MFA sonar has a negligible impact on the subsequent calculations, because the risk function does not attain appreciable values at received levels that low.

3.1.5.2 THE K PARAMETER

NMFS and the Navy used the mean of the following values to define the midpoint of the function: (1) the mean of the lowest received levels (185.3 dB) at which individuals responded with altered behavior to 3 kHz tones in the SSC data set; (2) the estimated mean received level value of 169.3 dB produced by the reconstruction of the USS SHOUP incident in which killer whales exposed to MFA sonar (range modeled possible received levels: 150 to 180 dB); and (3) the mean of the 5 maximum received levels at which Nowacek et al. (2004) observed significantly altered responses of right whales to the alert stimuli than to the control (no input signal) is 139.2 dB SPL. The arithmetic mean of these three mean values is 165 dB SPL. The value of K is the difference between the value of B (120 dB SPL) and the 50 percent value of 165 dB SPL; therefore, K=45.

3.1.5.3 RISK TRANSITION—THE A PARAMETER

The A parameter controls how rapidly risk transitions from low to high values with increasing receive level. As A increases, the slope of the risk function increases. For very large values of A, the risk function can approximate a threshold response or step function. NMFS has recommended that Navy use A=10 as the value for odontocetes, and pinnipeds (Figure 3.1.5.3-1) (National Marine Fisheries Service, 2008). This is the same value of A that was used for the SURTASS LFA sonar analysis. As stated in the SURTASS LFA Sonar Final OEIS/EIS (U.S. Department of the Navy, 2001), the value of A=10 produces a curve that has a more gradual transition than the curves developed by the analyses of migratory gray whale studies (Malme et al., 1984). The choice of a more gradual slope than the empirical data was consistent with other decisions for the SURTASS LFA Sonar Final OEIS/EIS to make conservative assumptions when extrapolating from other data sets (see Subchapter 1.43 and Appendix D of the SURTASS LFA Sonar EIS). (National Marine Fisheries Service, 2008)

Based on NMFS' direction, the Navy will use a value of A=8 for mysticetes to allow for greater consideration of potential harassment at the lower received levels based on Nowacek et al., 2004 (Figure 3.1.5.3-2). (National Marine Fisheries Service, 2008)

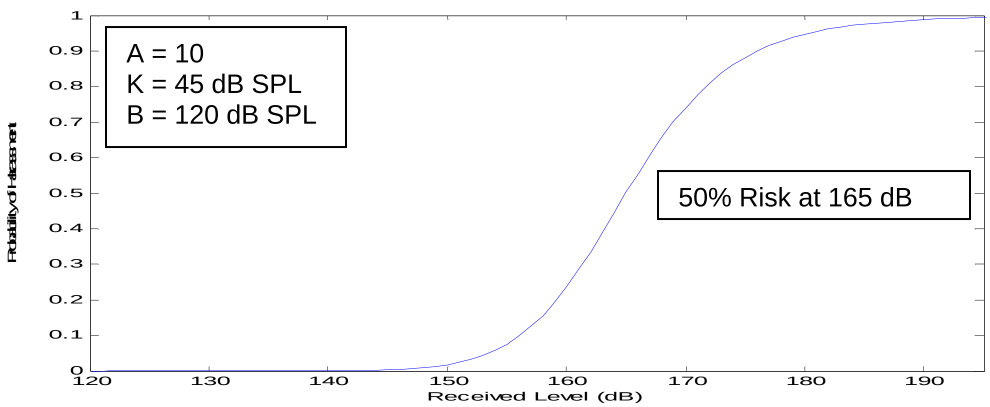

Figure 3.1.5.3-1. Risk Function Curve for Odontocetes (toothed whales) and Pinnipeds

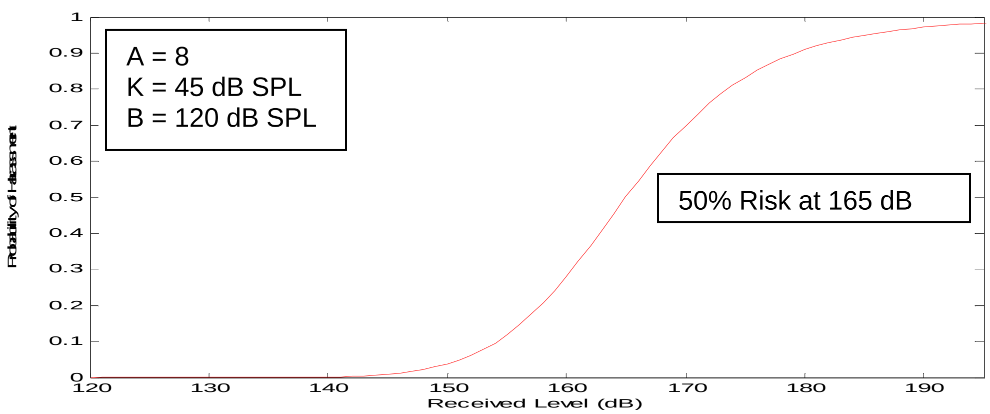

Figure 3.1.5.3-2. Risk Function Curve for Mysticetes (Baleen Whales)

3.1.6 BASIC APPLICATION OF THE RISK FUNCTION

Relation of the Risk Function to the Current Regulatory Scheme

The risk function is used to estimate the percentage of an exposed population that is likely to exhibit behaviors that would qualify as harassment (as that term is defined by the MMPA applicable to military readiness activities, such as the Navy's testing and training with MFA sonar) at a given received level of sound. For example, at 165 dB SPL (dB re: 1µPa rms), the risk (or probability) of harassment is defined according to this function as 50 percent, and Navy/NMFS applies that by estimating that 50 percent of the individuals exposed at that received level are likely to respond by exhibiting behavior that NMFS would classify as behavioral harassment. The risk function is not applied to individual animals, only to exposed populations.

The data used to produce the risk function were compiled from four species that had been exposed to sound sources in a variety of different circumstances. As a result, the risk function represents a general relationship between acoustic exposures and behavioral responses that is then applied to specific circumstances. That is, the risk function represents a relationship that is deemed to be generally true, based on the limited, best-available science, but may not be true in specific circumstances. In particular, the risk function, as currently derived, treats the received level as the only variable that is relevant to a marine mammal's behavioral response. However, we know that many other variables—the marine mammal's gender, age, and prior experience; the activity it is engaged in during an exposure event, its distance from a sound source, the number of sound sources, and whether the sound sources are approaching or moving away from the animal—can be critically important in determining whether and how a marine mammal will respond to a sound source (Southall et al., 2007). The data that are currently available do not allow for incorporation of these other variables in the current risk functions; however, the risk function represents the best use of the data that are available.

As more specific and applicable data become available, NMFS can use these data to modify the outputs generated by the risk function to make them more realistic (and ultimately, data may exist to justify the use of additional, alternate, or multi-variate functions). As mentioned above, it is known that the distance from the sound source and whether it is perceived as approaching or moving away can affect the way an animal responds to a sound (Wartzok et al., 2003). In the HRC example, animals exposed to received levels between 120 and 130 dB may be more than 65 nautical miles (131,651 yards) from a sound source; those distances would influence whether those animals might perceive the sound source as a potential threat, and their behavioral responses to that threat. Though there are data showing marine mammal responses to sound sources at that *received level*, NMFS does not currently have any data that describe the response of marine mammals to sounds at that *distance* (or to other contextual aspects of the exposure, such as the presence of higher frequency harmonics), much less data that compare responses to similar sound levels at varying distances. However, if data were to become available that suggested animals were less likely to respond (in a manner NMFS would classify as harassment) to certain levels beyond certain distances, or that they were more likely to respond at certain closer distances, Navy will re-evaluate the risk function to try to incorporate any additional variables into the "take" estimates.

Last, pursuant to the MMPA, an applicant is required to estimate the number of animals that will be "taken" by their activities. This estimate informs the analysis that NMFS must perform to determine whether the activity will have a "negligible impact" on the species or stock. Level B (behavioral) harassment occurs at the level of the individual(s) and does not assume any resulting population-level consequences, though there are known avenues through which behavioral disturbance of individuals can result in population-level effects. Alternately, a negligible impact finding is based on the lack of likely adverse effects to annual rates of recruitment or survival (i.e., population-level effects). An estimate of the number of Level B harassment takes, alone, is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS must consider other factors, such as the nature of any responses (their intensity, duration, etc.), the context of any responses (critical reproductive time or location, migration, etc.), or any of the other variables mentioned in the first paragraph (if known), as well as the number and nature of estimated Level A takes, the number of estimated mortalities, and effects on habitat. For example, in the case of sonar usage in HRC, due to the nature of sound propagation, a relatively large portion of the animals that are likely to be "taken" through behavioral harassment are expected to be exposed at relatively low received levels (120-135 dB) where the significance of those responses would be reduced because of the distance from a sound source. Alternatively, only a relatively very small portion of the animals that are expected to be "taken" through behavioral harassment are expected to occur when animals are exposed to higher received levels, such as those approaching the onset of TTS (180-195 dB). Generally speaking, Navy and NMFS anticipate more severe effects from takes resulting from exposure to higher received levels (though this is in no way a strictly linear relationship throughout species, individuals, or circumstances) and less severe effects from takes resulting from exposure to lower received levels.

