Pinniped Monitoring during Missile Launches on San Nicolas Island, California, December 2015 - November 2016

Naval Air Warfare Center Weapons Division
Point Mugu, California

For Submittal To

National Marine Fisheries Service
Silver Spring, Maryland, and Long Beach, California

30 December 2016

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ACRONYMS AND ABBREVIATIONS

3-D	3-dimensional
ASL	above sea level
ATAR	Autonomous Terrestrial Acoustic Recorder
B807	Building 807
CFR	Code of Federal Regulations
cm	centimeter
CPA	Closest Point of Approach
dB	decibel
dBA	decibel, A-weighted, to emphasize mid-frequencies and to de-emphasize low and high frequencies to which human (and pinniped) ears are less sensitive
F	Fahrenheit
FOV	field of view
ft	feet
FLIR	Forward Looking Infrared
hr	hour
Hz	Hertz
IHA	Incidental Harassment Authorization
in	inches
kg	kilogram
kHz	kilohertz
km	kilometer (1 km = 3281 ft, 0.62 mi, or 0.54 n.mi)
kts	knots or nautical miles per hour
lb	pounds
LOA	Letter of Authorization
m	meter
mi	mile
min	minute
mm	millimeter
MMPA	Marine Mammal Protection Act
M_{pa}	Frequency weighting appropriate for pinnipeds in air (see Gentry et al. 2004; Southall et al. 2007)
NAWCWD	Naval Air Warfare Center Weapons Division
nm	nautical miles
NMFS	National Marine Fisheries Service
PTS	Permanent Threshold Shift
rms	root mean square (a type of average)
s	second
SEL	sound exposure level
SEL-A	A-weighted sound exposure level
SEL-M	M_{pa}-weighted sound exposure level
SNI	San Nicolas Island
SPL	sound pressure level
SPL-f	flat-weighted sound pressure level
TTS	Temporary Threshold Shift
µPa	micropascal

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EXECUTIVE SUMMARY

The Naval Air Warfare Center Weapons Division (NAWCWD) holds a Letter of Authorization (LOA) issued by the National Marine Fisheries Service (NMFS) allowing non-lethal takes of pinnipeds incidental to the Navy's missile launch operations on San Nicolas Island (SNI), California. Past LOAs span the periods of June 2009 through June 2014. New small take regulations and an associated LOA for the period of 3 June 2014 through 3 June 2019 were issued pursuant to 50 Code of Federal Regulations (CFR) 216.151–158 and §101(a)(5)(A) of the Marine Mammal Protection Act (MMPA), 16 United States Code (USC) §1371(a)(5)(A). Those regulations were initially issued for the period 2 October 2003 through 2 October 2008, and were reissued for the period of 2 June 2009 through 2 June 2014. The regulations and associated LOA allows for the 'take by harassment' of small numbers of northern elephant seals (*Mirounga angustirostris*), Pacific harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*) during routine launches on Navy-owned SNI.

In the Navy's original Petition for Regulations that led to promulgation of 50 CFR 216.151–158 a Monitoring Plan and subsequent reporting was proposed to NMFS. The Plan includes provisions to monitor any effects of missile launch activities on pinnipeds hauled out at SNI in a manner similar to preliminary pinniped monitoring that took place during Navy activities from 2001–2008. Pinniped species monitored on SNI during that period included the Pacific harbor seal, northern elephant seal, and California sea lion. In June 2010, a revised Monitoring Plan was submitted to NMFS proposing discontinuation of monitoring for northern elephant seals, as this species had shown little or no reaction to most missile launches. NMFS accepted the proposed change to the Monitoring Plan (NMFS 2010) and issued the new LOA to acknowledge the change. Thus, elephant seal responses are not discussed in detail in this report.

Missiles Launched

This report describes the results of the visual and acoustic Monitoring Plan for missile launches from SNI between December 2015 and November 2016. It includes results from nine missile launches on six separate days. During this monitoring period three dual launches –consisting of two missiles launched in rapid succession (e.g., less than 1 minute apart) – occurred. Missiles launched included the GQM 163A "coyote" (GQM), Standard Missile 3 Block IIA (SM-3), and the SSM-I (KAI). All missiles were launched during daytime hours.

The launch azimuths resulted in missiles crossing SNI's shoreline on the island's western end and passing over and/or near various pinniped haul-outs. Up to three video monitoring sites were established for each launch overlooking beaches occupied by pinnipeds. Autonomous Terrestrial Acoustic Recorders (ATARs) and video systems were deployed at observation points nearby. An additional audio recording site was also established at the missile launch site for each launch. Audio recordings document launch sound at several distances from the launch trajectory of the missile. Audio, video and direct visual monitoring provided data on the behavioral reactions of pinnipeds hauled out during launches.