It is worth noting that Navy and NMFS would expect a relatively large portion of the animals that are likely to be "taken" in HRC (those that occur when an animal is exposed to the levels at the bottom of the risk function), to exhibit behavioral responses that are less likely to adversely affect the longevity, survival, or reproductive success of the animals that might be exposed, based on received level, and the fact that the exposures will occur in the absence of some of the other contextual variables that would likely be associated with increased severity of effects, such as the proximity of the sound source(s) or the proximity of other vessels, aircraft, submarines, etc. maneuvering in the vicinity of the exercise. NMFS will consider all available information (other variables, etc.), but all else being equal, takes that result from exposure to lower received levels and at greater distances from the exercises would be less likely to contribute to population level effects.

3.1.7 NAVY POST ACOUSTIC MODELING ANALYSIS

The environmental provinces used to characterize sound propagation throughout the HRC are the same in the Supplement to the DEIS/OEIS as those described in the DEIS/OEIS. The description of animal densities and their depth distributions for modeling purposes has not changed from the DEIS/OEIS.

In a change from the DEIS/OEIS, the quantification of sonar hours analyzed in the Supplement to the DEIS/OEIS were derived from SPORTS, which serves as a basis for a more accurate assessment of the training needs and sonar hours being modeled (see Chapter 1.0).

The acoustic sources in the Supplement to the DEIS/OEIS are the same as those described in the DEIS/OEIS. For modeling purposes, however, the sonar hours attributed to the AN/SQS 56, dipping sonar, and submarine sonar are now analyzed using the parameters for those systems. Estimates of HFA sonar use (MK-48 torpedo) remain unchanged from the DEIS/OEIS.

For this Supplement to the DEIS/OEIS, the acoustic modeling results include additional analysis to account for the model's previous overestimation of potential effects. Specifically, the previous modeling overestimated effects because:

- Acoustic footprints for sonar sources did not account for land masses.
- Acoustic footprints for sonar sources were added independently and, therefore, did not account for overlap they would have with other sonar systems used during the same active sonar activity. As a consequence, the area of the total acoustic footprint was larger than the actual acoustic footprint when multiple ships are operating together.
- Acoustic modeling did not account for limitations the NMFS defined refresh rate of 24 hours. This time period represents the amount of time in which individual marine mammals can be harasses no more than once.

The result of this change from the DEIS/OEIS will lead to more consistent and accurate modeling outputs. Table 3.1.7-1 provides a summary of the modeling protocols used in the analysis for this Supplement to the DEIS/OEIS.

Table 3.1.7-1. Navy Protocols Providing for Accurate Modeling Quantification of Marine Mammal Exposures

Historical Data	Sonar Positional Reporting System (SPORTS)	Annual active sonar usage data will be obtained from the SPORTS database to determine the number of active sonar hours and the geographic location of those hours for modeling purposes.
Acoustic Parameters	AN/SQS-53 and AN/SQS-56	Model the AN/SQS-53 and the AN/SQS-56 active sonar sources separately to account for the differences in source level, frequency, and exposure effects.
	Submarine Sonar	Submarine active sonar use will be included in effects analysis calculations using the SPORTS database
Post Modeling Analysis	Land Shadow	For sound sources within the acoustic footprint of land, (approximately 65 nautical miles [nm] for the Hawaii Range Complex [HRC]) subtract the land area from the marine mammal exposure calculation.
	Multiple Ships	Correction factors will be used to address overestimates of exposures to marine mammals resulting from multiple counting when there are more than one ship operating in the same vicinity.
	Multiple Exposures	The following refresh rates for HRC training events will be included to account for multiple exposures: • Other HRC ASW training – 13.5 hours • RIMPAC – 12 hours • USWEX – 16 hours • Multi-strike group – 12 hours.

3.2 CHANGES TO TTS AND PTS EXPOSURES FROM DEIS/OEIS

As described in detail in the DEIS/OEIS, acoustic exposures can result in noise induced hearing loss that is a function of the interactions of several factors, including individual hearing sensitivity and exposure amplitude, exposure duration, frequency, and other variables that have not been studied extensively (e.g., kurtosis, temporal pattern, directionality). Loss of hearing sensitivity is referred to as a "threshold shift." The extent and duration of threshold shift depends on a combination of several acoustic features and is specific to particular species. A shift in hearing sensitivity may be temporary (temporary threshold shift or TTS) or it may be permanent (permanent threshold shift or PTS) depending on how the frequency, amplitude, and duration of the exposure combine to produce damage and if that change is reversible.

There was no change in the acoustic effects modeling methodology involving PTS and TTS thresholds from the DEIS/OEIS, As a result of the change in sonar hours, the accurate modeling of the AN/SQS 56 sonar, and the modeling of submarine sonar, however, there was a decrease in the number of TTS and PTS exposures between the DEIS/OEIS and the Supplement to the DEIS/OEIS for all Alternatives. Quantification of the TTS and PTS exposures under each of the alternatives are described in detail in Sections 3.4 to 3.7.

New Monk Seal TTS/PTS Criteria

Research by Kastak et al. (1999; 2005) provided estimates of the average SEL (EFD level) for onset-TTS for a harbor seal, sea lion, and Northern Elephant seal. Although the exposure sessions duration are well beyond those typically used with tactical sonars, the frequency ranges are similar (2.5 kHz -3.5 kHz). This data provides good estimates for the onset of TTS in pinnipeds since the researchers tested different combinations of SPL and exposure duration, and plotted the growth of TTS with an increasing energy exposure level.

Of the three pinniped groups studied by Kastak et al. elephant seals are the most closely related to the Hawaiian monk seal (the family *Monachinae*). The onset-TTS number, provided by Kastak et al. for elephant seals and used to analyze impacts to monk seals is 204 dB re 1µPa^2-s. Using the same rationale described previously for the establishment of the PTS threshold based on odontocete onset-TTS (20 dB up from onset-TTS), the PTS threshold for monk seals used in the HRC analysis is 224 dB re 1µPa^2-s.

3.3 NO-ACTION ALTERNATIVE

3.3.1 SUMMARY OF EXPOSURES—NO-ACTION ALTERNATIVE

Section 2.1 details the amount of MFA sonar proposed for ASW training under the No-action Alternative. The sonar modeling input includes surface ship and submarine MFA tactical sonar, the associated sonobuoy, dipping sonar, and MK-48 torpedo sonar. These exposure numbers are generated by the model without consideration of mitigation measures that would reduce the potential for marine mammal exposures to sonar. Table 3.3.1-1 provides a summary of the total sonar exposures from all No-action Alternative ASW training that will be conducted over the course of a year. The number of exposures from each type of exercise are presented separately in the sections that follow.

The behavioral patterns and acoustic abilities for each species were analyzed in the DEIS/OEIS. Based on that analysis, results of past training, and the implementation of mitigation measures the Navy found that the HRC training events would not result in any death or injury to any marine mammal species. The DEIS/OEIS also found that while the acoustic modeling results indicated MFA sonar may expose all species to acoustic energy levels resulting in temporary behavioral effects, these exposures would have negligible impact on annual survival, recruitment, and birth rates.

Based on the modeling results under the No-action Alternative presented in this Supplement to the DEIS/OEIS, the total number of exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s decreased by 54 percent, and the total number of behavioral exposures decreased by 15 percent as compared to the modeling results in the DEIS/OEIS. The analysis and conclusions for each species, as presented in the DEIS/OEIS for the No-action Alternative, are incorporated by reference in this Supplement to the DEIS/OEIS. Therefore, the Navy finds that the HRC training events analyzed in this Supplement to the DEIS/OEIS for the No-action Alternative would not result in any death or injury to any marine mammal species and would have negligible impact on annual survival, recruitment, and birth rates.

Table 3.3.1-1. No-action Alternative Sonar Modeling Summary—Yearly Marine Mammal Exposures From all ASW (RIMPAC, USWEX and Other HRC ASW Training)

Marine Mammals	Risk Function 120-195 dB SPL	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	88	173	0	0
Fin whale[1, 2]	68	53	0	0
Sei whale[1, 2]	68	53	0	0
Humpback whale[1]	15,254	28,359	228	0
Sperm whale[1]	1,050	767	10	0
Dwarf sperm whale	2,799	1,653	40	0
Pygmy sperm whale	1,141	675	16	0
Cuvier's beaked whale	1,435	1,025	5	0
Longman's beaked whale	143	113	1	0
Blainville's beaked whale	471	391	6	0
Unidentified beaked whale	47	33	0	0
Bottlenose dolphin	1,061	887	19	0
False killer whale	68	53	0	0
Killer whale	68	53	0	0
Pygmy killer whale	279	214	4	0
Short-finned pilot whale	2,559	2,012	46	0
Risso's dolphin	710	559	12	0
Melon-headed whale	852	671	15	0
Rough-toothed dolphin	1,431	869	20	0
Fraser's dolphin	1,660	1,003	22	0

Table 3.3.1-1. No-action Alternative Sonar Modeling Summary—Yearly Marine Mammal Exposures From all ASW (RIMPAC, USWEX and Other HRC ASW Training) (Continued)

Marine Mammals	Risk Function 120-195 dB SPL	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Pantropical spotted dolphin	3,211	2,770	56	0
Spinner dolphin	555	338	7	0
Striped dolphin	4,684	4,043	84	0
Monk seal[1]	161	362	3	0
TOTAL	39,863	47,129	594	0

Notes: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
[3] For cetacea TTS is the following range 195-215 dB re 1 µPa^2-s. For monk seals TTS is 204-224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
[4] For cetacea PTS is >215 dB re 1 µPa^2-s. For monk seals PTS is >224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
Risk Function Curve
195 dB – TTS 195-215 dB re 1 µPa^2-s
215 dB – PTS >215 dB re 1 µPa^2-s
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.3.2 ESTIMATED BEHAVIORAL EFFECTS ON ENDANGERED SPECIES ACT (ESA) LISTED MARINE MAMMAL SPECIES—NO-ACTION ALTERNATIVE

ESA listed species that may be affected as a result of implementation of the HRC No-action Alternative include the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), Hawaiian monk seal (*Monachus schauinslandi*) humpback whale (*Megaptera novaeangliae*), North Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*).

Blue Whale (*Balaenoptera musculus*)

There is no change from the DEIS/OEIS with regard to blue whales. There is no density information available for blue whales in Hawaiian waters given they have not been seen during any surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any blue whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Fin Whale (*Balaenoptera physalus*)

There is no density information for fin whales in the Hawaiian Islands (Barlow, 2006). For purposes of acoustic effects analysis, it was assumed that the number and density of fin whales did not exceed that of false killer whales and the modeled number of exposures for both species will therefore be the same. The risk function and Navy post-modeling analysis estimates 68 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect fin whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.3.1-1). Modeling indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 15,254 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect humpback whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.3.1-1). Modeling indicates there would be 228 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates there would be one exposure for humpback whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

North Pacific Right Whale (*Eubalaena japonica*)

There is no change from the DEIS/OEIS with regard to effects on North Pacific right whales. There is no density information available for North Pacific right whales in Hawaiian waters since they have not been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any North Pacific right whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Sei Whale (*Balaenoptera borealis*)

For purposes of the acoustic effects analysis, the same assumptions made previously regarding fin whales are also made for sei whales. It was therefore assumed that the number and density of sei whales did not exceed that of false killer whales, and the modeled number of exposures for both species would therefore be the same. The risk function and Navy post-modeling analysis estimates 68 sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sei whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.3.1-1). Modeling indicates there would be no exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates no exposures for sei whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 1,050 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sperm whales; therefore, the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.3.1-1). Modeling also indicates there would 10 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates no exposures for sperm whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Hawaiian Monk Seal (*Monachus schauinslandi*)

The risk function and Navy post-modeling analysis estimates 161 Hawaiian monk seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect Hawaiian monk seals, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.3.1-1). Modeling also indicates there would be three exposures to accumulated acoustic energy between 204 dB and 224 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates there would be no exposures for monk seals to accumulated acoustic energy above 224 dB re 1 µPa^2-s.

3.3.3 ESTIMATED BEHAVIORAL HARASSMENT EXPOSURES FOR NON-ESA SPECIES—NO-ACTION ALTERNATIVE

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates 88 Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS.

Minke Whale (*Balaenoptera acutorostrata*)

There is no change from the DEIS/OEIS with regard to effects on minke whales. There is no density information available for minke whales in Hawaiian waters given they have rarely been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any minke whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

The risk function and Navy post-modeling analysis estimates 471 Blainville's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates six exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no Blainville's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 1,061 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 19 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no bottlenose dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 1,435 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates five exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no Cuvier's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Dwarf Sperm Whale (*Kogia sima*)

The risk function and Navy post-modeling analysis estimates 2,799 dwarf sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 40 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no dwarf sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

False Killer Whale (*Pseudorca crassidens*)

The risk function and Navy post-modeling analysis estimates 68 false killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS.

Fraser's Dolphin (*Lagenodelphis hosei*)

The risk function and Navy post-modeling analysis estimates 1,660 Fraser's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 22 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no Fraser's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates 68 killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS.

Longman's Beaked Whale (*Indopacetus pacificus*)

The risk function and Navy post-modeling analysis estimates 145 Longman's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates one exposure to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no Longman's beaked whale would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Melon-headed Whale (*Peponocephala electra*)

The risk function and Navy post-modeling analysis estimates 852 melon-headed whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 15 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no melon-headed whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Pantropical Spotted Dolphin (*Stenella attenuata*)

The risk function and Navy post-modeling analysis estimates 3,211 pantropical spotted dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 56 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no pantropical spotted dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Pygmy Killer Whale (*Feresa attenuata*)

The risk function and Navy post-modeling analysis estimates 279 pygmy killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates four exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no pygmy killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Pygmy Sperm Whale (*Kogia breviceps*)

The risk function and Navy post-modeling analysis estimates 1,141 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 16 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no pygmy sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 710 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 12 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no Risso's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Rough-Toothed Dolphin (*Steno bredanensis*)

The risk function and Navy post-modeling analysis estimates 1,431 rough-toothed dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 20 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no rough-toothed dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 2,559 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 46 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset

PTS respectively). Modeling for the No-action Alternative indicates that no short-finned pilot whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa²-s.

Spinner Dolphin (*Stenella longirostris*)

The risk function and Navy post-modeling analysis estimates 555 spinner dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates seven exposures to accumulated acoustic energy above 195 dB re 1 µPa²-s, which is the threshold established indicative of onset TTS. Modeling for the No-action Alternative indicates that no spinner dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa²-s, which is the threshold indicative of onset PTS.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 4,684 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates 84 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa²-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for the No-action Alternative indicates that no striped dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa²-s.

Unidentified Beaked Whales

The risk function and Navy post-modeling analysis estimates 47 unidentified beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.3.1-1). Modeling also indicates no exposures to accumulated acoustic energy above 195 dB re 1 µPa²-s, which is the threshold established indicative of onset TTS

3.3.4 SUMMARY OF COMPLIANCE WITH ESA AND MMPA—NO-ACTION ALTERNATIVE

ESA

Based on analytical risk function modeling results, NMFS conclusions in the Biological Opinions issued regarding RIMPAC 2006 and USWEX 2007, and in accordance with the ESA, the Navy finds these estimates of harassment resulting from the proposed use of MFA sonar may affect endangered blue whale, North Pacific right whale, fin whales. Hawaiian monk seals, humpback whales, sei whales, and sperm whales.

MMPA

Based on the risk function and Navy post-modeling analysis estimates 39,863 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. Modeling for Alternative 2 indicates 594 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa²-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling also indicates no exposures to accumulated acoustic energy above 215 dB re 1 µPa²-s. Should the Navy decide to implement the No-action Alternative, the effects to marine mammals will need to be considered by NMFS for purposes of consultation.

3.3.5 HRC ASW TRAINING—NO-ACTION ALTERNATIVE

The No-action Alternative modeling included surface ship sonar, submarine sonar, associated sonobuoys, MK-48 torpedo sonar, and dipping sonars per year. The modeled exposures for marine mammals during ASW training, without consideration of mitigation measures are presented in Table 3.3.5-1. Effects on marine mammals from these exposures are included in the discussion in Sections 3.3.2 for ESA listed species and 3.3.3 for non-ESA listed species.

Table 3.3.5-1. No-action Alternative Sonar Modeling Summary—Yearly Marine Mammal Exposures from Other HRC ASW Training

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	34	84	0	0
Fin whale[1, 2]	29	28	0	0
Sei whale[1, 2]	29	28	0	0
Humpback whale[1]	6,703	8,938	63	0
Sperm whale[1]	415	391	2	0
Dwarf sperm whale	1,089	836	11	0
Pygmy sperm whale	444	342	4	0
Cuvier's beaked whale	521	490	1	0
Longman's beaked whale	55	56	0	0
Blainville's beaked whale	183	191	2	0
Unidentified beaked whale	18	16	0	0
Bottlenose dolphin	457	454	5	0
False killer whale	29	28	0	0
Killer whale	29	28	0	0
Pygmy killer whale	118	110	1	0
Shortfinned pilot whale	1,090	1,044	13	0
Risso's dolphin	302	290	3	0
Melonheaded whale	363	348	4	0
Roughtoothed dolphin	558	439	5	0
Fraser's dolphin	647	507	6	0
Pantropical spotted dolphin	1,402	1,424	15	0
Spinner dolphin	216	171	2	0
Striped dolphin	2,046	2,078	23	0
Monk seal[1]	81	177	1	0
TOTAL	16,858	18,498	160	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.3.6 MAJOR EXERCISES—NO-ACTION ALTERNATIVE

Rim of the Pacific (RIMPAC)

There are no changes in the Alternatives for the RIMPAC exercise between the DEIS/OEIS and the Supplement to the DEIS/OEIS. The modeled exposures for marine mammals during RIMPAC, without consideration of mitigation measures are presented in Table 3.3.6-1.