Pinniped Behavior during Missile Launches

Behavior of pinnipeds (California sea lions and Pacific harbor seals) hauled out on SNI beaches during missile launches is monitored by unattended video cameras set up before each launch. Video data are supplemented by direct visual scans of the haul-out groups several hours prior to the launches and the hour following the launches. Monitoring is attempted at up to three sites during each launch, with launch-to-launch variation in the locations monitored and number of locations depending upon presence of hauled out pinnipeds. For each launch, the number, proportion, and maturity (adult or pup - where

determinable) of individual pinnipeds that responded in various ways is tabulated using the video recordings, along with comparable data, for those that do not overtly respond.

Estimated Numbers of Pinnipeds Affected

No evidence of pinniped injuries, fatalities or pup abandonment related to the monitored launches was evident, nor was it expected, during the monitoring period. Approximately 1,431 California sea lions, 4 Pacific harbor seals, and 1 northern elephant seal were estimated to have been affected during the December 2015 to November 2016 monitoring period. These figures are approximate and likely overestimate California sea lions affected because they; (a) include extrapolations for pinnipeds on beaches that were not monitored, but within the area of potential effect, on any given launch day, (b) are based on proportions of numbers found during breeding season for unmonitored beaches, and (c) very likely count some of the same individuals more than once. The pinnipeds included in these estimates either left the haul-out site in response to the launch, or exhibited prolonged movement or behavioral changes relative to their behavior immediately prior to the launch.

The results from the 2015-2016 monitoring period (and those from previous monitoring periods) suggest that any effects of the launch operations were minor, short-term, and localized, at least for northern elephant seals and California sea lions. Some Pacific harbor seals may have left their haul-out site until the following low tide, but numbers occupying haul-out sites shortly after a launch or the next day, were generally similar to pre-launch levels. It is not likely that any of the pinnipeds on SNI were adversely impacted by such behavioral reactions. No sound levels exceeded those which might cause temporary threshold shift (TTS) in harbor seals [129 dB re 20 μPa^2 s Sound Exposure Level (SEL) for M-weighting (SEL-M)]. Similarly, No measured sound levels exceeded the SEL-M or peak pressure level (flat weighting) criteria for permanent threshold shift (PTS).

1. MONITORING PROGRAM AND MISSILE LAUNCHES DESCRIBED

1.1 Monitoring Program

San Nicolas Island (SNI) is located approximately 65 miles (m) (~100 kilometers (km)) from the mainland coast of southern California (Fig. 1.1). Missiles are launched from one of two land-based launch complexes on the western part of SNI: Building 807 (B807) Launch Complex is located on the west coast of SNI, approximately 35 feet (ft) (11 meters (m)) above sea level (ASL), and the Alpha Launch Complex is located approximately 625 ft (190.5 m) ASL on the west-central part of SNI (Fig. 1.2). The missiles pass over or near pinniped haul-out sites located around the northwestern periphery of SNI. The pinniped species that commonly occur on SNI include northern elephant seals (*Mirounga angustirostris*), Pacific harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*).

The Naval Air Warfare Center Weapons Division (NAWCWD) holds a Letter of Authorization (LOA) issued by the National Marine Fisheries Service (NMFS) allowing non-lethal takes of pinnipeds incidental to the Navy's missile launch operations on San Nicolas Island (SNI), California. This LOA spans the period of June 2014 through June 2019. The LOA was issued pursuant to small take regulations (See Appendix A) found in 50 Code of Federal Regulations (CFR) 216.151–158 and §101(a)(5)(A) of the Marine Mammal Protection Act (MMPA), 16 United States Code (USC) §1371(a)(5)(A). Those regulations were initially issued for the period 2 October 2003 through 2 October 2008 and were reissued for the period 2 June 2009 through 2 June 2014 and 3 June 2014 through 3 June 2019, with separate LOAs for each year within each regulatory period. The regulations and the associated LOA allow for the 'take by harassment' of small numbers of northern elephant seals (*Mirounga angustirostris*), Pacific harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*) during routine launches on Navy-owned SNI (Appendix A).

A Monitoring Plan was proposed in the Petition for Regulations under which the original LOA was issued. The purpose of the monitoring was to characterize any effects of missile launch activities on Pacific harbor seals, northern elephant seals, and California sea lions hauled out at SNI. In June 2010, a revised Monitoring Plan was submitted to NMFS that proposed the discontinuation of monitoring for northern elephant seals, as this species had shown little reaction to most missile launches at SNI. NMFS accepted this proposed change to the Monitoring Plan (NMFS 2010); thus, elephant seals were not targeted for monitoring after December 2010, but occurred in the field of view (FOV) of some cameras monitoring other species.

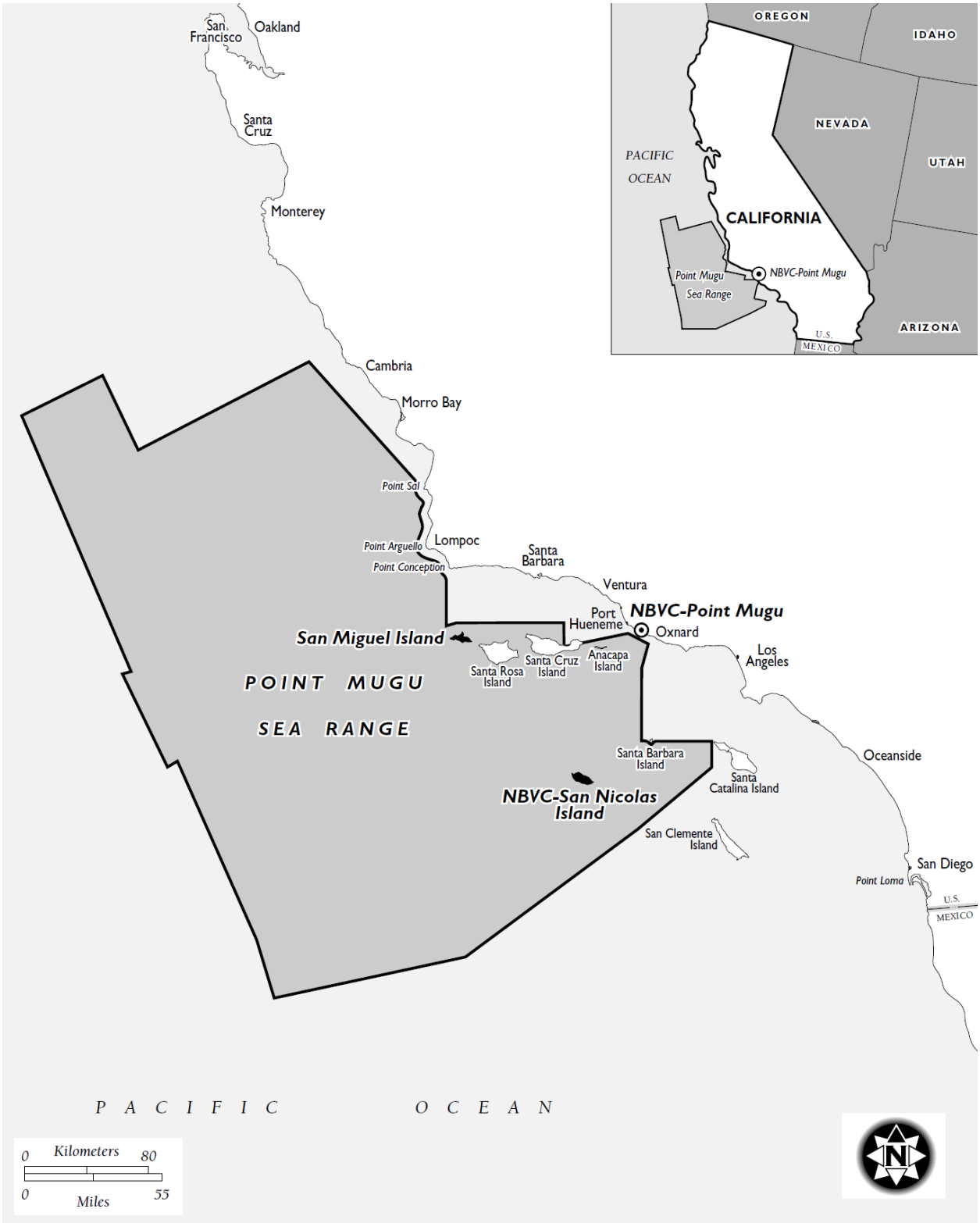

FIGURE 1.1. Regional site map of the Point Mugu Sea Range and San Nicolas Island, California