Table 3.3.6-1. No-action Alternative Sonar Modeling Summary—Yearly Marine Mammal Exposures for RIMPAC (Conducted Every Other Year)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	21	2	0	0
Fin whale[1, 2]	15	7	0	0
Sei whale[1, 2]	15	7	0	0
Humpback whale[1, 5]	-	-	-	-
Sperm whale[1]	264	115	3	0
Dwarf sperm whale	650	211	13	0
Pygmy sperm whale	264	89	5	0
Cuvier's beaked whale	372	157	2	0
Longman's beaked whale	35	16	0	0
Blainville's beaked whale	109	54	2	0
Unidentified beaked whale	12	5	0	0
Bottlenose dolphin	242	128	6	0
False killer whale	15	7	0	0
Killer whale	15	7	0	0
Pygmy killer whale	62	30	1	0
Shortfinned pilot whale	588	289	14	0
Risso's dolphin	163	80	4	0
Melonheaded whale	196	96	5	0
Roughtoothed dolphin	332	115	7	0
Fraser's dolphin	386	133	7	0
Pantropical spotted dolphin	737	409	18	0
Spinner dolphin	129	45	2	0
Striped dolphin	1,074	596	27	0
Monk seal[1]	37	49	1	0
TOTAL	5,733	2,676	117	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[5]RIMPAC is conducted during the summer when humpback whales are not present in Hawaii
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

Undersea Warfare Training Exercise (USWEX)

The No-action Alternative for USWEX has changed from the Alternatives presented in the DEIS/OEIS and the Supplement to the DEIS/OEIS. There were six USWEXs analyzed in the DEIS/OEIS proposed under the No-action Alternative, and in the Supplement to the DEIS/OEIS there are five USWEX proposed (Table 3.3.6-2).

Table 3.3.6-2. No-action Alternative Sonar Modeling Summary—Yearly Marine Mammal Exposures from USWEX (5 per year)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	33	65	0	0
Fin whale[1, 2]	24	19	0	0
Sei whale[1, 2]	24	19	0	0
Humpback whale[1]	8,551	19,421	166	0
Sperm whale[1]	371	262	5	0
Dwarf sperm whale	1,060	599	16	0
Pygmy sperm whale	433	244	7	0
Cuvier's beaked whale	542	378	2	0
Longman's beaked whale	53	41	1	0
Blainville's beaked whale	179	145	2	0
Unidentified beaked whale	17	12	0	0
Bottlenose dolphin	362	305	8	0
False killer whale	24	19	0	0
Killer whale	24	19	0	0
Pygmy killer whale	99	74	2	0
Shortfinned pilot whale	881	679	19	0
Risso's dolphin	245	189	5	0
Melonheaded whale	293	226	6	0
Roughtoothed dolphin	541	315	8	0
Fraser's dolphin	627	363	9	0
Pantropical spotted dolphin	1,072	938	23	0
Spinner dolphin	210	122	3	0
Striped dolphin	1,564	1,368	34	0
Monk seal[1]	43	136	1	0
TOTAL	17,272	25,958	317	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3] 195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4] 215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.4 ALTERNATIVE 1

3.4.1 SUMMARY OF EXPOSURES—ALTERNATIVE 1

Section 2.2 details the amount of MFA sonar proposed for ASW training under Alternative 1. The sonar modeling input includes surface ship and submarine MFA tactical sonar, the associated sonobuoy, dipping sonar, and MK-48 torpedo sonar. These exposure numbers are generated by the model without consideration of mitigation measures that would reduce the potential for marine mammal exposures to sonar. Table 3.4.1-1 provides a summary of the total sonar exposures from all Alternative 1 ASW Exercises that would be conducted over the course of a year. The number of exposures from each type of exercise are presented separately in the following sections.

The behavioral patterns and acoustic abilities for each species were analyzed in the DEIS/OEIS. Based on that analysis, results of past training, and the implementation of mitigation measures the Navy found that the HRC training events would not result in any death or injury to any marine mammal species. The DEIS/OEIS also found that while the acoustic modeling results indicated MFA sonar may expose all species to acoustic energy levels resulting in temporary behavioral effects, these exposures would have negligible impact on annual survival, recruitment, and birth rates.

Based on the modeling results under Alternative 1 presented in this Supplement to the DEIS/OEIS, the total number of exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s decreased by 49 percent, and the total number of behavioral exposures decreased by 5 percent as compared to the modeling results in the DEIS/OEIS. The analysis and conclusions for each species, as presented in the DEIS/OEIS for Alternative 1, are incorporated by reference in this Supplement to the DEIS/OEIS. Therefore, the Navy finds that the HRC training events analyzed in this Supplement to the DEIS/OEIS for Alternative 1 would not result in any death or injury to any marine mammal species and would have negligible impact on annual survival, recruitment, and birth rates.

Table 3.4.1-1. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures from All ASW (RIMPAC, USWEX and Other HRC ASW Training)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	115	198	0	0
Fin whale[1, 2]	90	61	2	0
Sei whale[1, 2]	90	61	2	0
Humpback whale[1]	15,410	28,359	228	0
Sperm whale[1]	1,385	882	14	0
Dwarf sperm whale	3,622	1,871	56	0
Pygmy sperm whale	1,480	764	22	0
Cuvier's beaked whale	1,906	1,182	8	0
Longman's beaked whale	184	130	2	0

Table 3.4.1-1. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures From all ASW (TRACKEX, TORPEX, RIMPAC, USWEX) (Continued)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Blainville's beaked whale	610	444	10	0
Unidentified beaked whale	62	38	0	0
Bottlenose dolphin	1,362	1,015	27	0
False killer whale	90	61	2	0
Killer whale	90	61	2	0
Pygmy killer whale	358	243	6	0
Short-finned pilot whale	3,294	2,301	64	0
Risso's dolphin	913	639	17	0
Melon-headed whale	1,097	767	20	0
Rough-toothed dolphin	1,854	984	28	0
Fraser's dolphin	2,150	1,136	33	0
Pantropical spotted dolphin	4,122	3,179	79	0
Spinner dolphin	719	383	11	0
Striped dolphin	6,017	4,639	117	0
Monk seal[1]	205	411	4	0
TOTAL	47,225	49,809	754	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 µPa^2-s; for monk seals TTS is 204-224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB- PTS >215 dB re 1 µPa^2-s; for monk seals PTS is >224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

The implementation of the mitigation and monitoring procedures presented in the DEIS/OEIS will minimize the potential for marine mammal exposure and harassment through range clearance procedures.

3.4.2 ESTIMATED BEHAVIORAL EFFECTS ON ESA LISTED MARINE MAMMAL SPECIES—ALTERNATIVE 1

The endangered species that may be affected as a result of implementation of Alternative 1 include the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), Hawaiian monk seal (*Monachus schauinslandi*), humpback whale (*Megaptera novaeangliae*), North Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*).

Blue Whale (*Balaenoptera musculus*)

There is no change from the DEIS/OEIS with regard to effects on blue whales. There is no density information available for blue whales in Hawaiian waters given they have not been seen during any surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any blue whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Fin Whale (*Balaenoptera physalus*)

There is no density information for fin whales in the Hawaiian Islands (Barlow, 2006). For purposes of acoustic effects analysis, it was assumed that the number and density of fin whales did not exceed that of false killer whales and the modeled number of exposures for both species will therefore be the same. The risk function and Navy post-modeling analysis estimates 90 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect fin whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.4.1-1). Modeling also indicates that there would be two exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates no exposures for fin whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 15,410 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect humpback whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.4.1-1). Modeling also indicates there would be 228 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively).

North Pacific Right Whale (*Eubalaena japonica*)

There is no change from the DEIS/OEIS with regard to effects on North Pacific right whales. There is no density information available for North Pacific right whales in Hawaiian waters since they have not been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any North Pacific right whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Sei Whale (*Balaenoptera borealis*)

For purposes of the acoustic effects analysis, the same assumptions made previously regarding fin whales are also made for sei whales. It was therefore assumed that the number and density of sei whales did not exceed that of false killer whales, and the modeled number of exposures for both species would therefore be the same. The risk function and Navy post-modeling analysis estimates 90 sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sei whales, therefore the Navy has initiated Section 7 consultation with NMFS (Table 3.4.1-1). Modeling also predicts two exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts no exposures for sei whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 1,385 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sperm whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.4.1-1). Modeling also predicts 14 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts no exposures for sperm whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Hawaiian Monk Seal (*Monachus schauinslandi*)

The risk function and Navy post-modeling analysis estimates 205 Hawaiian monk seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect Hawaiian monk seals, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.4.1-1). Modeling also predicts four exposures to accumulated acoustic energy between 204 dB and 224 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts there would be no exposures for monk seals to accumulated acoustic energy above 224 dB re 1 μPa^2-s.

3.4.3 ESTIMATED BEHAVIORAL HARASSMENT EXPOSURES FOR NON-ESA SPECIES—ALTERNATIVE 1

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates 115 Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS.