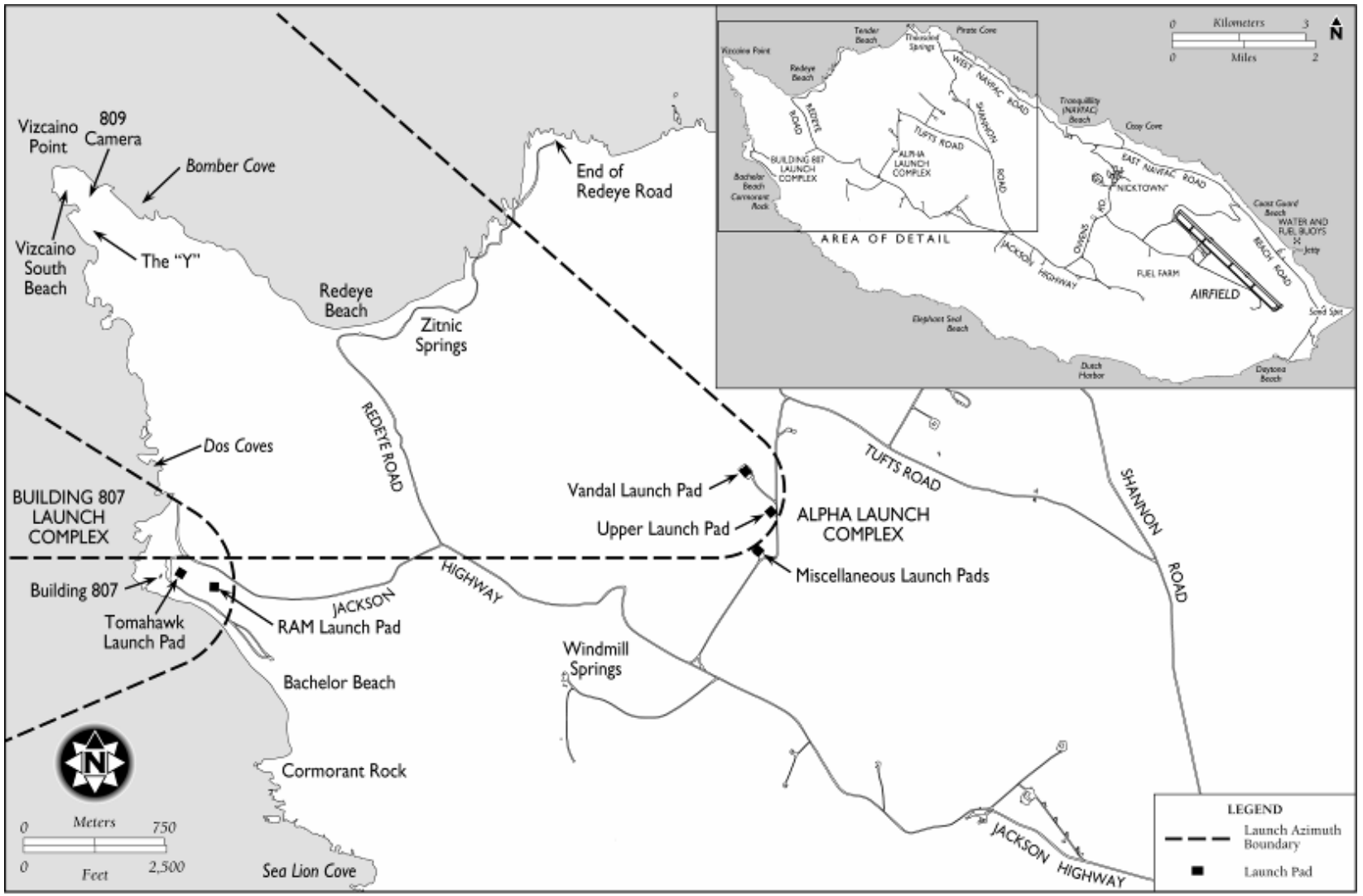

FIGURE 1.2. Map of San Nicolas Island, California, and the general launch azimuths (dashed lines) for each launch complex. These launch azimuths are typical, although occasionally launch paths could pass outside these boundaries.

The Monitoring Plan requires that, for each missile launched from SNI, simultaneous autonomous audio recording of launch sounds and video recording of sea lion and harbor seal behavior occur. Generally monitoring occurs at three haul outs during each launch, dependent upon the presence of pinnipeds in various locations. This land-based monitoring provides data required to characterize the extent and nature of "taking". In particular, it provides information needed to document the nature, frequency, occurrence, and duration of any changes in sea lion and harbor seal behavior resulting from missile launches, including the occurrence of stampedes (if any). The video and audio records are used to further document sea lion and harbor seal responses to the launches. Documentation includes the following components:

- Identify and document any change in behavior or movement that may occur at the time of the launch;
- Compare pre- and post-launch behavioral data on each launch day to quantify the interval required for pinniped numbers and behavior to return to normal[1] if there is a change as a result of launch activities;
- Collect received levels of launch sound with pinniped responses, based on acoustic and behavioral data across a series of previous and future launches, to help establish the "dose-response" relationship[2] for launch sounds under different launch conditions;
- Ascertain periods or launch conditions when pinnipeds are most and least responsive to launch activities, and
- Document take by harassment and, although unlikely, any mortality or injury.