Minke Whale (*Balaenoptera acutorostrata*)

There is no change from the DEIS/OEIS with regard to effects on the minke whale. There is no density information available for minke whales in Hawaiian waters given they have rarely been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any minke whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

The risk function and Navy post-modeling analysis estimates 610 Blainville's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 10 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no Blainville's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 1,362 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table

3.4.1-1). Modeling also indicates 27 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no bottlenose dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 1,906 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates eight exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no Cuvier's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Dwarf Sperm Whale (*Kogia sima*)

The risk function and Navy post-modeling analysis estimates 3,622 dwarf sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 56 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no dwarf sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

False Killer Whale (*Pseudorca crassidens*)

The risk function and Navy post-modeling analysis estimates 90 false killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates two exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no false killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Fraser's Dolphin (*Lagenodelphis hosei*)

The risk function and Navy post-modeling analysis estimates 2,150 Fraser's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 33 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no Fraser's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates 90 killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates two exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Longman's Beaked Whale (*Indopacetus pacificus*)

The risk function and Navy post-modeling analysis estimates 184 Longman's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates two exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no Longman's beaked whale would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Melon-headed Whale (*Peponocephala electra*)

The risk function and Navy post-modeling analysis estimates 1,097 melon-headed whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 20 exposures to accumulated acoustic energy. Modeling for Alternative 1 indicates that no melon-headed whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Pantropical Spotted Dolphin (*Stenella attenuata*)

The risk function and Navy post-modeling analysis estimates 4,122 pantropical spotted dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 79 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no pantropical spotted dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Pygmy Killer Whale (*Feresa attenuata*)

The risk function and Navy post-modeling analysis estimates 358 pygmy killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates six exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no pygmy killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Pygmy Sperm Whale (*Kogia breviceps*)

The risk function and Navy post-modeling analysis estimates 1,480 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 22 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no pygmy sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 913 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 17 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no Risso's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Rough-Toothed Dolphin (*Steno bredanensis*)

The risk function and Navy post-modeling analysis estimates 1,854 rough-toothed dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 28 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no rough-toothed dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 3,294 short-finned pilot whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 64 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no short-finned pilot whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Spinner Dolphin (*Stenella longirostris*)

The risk function and Navy post-modeling analysis estimates 719 spinner dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 11 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates that no spinner dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 6,017 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates 117 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 1 indicates no exposures to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Unidentified Beaked Whales

The risk function and Navy post-modeling analysis estimates 62 unidentified beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.4.1-1). Modeling also indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 µPa^2-s, which is the threshold established indicative of onset TTS.

3.4.4 SUMMARY OF COMPLIANCE WITH MMPA AND ESA—ALTERNATIVE 1

ESA

Based on analytical risk function modeling results, NMFS conclusions in the Biological Opinions issued regarding RIMPAC 2006 and USWEX 2007, and in accordance with the ESA, the Navy finds these estimates of harassment resulting from the proposed use of MFA sonar may affect endangered blue whale, North Pacific right whale, fin whales. Hawaiian monk seals, humpback whales, sei whales, and sperm whales.

MMPA

Based on the risk function and Navy post-modeling analysis estimates 47,225 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. Modeling for Alternative 2 indicates 754 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling also indicates no exposures to accumulated acoustic energy above 215 dB re 1 µPa^2-s. Should the Navy decide to implement Alternative 1, the effects to marine mammals will need to be considered by NMFS for purposes of consultation.

3.4.5 INCREASED TEMPO AND FREQUENCY OF HRC ASW TRAINING—ALTERNATIVE 1

Section 2.2 details the amount of MFA sonar proposed for ASW training under Alternative 1. The sonar modeling input includes surface ship and submarine MFA tactical sonar, the associated sonobuoy, dipping sonar, and MK-48 torpedo sonar. The modeled exposures for marine mammals during other ASW training, without consideration of mitigation measures are presented in Table 3.4.5-1.

Table 3.4.5-1. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures from Other HRC ASW Training

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	35	84	0	0
Fin whale[1, 2]	29	28	0	0
Sei whale[1, 2]	29	28	0	0
Humpback whale[1]	6,712	8,938	63	0
Sperm whale[1]	415	391	2	0
Dwarf sperm whale	1,092	836	11	0
Pygmy sperm whale	445	342	4	0
Cuvier's beaked whale	522	490	1	0
Longman's beaked whale	55	56	0	0
Blainville's beaked whale	183	191	2	0
Unidentified beaked whale	18	16	0	0
Bottlenose dolphin	458	454	5	0
False killer whale	29	28	0	0
Killer whale	29	28	0	0
Pygmy killer whale	118	110	1	0
Short-finned pilot whale	1,092	1,044	13	0
Risso's dolphin	303	290	3	0
Melon-headed whale	364	348	4	0
Rough-toothed dolphin	560	439	5	0

Table 3.4.5-1. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures from Other HRC ASW Training (Continued)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Fraser's dolphin	649	507	6	0
Pantropical spotted dolphin	1,404	1,424	15	0
Spinner dolphin	216	171	2	0
Striped dolphin	2,049	2,078	23	0
Monk seal[1]	82	177	1	0
TOTAL	16,888	18,498	160	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 µPa^2-s; for monk seals TTS is 204-224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB – PTS >215 dB re 1 µPa^2-s; for monk seals PTS is >224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.4.6 MAJOR EXERCISES—ALTERNATIVE 1

RIMPAC

The training events and impacts to marine mammals from one a one-Carrier Strike Group RIMPAC Exercise have been summarized in the RIMPAC 2006 Supplement to the 2002 RIMPAC EA (U.S. Department of the Navy, Commander Third Fleet, 2006). The Alternative 1 modeling assumes two Strike Groups and includes surface ship sonar and associated dipping sonar, sonobuoys, and MK-48 torpedoes, per RIMPAC (conducted every other year). The modeled exposures for marine mammals during RIMPAC, without consideration of mitigation measures are presented in Table 3.4.6-1. Effects on marine mammals from these exposures are included in the discussion in Sections 3.4.2 for ESA listed species and 3.4.3 for non-ESA listed species.

USWEX

The training events and impacts on marine mammals from USWEX have been summarized in the USWEX Programmatic EA/OEA (U.S. Department of the Navy, 2007b). The Alternative 1 number of hours modeled more than the No-action Alternative due to the addition a sixth USWEX, and included 840 hours of surface ship sonar and associated dipping sonar and sonobuoys per year. The modeled exposures for marine mammals during up to six USWEX per year, without consideration of mitigation measures are presented in Table 3.4.6-2. Effects on marine mammals from these exposures are included in the discussion in Sections 3.4.2 for ESA listed species and 3.4.3 for non-ESA listed species.

Table 3.4.6-1. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures for RIMPAC with 2 Strike Groups (Conducted Every Other Year)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	41	49	0	0
Fin whale[1, 2]	32	15	1	0
Sei whale[1, 2]	32	15	1	0
Humpback whale[1, 5]	-	-	-	-
Sperm whale[1]	525	225	7	0
Dwarf sperm whale	1,288	437	25	0
Pygmy sperm whale	527	178	10	0
Cuvier's beaked whale	739	315	4	0
Longman's beaked whale	67	32	1	0
Blainville's beaked whale	217	108	5	0
Unidentified beaked whale	23	10	0	0
Bottlenose dolphin	475	255	13	0
False killer whale	32	15	1	0
Killer whale	32	15	1	0
Pygmy killer whale	123	59	3	0
Short-finned pilot whale	1,158	578	29	0
Risso's dolphin	321	160	8	0
Melon-headed whale	386	152	9	0
Rough-toothed dolphin	660	230	13	0
Fraser's dolphin	766	266	15	0
Pantropical spotted dolphin	1,443	817	36	0
Spinner dolphin	256	89	5	0
Striped dolphin	2,107	1,152	53	0
Monk seal[1]	74	57	2	0
TOTAL	11,324	5,352	242	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[5]RIMPAC is conducted during the summer when humpback whales are not present in Hawaii
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

Table 3.4.6-2. Alternative 1 Sonar Modeling Summary—Yearly Marine Mammal Exposures from USWEX (6 per year)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	39	65	0	0
Fin whale[1, 2]	29	19	1	0
Sei whale[1, 2]	29	19	1	0
Humpback whale[1]	8,698	19,421	166	0
Sperm whale[1]	445	262	5	0
Dwarf sperm whale	1,242	599	20	0
Pygmy sperm whale	508	244	8	0
Cuvier's beaked whale	645	378	3	0
Longman's beaked whale	62	41	1	0
Blainville's beaked whale	210	145	3	0
Unidentified beaked whale	21	12	0	0
Bottlenose dolphin	429	305	9	0
False killer whale	29	19	1	0
Killer whale	29	19	1	0
Pygmy killer whale	117	74	2	0
Shortfinned pilot whale	1,044	679	22	0
Risso's dolphin	289	189	6	0
Melonheaded whale	347	226	7	0
Roughtoothed dolphin	634	315	10	0
Fraser's dolphin	735	363	12	0
Pantropical spotted dolphin	1,275	938	28	0
Spinner dolphin	247	122	4	0
Striped dolphin	1,861	1,368	41	0
Monk seal[1]	49	136	1	0
TOTAL	19,013	25,958	352	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Dose Function Curve
[3] 195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4] 215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.5 ALTERNATIVE 2

3.5.1 SUMMARY OF EXPOSURES—ALTERNATIVE 2

Section 2.3 details the amount of MFA sonar proposed for ASW training under Alternative 2. The sonar modeling input includes surface ship and submarine MFA tactical sonar, the associated sonobuoys, dipping sonar, and MK-48 torpedo sonar. These exposure numbers are generated by the model without consideration of mitigation measures that would reduce the potential for marine mammal exposures to sonar. Table 3.5.1-1 provides a summary of the total sonar exposures from all Alternative 2 ASW Exercises that would be conducted over the course of a year. The number of exposures from each type of exercise is presented separately in the following sections.

The behavioral patterns and acoustic abilities for each species were analyzed in the DEIS/OEIS. Based on that analysis, results of past training, and the implementation of mitigation measures the Navy found that the HRC training events would not result in any death or injury to any marine mammal species. The DEIS/OEIS also found that while the acoustic modeling results indicated MFA sonar may expose all species to acoustic energy levels resulting in temporary behavioral effects, these exposures would have negligible impact on annual survival, recruitment, and birth rates.

Based on the modeling results under Alternative 2 presented in this Supplement to the DEIS/OEIS, the total number of exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s decreased by 38 percent, and the total number of behavioral exposures increased by 5 percent as compared to the modeling results in the DEIS/OEIS. The analysis and conclusions for each species, as presented in the DEIS/OEIS for Alternative 2, are incorporated by reference in this Supplement to the DEIS/OEIS. Therefore, the Navy finds that the HRC training events analyzed in this Supplement to the DEIS/OEIS for Alternative 2 would not result in any death or injury to any marine mammal species and would have negligible impact on annual survival, recruitment, and birth rates.

Table 3.5.1-1. Alternative 2 Sonar Modeling Summary—Yearly Marine Mammal Exposures From all ASW (RIMPAC, USWEX, Multiple Strike Group and Other HRC ASW Training)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	156	271	0	0
Fin whale[1, 2]	122	82	3	0
Sei whale[1, 2]	122	82	3	0
Humpback whale[1]	23,249	34,758	379	1
Sperm whale[1]	1,866	1,152	19	0
Dwarf sperm whale	4,958	2,564	77	0
Pygmy sperm whale	2,026	1,047	30	0
Cuvier's beaked whale	2,600	1,592	13	0

Table 3.5.1-1. Alternative 2 Sonar Modeling Summary—Yearly Marine Mammal Exposures From all ASW (RIMPAC, USWEX, Multiple Strike Group and HRC ASW Training) (Continued)

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Longman's beaked whale	252	174	3	0
Blainville's beaked whale	837	611	13	0
Unidentified beaked whale	84	50	0	0
Bottlenose dolphin	1,831	1,344	38	0
False killer whale	122	82	3	0
Killer whale	122	82	3	0
Pygmy killer whale	486	327	9	0
Short-finned pilot whale	4,445	3,046	89	0
Risso's dolphin	1,234	844	24	0
Melon-headed whale	1,480	1,014	28	0
Rough-toothed dolphin	2,538	1,349	39	0
Fraser's dolphin	2,941	1,557	47	0
Pantropical spotted dolphin	5,525	4,183	109	0
Spinner dolphin	985	523	16	0
Striped dolphin	8,063	6,104	161	0
Monk seal[1]	283	568	6	0
TOTAL	66,327	63,446	1,110	1

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3] 195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4] 215 dB- PTS > 215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
Assumes 3 Strike Group Exercise in winter
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.5.2 ESTIMATED BEHAVIORAL EFFECTS ON ESA LISTED MARINE MAMMAL SPECIES—ALTERNATIVE 2

The endangered species that may be affected as a result of implementation of Alternative 2 include the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), Hawaiian monk seal (*Monachus schauinslandi*), humpback whale (*Megaptera novaeangliae*), North Pacific right whale (*Eubalaena japonica*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*).

Blue Whale (*Balaenoptera musculus*)

There is no change from the DEIS/OEIS with regard to effects on blue whales. There is no density information available for blue whales in Hawaiian waters given they have not been seen during any surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any blue whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Fin Whale (*Balaenoptera physalus*)

There is no density information for fin whales in the Hawaiian Islands (Barlow, 2006). For purposes of acoustic effects analysis, it was assumed that the number and density of fin whales did not exceed that of false killer whales and the modeled number of exposures for both species will therefore be the same. The risk function and Navy post-modeling analysis estimates 122 fin whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect fin whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.5.1-1). Modeling also indicates there would be three exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates no exposures for fin whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Humpback Whale (*Megaptera novaeangliae*)

The risk function and Navy post-modeling analysis estimates 23,249 humpback whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect humpback whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.5.1-1). Modeling also indicates there would be 379 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling indicates one exposure for humpback whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

North Pacific Right Whale (*Eubalaena japonica*)

There is no change from the DEIS/OEIS with regard to effects on North Pacific right whales. There is no density information available for North Pacific right whales in Hawaiian waters since they have not been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any North Pacific right whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Sei Whale (*Balaenoptera borealis*)

For purposes of the acoustic effects analysis, the same assumptions made previously regarding fin whales are also made for sei whales. It was therefore assumed that the number and density of sei whales did not exceed that of false killer whales, and the modeled number of exposures for both species would therefore be the same. The risk function and Navy post-modeling analysis estimates 122 sei whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sei whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.5.1-1). Modeling also predicts three exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts no exposures for sei whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Sperm Whales (*Physeter macrocephalus*)

The risk function and Navy post-modeling analysis estimates 1,866 sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect sperm whales, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.5.1-1). Modeling also predicts 19 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts there would be no exposures for sperm whales to accumulated acoustic energy above 215 dB re 1 μPa^2-s.

Hawaiian Monk Seal (*Monachus schauinslandi*)

The risk function and Navy post-modeling analysis estimates 283 Hawaiian monk seals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. The Navy believes this may affect Hawaiian monk seals, therefore the Navy has initiated ESA Section 7 consultation with NMFS (Table 3.5.1-1). Modeling also predicts six exposures to accumulated acoustic energy between 204 dB and 224 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling predicts there would be no exposures for monk seals to accumulated acoustic energy above 224 dB re 1 μPa^2-s.

3.5.3 ESTIMATED BEHAVIORAL HARASSMENT EXPOSURES FOR NON-ESA SPECIES—ALTERNATIVE 2

Bryde's Whale (*Balaenoptera edeni*)

The risk function and Navy post-modeling analysis estimates 156 Bryde's whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling indicates there would be no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS.

Minke Whale (*Balaenoptera acutorostrata*)

There is no change from the DEIS/OEIS with regard to effects on minke whales. There is no density information available for minke whales in Hawaiian waters given they have rarely been seen during surveys. Given they are so few in number, it is unlikely that HRC training events will result in the exposure of any minke whales to accumulated acoustic energy in excess of any energy flux threshold or an SPL that would result in a behavioral response.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

The risk function and Navy post-modeling analysis estimates 837 Blainville's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 13 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no Blainville's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Bottlenose Dolphin (*Tursiops truncatus*)

The risk function and Navy post-modeling analysis estimates 1,831 bottlenose dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table

3.5.1-1). Modeling also indicates 38 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no bottlenose dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

The risk function and Navy post-modeling analysis estimates 2,600 Cuvier's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 11 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no Cuvier's beaked whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Dwarf Sperm Whale (*Kogia sima*)

The risk function and Navy post-modeling analysis estimates 4,958 dwarf sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 77 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no dwarf sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

False Killer Whale (*Pseudorca crassidens*)

The risk function and Navy post-modeling analysis estimates 122 false killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates three exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no false killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Fraser's Dolphin (*Lagenodelphis hosei*)

The risk function and Navy post-modeling analysis estimates 2,941 Fraser's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 47 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no Fraser's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Killer Whale (*Orcinus orca*)

The risk function and Navy post-modeling analysis estimates 122 killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates three exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 µPa^2-s.

Longman's Beaked Whale (*Indopacetus pacificus*)

The risk function and Navy post-modeling analysis estimates 253 Longman's beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates three exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no Longman's beaked whale would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Melon-headed Whale (*Peponocephala electra*)

The risk function and Navy post-modeling analysis estimates 1,480 melon-headed whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 28 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no melon-headed whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Pantropical Spotted Dolphin (*Stenella attenuata*)

The risk function and Navy post-modeling analysis estimates 5,525 pantropical spotted dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 109 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no pantropical spotted dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Pygmy Killer Whale (*Feresa attenuata*)

The risk function and Navy post-modeling analysis estimates 486 pygmy killer whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates nine exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no pygmy killer whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Pygmy Sperm Whale (*Feresa attenuata*)

The risk function and Navy post-modeling analysis estimates 2,026 pygmy sperm whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 30 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no pygmy sperm whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Risso's Dolphin (*Grampus griseus*)

The risk function and Navy post-modeling analysis estimates 1,234 Risso's dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 24 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no Risso's dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Rough-Toothed Dolphin (*Steno bredanensis*)

The risk function and Navy post-modeling analysis estimates 2,538 rough-toothed dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 39 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no rough-toothed dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

The risk function and Navy post-modeling analysis estimates 4,445 short-finned whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 89 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no short-finned pilot whales would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Spinner Dolphin (*Stenella longirostris*)

The risk function and Navy post-modeling analysis estimates 985 spinner dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 16 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no spinner dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s.

Striped Dolphin (*Stenella coeruleoalba*)

The risk function and Navy post-modeling analysis estimates 8,063 striped dolphins will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates 161 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling for Alternative 2 indicates that no striped dolphins would be exposed to accumulated acoustic energy at or above 215 dB re 1 μPa^2-s

Unidentified Beaked Whales

The risk function and Navy post-modeling analysis estimates 84 unidentified beaked whales will exhibit behavioral responses NMFS will classify as harassment under the MMPA (Table 3.5.1-1). Modeling also indicates no exposures to accumulated acoustic energy above 195 dB re 1 μPa^2-s, which is the threshold established indicative of onset TTS.

3.5.4 SUMMARY OF COMPLIANCE WITH MMPA AND ESA—ALTERNATIVE 2

ESA

Based on analytical risk function modeling results, NMFS conclusions in the Biological Opinions issued regarding RIMPAC 2006 and USWEX 2007, and in accordance with the ESA, the Navy finds these estimates of harassment resulting from the proposed use of MFA sonar may affect endangered blue whale, North Pacific right whale, fin whales. Hawaiian monk seals, humpback whales, sei whales, and sperm whales.

MMPA

Based on the risk function and Navy post-modeling analysis estimates 66,327 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. Modeling for Alternative 2 indicates 1,110 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 µPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling also indicates one exposure to accumulated acoustic energy above 215 dB re 1 µPa^2-s. Should the Navy decide to implement the Alternative 2, the effects to marine mammals will need to be considered by NMFS for purposes of consultation.

3.5.5 INCREASED TEMPO AND FREQUENCY OF HRC ASW TRAINING—ALTERNATIVE 2

Section 2.3 details the amount of MFA sonar proposed for ASW training under Alternative 2. The sonar modeling input includes surface ship and submarine MFA tactical sonar, the associated sonobuoy, dipping sonar, and MK-48 torpedo sonar. The modeled exposures for marine mammals during other ASW training, without consideration of mitigation measures are presented in Table 3.5.5-1.

3.5.6 ADDITIONAL MAJOR EXERCISES—MULTIPLE STRIKE GROUP TRAINING—ALTERNATIVE 2

RIMPAC and USWEX

The number of hours of sonar modeled for Alternative 2 for RIMPAC is the same as Alternative 1. The modeled exposures for marine mammals during RIMPAC for Alternative 2, without consideration of mitigation measures, are presented in Table 3.4.6-1. Effects on marine mammals from these exposures under Alternative 2 are included in the discussion in Section 3.5.2 for ESA listed species and Section 3.5.3 for non-ESA listed species.

Table 3.5.5-1. Alternative 2 Sonar Modeling Summary—Yearly Marine Mammal Exposures from Other HRC ASW Training

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	35	93	0	0
Fin whale[1, 2]	29	30	0	0
Sei whale[1, 2]	29	30	0	0
Humpback whale[1]	6,780	10,013	67	0
Sperm whale[1]	418	436	2	0
Dwarf sperm whale	1,099	933	11	0
Pygmy sperm whale	448	381	4	0
Cuvier's beaked whale	527	545	1	0
Longman's beaked whale	56	62	0	0
Blainville's beaked whale	185	213	2	0
Unidentified beaked whale	18	17	0	0
Bottlenose dolphin	459	508	5	0
False killer whale	29	30	0	0
Killer whale	29	30	0	0
Pygmy killer whale	118	123	1	0
Short-finned pilot whale	1,096	1,165	13	0
Risso's dolphin	305	324	3	0
Melon-headed whale	365	389	4	0
Rough-toothed dolphin	565	490	5	0
Fraser's dolphin	653	565	7	0
Pantropical spotted dolphin	1,409	1,589	15	0
Spinner dolphin	218	190	2	0
Striped dolphin	2,055	2,319	23	0
Monk seal[1]	83	197	1	0
TOTAL	17,008	20,672	165	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve:
[3]195 dB – TTS 195-215 dB re 1 µPa^2-s; for monk seals TTS is 204-224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB – PTS >215 dB re 1 µPa^2-s; for monk seals PTS is >224 dB re 1 µPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

The number of hours of sonar modeled for Alternative 2 for USWEX is the same as Alternative 1. The modeled exposures for marine mammals during up to six USWEX per year, without consideration of mitigation measures, are presented in Table 3.4.6-2. Effects on marine mammals from these exposures under Alternative 2 are included in the discussion in Sections 3.5.2 for ESA listed species and 3.5.3 for non-ESA listed species.

Multiple Strike Group Training Exercise

Up to three Strike Groups would conduct training simultaneously in the HRC. The modeled exposures for marine mammals during the Multiple Strike Group training exercise, without consideration of mitigation measures are presented in Table 3.5.6-2. Modeling assumed the exercise is conducted during the winter to account for potential humpback whale exposures. Effects on marine mammals from these exposures under Alternative 2 are included in the discussion in Sections 3.5.2 for ESA listed species and 3.5.3 for non-ESA listed species.

Table 3.5.6-2. Alternative 2 Sonar Modeling Summary—Yearly Marine Mammal Exposures for Three Strike Group Exercise

Marine Mammals	Risk Function	DEIS/OEIS Dose Function	TTS[3]	PTS[4]
Bryde's whale	41	66	0	0
Fin whale[1, 2]	32	18	1	0
Sei whale[1, 2]	32	18	1	0
Humpback whale[1]	7,771	5,364	147	0
Sperm whale[1]	478	227	5	0
Dwarf sperm whale	1,329	597	21	0
Pygmy sperm whale	543	244	8	0
Cuvier's beaked whale	689	355	3	0
Longman's beaked whale	67	41	1	0
Blainville's beaked whale	225	146	3	0
Unidentified beaked whale	22	11	0	0
Bottlenose dolphin	468	280	11	0
False killer whale	32	18	1	0
Killer whale	32	18	1	0
Pygmy killer whale	128	71	3	0
Short-finned pilot whale	1,147	624	25	0
Risso's dolphin	319	173	7	0
Melon-headed whale	382	208	8	0
Rough-toothed dolphin	679	313	11	0
Fraser's dolphin	787	361	13	0
Pantropical spotted dolphin	1,398	840	30	0
Spinner dolphin	264	122	5	0
Striped dolphin	2,040	1,226	44	0
Monk seal[1]	77	136	2	0
TOTAL	18,982	11,480	351	0

Note: [1] Endangered Species
[2] Due to a lack of density data for fin and sei whales, false killer whale results were used because they have a similar size population within the HRC.
Risk Function Curve
[3]195 dB – TTS 195-215 dB re 1 μPa^2-s; for monk seals TTS is 204-224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
[4]215 dB- PTS >215 dB re 1 μPa^2-s; for monk seals PTS is >224 dB re 1 μPa^2-s (Kastak et al., 1999; 2005)
dB = decibel
TTS = temporary threshold shift
PTS = permanent threshold shift

3.6 ALTERNATIVE 3

Alternative 3, a newly proposed alternative, would include all training and RDT&E activities described and analyzed for Alternative 2 in the DEIS/OEIS except that the MFA sonar hours would be as analyzed in the No-action Alternative (Section 3.3) of this Supplement to the DEIS/OEIS. Sonar hours for Alternative 3 and the impacts associated with ASW training would be identical to the sonar hours and analysis presented for the No-action Alternative (Tables 3.3.1-1, 3.3.5-1, 3.3.6-1, and 3.3.6-2) in this Supplement to the DEIS/OEIS.

The behavioral patterns and acoustic abilities for each species analyzed in the DEIS/OEIS are incorporated by reference in this Supplement to the DEIS/OEIS. This information was used to analyze the No-action alternative in this document. Impacts and conclusions for Alternative 3 would be identical to those made for each marine species under the No-action Alternative in this Supplement. The Navy finds that the HRC training events analyzed for Alternative 3 would not result in any death or injury to any marine mammal species and would have negligible impact on annual survival, recruitment, and birth rates.

3.6.1 SUMMARY OF COMPLIANCE WITH ESA AND MMPA—ALTERNATIVE 3

ESA

Based on analytical risk function modeling results, NMFS conclusions in the Biological Opinions issued regarding RIMPAC 2006 and USWEX 2007, and in accordance with the ESA, the Navy finds these estimates of harassment resulting from the proposed use of MFA sonar may affect endangered blue whale, North Pacific right whale, fin whales. Hawaiian monk seals, humpback whales, sei whales, and sperm whales. The Navy initiated consultation with NMFS in accordance with Section 7 of the ESA for concurrence. The Navy has initiated consultation with NMFS in accordance with Section 7 of the ESA previously on the DEIS/OEIS Alternative 2 (the previously preferred alternative). The Navy remains in consultation with NMFS, and requests that they consider this new preferred alternative for purposes of ESA consultation.

MMPA

The Navy has initiated consultation with NMFS in accordance with the MMPA previously on the DEIS/OEIS Alternative 2 (the previously preferred alternative). The impacts of this new alternative (Alternative 3) are less than previously considered for consultation. Based on the risk function and Navy post-modeling analysis estimates 39,863 marine mammals will exhibit behavioral responses NMFS will classify as harassment under the MMPA. Modeling for Alternative 3 indicates 594 exposures to accumulated acoustic energy between 195 dB and 215 dB re 1 μPa^2-s (the thresholds established to be indicative of onset TTS and onset PTS respectively). Modeling also indicates no exposures to accumulated acoustic energy above 215 dB re 1 μPa^2-s. The Navy remains in consultation with NMFS, and would request authorization from NMFS for 40,457 MMPA Level B harassment takes and no Level A harassments under Alternative 3 (preferred alternative).

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U.S. Fish & Wildlife Service
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Environmental Management Division
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Hilo HI

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City and County of Honolulu Office of the Mayor
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City and County of Honolulu Office of the Managing Director
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7th Senatorial District
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Hawaii State Legislature
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Education Committee
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Director
City and County of Honolulu
Environmental Services Department

Kapolei HI
Councilmember Rod Tam
Honolulu City Council, District 6
Honolulu HI

Libraries

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Hilo, Hawaii HI

Kahului Public Library
Kahului, Maui HI

Wailuku Public Library
Wailuku, Maui HI

Lihue Public Library
Lihue, Kauai HI

Princeville Public Library
Princeville, Kauai, HI 96722

Waimea Public Library
Waimea, Kauai HI

Hawaii State Library
Hawaii and Pacific Section Document Unit
Honolulu, Oahu HI

Private Citizens

Island of Hawaii

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Hilo HI

Roberta Goodman
Hilo HI

Cory Harden
Hilo, HI

Colby Kearns
Hilo HI

Diane Ley
Hilo HI

John and Ruth Ota
Hilo, HI

Lauren Pagarigan
Hilo HI

Odette Rickert
Hilo HI

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Hilo HI

Peter Sur
Hilo HI

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F.K. Vesperas
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Keaau, HI

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Kurtistown, HI

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Kurtistown HI

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Pahoa HI

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Pahoa HI

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Pahoa HI

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Pahoa, HI

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Maui

Melissa Prince
Haiku HI

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Kahului HI

David Mattila
Kihei HI

Vicki Vallis
Kihei HI

Jan Wine
Kihei HI

Marilyn H. Parris
Makawao HI

Kallie and Gil Keith-Agaran
Wailuku HI

Skippy Hau
Wailuku HI

Lukas D. Shield
Wailuku HI

Kauai
Robert Sato
Kalaheo HI

Rob Dorman – Gabrielle Olivier
Kapaa HI

Rich Hoeppner
Kapaa HI

Alan Hoffman
Kapaa HI

Anne Walton
Kapaa HI

Rayne Regush
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Jose Bulatao, Jr.
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Kilauea HI

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Nina Monasevitch
Lihue HI

Ed Nakaya
Lihue HI

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Jean Souza
Lihue HI

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Honolulu HI

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Kristen U`ilani Chong
Kaneohe HI

Deborah Kern
Mililani HI

Fred Dodge
Waianae HI

California

Marcie Powers
San Francisco CA

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Appendix A
National Marine Fisheries Service, Office of Protected Resources Letter of 31 January 2008

APPENDIX A
NATIONAL MARINE FISHERIES SERVICE, OFFICE OF PROTECTED RESOURCES LETTER OF 31 JANUARY 2008

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

JAN 3 1 2008

Rear Admiral Larry Rice
Chief, Naval Operations (N45)
2511 Jefferson Davis Highway
Arlington, VA 22202

Dear Admiral Rice:

At the December 13, 2007 meeting between NOAA and the Navy, we agreed to analyze the risk function that is an adaptation from the solution in Feller (1968) to develop a dose response curve for purposes of assessing the probability of marine mammal behavioral responses that NMFS would classify as harassment given exposure to specific levels of mid-frequency active sonar (MFAS). We agreed to convene a panel of scientists and ask them to finalize the curve formula. Subsequent to our meeting we determined we could not ask the science panel to "finalize the curve formula" because of limitations imposed on Federal decision makers by the Federal Advisory Committee Act. Instead, we agreed to convene the panel of scientists and solicit their views, individually, of the use of the Feller adapted risk function versus the "mean of means" approach that NMFS and Navy had previously developed. We then asked our internal NMFS experts, Drs. Brandon Southall and Amy Scholik to synthesize the individual reviews and present a summary and a recommendation to me for consideration.

On December 20, 2007, we convened a panel of six scientists and presented them with background information on NOAA and Navy's joint efforts to develop a dose function curve and asked each of them to review the options and provide individual input on their scientific merit and relevance to the issues at hand. As requested, Drs. Southall and Scholik reviewed the responses and produced a summary and recommendation (Southall and Scholik memorandum to James H. Lecky, 3 January attached).

Drs. Southall and Scholik summarized the scientific reviews and determined that among them there was a distinct preference for an approach based on the Feller adapted risk function as opposed to the "mean-of-means" function. One reviewer provided a recommendation for adoption of the function as used in the low frequency acoustic sonar case, including the steepness parameter set at A = 10. One reviewer supported the Feller adapted risk function and indicated the steepness parameter needed to be determined. Four other reviewers did not explicitly discuss the appropriate steepness parameter of the Feller adapted risk function. Based on their synthesis of the reviews, Dr. Southall and Dr. Scholik recommended a single curve derived from the Feller adapted risk function with the input parameters of B = 120 dB, K = 45, A = 10, 99% point = 195 dB, and the 50% point = 165 dB.

In reviewing their recommendation, my office questioned whether the recommendation captured the breadth of views expressed by reviewers who posed alternatives beyond the ones we asked them to consider. Several of the reviewers suggested we consider deriving probabilistic functions directly from the data. Each of these generally reflect greater probability of a behavioral response that could be classified as harassment at relatively low received levels, as a function of the direct application of the Nowacek et al. (2004) data than those predicted by the Feller adapted risk function with a steepness parameter of A = 10. The derived Feller adapted risk function for MFAS is based on three datasets, the only mysticete data being that provided in Nowacek et al.(2004). Several reviewers also suggested that given variability in species and how they use sound more than one curve might be appropriate. Considering these views, I met with Drs. Southall and Scholik to discuss whether the curve they recommended gave appropriate consideration to the Nowacek study. In that discussion, we determined that applying the Feller adapted risk function with a steepness parameter of A=8 for mysticetes would better reflect the sense of the reviewers and the relevance of the Nowacek study than a single curve.

Therefore, I have concluded, based on the above, that we should adopt two curves: one for odontocetes and one for mysticetes. Both should be based on the Feller adapted risk function with input parameters of B = 120 dB, K = 45, 99% point = 195 dB, the 50% point = 165 dB. Only the steepness parameter should vary, and it should be A = 10 for odontocetes and A = 8 for mysticetes. We did not solicit comment on a curve for pinnipeds, but based on additional discussions with Dr. Southall, we should use the odontocete curve for pinnipeds.

Finally, NMFS agrees with many of the reviewers that exposure-response functions should be based directly on empirical measurements. However, the data currently available are too limited both in quantity and direct relevance to the situation in question to be used to support such a direct application. Consequently, the Feller adapted risk functions described in this document should be clearly identified by both NMFS and Navy as an interim approach (using the best available science) for Navy MMPA authorizations for major MFAS exercises and operating areas designated to be completed before the end of 2009. In the meanwhile, we expect to continue working with the Navy to fill the indicated data gaps to support the development of exposure-response functions based more directly on empirical measurements.

Thank you for your input regarding the Feller adapted risk function and your assistance convening the scientific reviewers. If you have any questions, please contact me at (301) 713-2332, ext. 127, or Jolie Harrison at (301) 713-2289, ext. 166.

Sincerely,

James H. Lecky
Director
Office of Protected Resources

Enclosure

Feller, W. (1968). Introduction to probability theory and its application. Vol 1. 3rd ed. John Wilay & Sons, NY, NY.

Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

ASW	Antisubmarine Warfare
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
dB	Decibel
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EIS	Environmental Impact Statement
EL	Energy Level
ESA	Endangered Species Act
HFA	High-Frequency Active
HRC	Hawaii Range Complex
Hz	Hertz
IHA	Incidental Harassment Authorization
kHz	Kilohertz
LFA	Low-Frequency Active
MFA	Mid-Frequency Active
MMPA	Marine Mammal Protection Act
µPa	Micropascal
μPa^2-s	Micropascal Squared-Second
NA	Not Applicable
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
OSHA	Occupational Safety and Health Administration
Pa	Pascal
PTS	Permanent Threshold Shift
RDT&E	Research, Development, Test, and Evaluation
RIMPAC	Rim of the Pacific
rms	Root Mean Square
ROD	Record of Decision
sec	Second
SEL	Sound Equivalent Level
SPAWAR	Space and Naval Warfare
SPL	Sound Pressure Level
SPORTS	Sonar Positional Reporting System
SSC	SPAWAR Systems Center
SURTASS	Surveillance Towed Array Sensor System
TORPEX	Torpedo Exercise
TRACKEX	Tracking Exercise

TTS	Temporary Threshold Shift
U.S.	United States
USWEX	Undersea Warfare Exercise