This report describes the missiles launched, the associated monitoring program, and the monitoring program results for the December 2015 to November 2016 period. During the monitoring period, nine missiles were launched on six separate days: 08 December 2015, 17 December 2015 (two missiles), 04 February 2016 (two missiles), 7 April 2016 (two missiles), 19 October 2016, and 27 October 2016. This report describes the missile launches that occurred, the acoustic and visual monitoring during the launches, and estimates the numbers of pinnipeds affected by the launches.

1.1.1 Audio Monitoring

Audio recordings attempt to document launch sounds at several distances from the launch trajectories of the missiles (See Chapter 2 for details). During all launches in this monitoring period audio recorders were placed in the same location as video cameras documenting pinniped reactions, thus obtaining paired acoustic and pinniped-response data. In addition to recording launch sounds, these audio recordings document ambient noise levels prior to and following launches. Objectives of the audio monitoring program include:

1. Document levels and characteristics of launch sounds at several distances from the missile paths;
2. Document levels and characteristics of ambient sounds at the same locations as launch sounds, as a measure of the background noise against which the pinnipeds will (or will not) detect the launch sounds; and

[1] If numbers and/or behavior have not returned to "normal" within the duration of the autonomous recording, the duration of the period with reduced numbers will be reported as "greater than *x* minutes".

[2] This is equivalent to estimating behavioral zones of influence by comparing pinnipeds' reactions to varying received levels of launch sounds.

3. Determine the sound levels from missile overflights were high enough to have the potential to induce Temporary Threshold Shift (TTS) in pinnipeds exposed to launch sounds[3].

1.1.2 Visual Monitoring

Video and visual monitoring provide data on focal groups of pinnipeds hauled out on SNI during launches (See Chapter 3 for details). The accumulation of such data across numerous launches provides information necessary to characterize the nature and extent of disturbance effects. In particular, it provides the information needed to document the nature, frequency, occurrence, and duration of any changes in pinniped behavior resulting from the missile launches, including the occurrence of stampedes from haul-out sites if they occur.

Video records document pinniped responses to missile launches. Objectives include the following:

1. Identify and document any change in behavior or movements that occurred at the time of the launch;
2. Quantify the interval required for pinniped numbers and behavior to return to normal if there was a change as a result of launch activities;
3. Collect received levels of launch sound with pinniped responses, based on acoustic and behavioral data across a series of previous and future launches, to help establish the "dose-response" relationship for launch sounds under different launch conditions
4. Ascertain periods or launch conditions when pinnipeds are most and least responsive to launch activities;
5. Document numbers of pinnipeds affected by missile launches and, although unlikely, any mortality or injury.

1.2 Impact Estimates

The monitoring program for the missile launches on SNI is designed, in part, to provide data necessary to estimate the numbers of pinnipeds affected by launches and the manner in which they were affected. Pinnipeds are assumed to be 'taken by harassment' if there is a reason to believe that auditory impairment (TTS) occurred as a result of a launch, or if biologically significant behavioral patterns of pinnipeds are disrupted. NMFS (2000) defines a biologically significant behavioral response as one "…that affects biologically important behavior[s], such as survival, breeding, feeding and migration, which have the potential to affect the reproductive success of the animal." As a corollary of that, NMFS (2002) states that "…one or more pinnipeds blinking its eyes, lifting or turning its head, or moving a few feet along the beach as a result of a human activity are not considered a 'take' under the MMPA definition of harassment."

In this report, consistent with previous related reports, it is assumed that only those animals that met the following criteria count as affected by launches:

1. Pinnipeds injured or killed during launches, if any (e.g., by stampedes);
2. Pinnipeds exposed to launch sounds strong enough to cause permanent or temporary auditory impairment (permanent threshold shift [PTS] or TTS);
3. Pinnipeds that left the haul-out site, or exhibited prolonged movement[4] or behavioral changes

[3] Based upon available TTS information harbor seals might have TTS onset at a received SEL-M of >129 dB re 20 $\mu Pa^2 \cdot s$ and California sea lions at SEL-M > 159 dB re 20 $\mu Pa^2 \cdot s$. As a conservative measure, all three species seals are assumed to have the same TTS onset level as harbor seals (see Section 4.2.1)

(such as pups separated from mothers) relative to their behavior immediately prior to the launch.

No pinnipeds are known to have been injured or killed since the launch monitoring began in August 2001, and few, if any, are believed to have received sounds strong enough to elicit TTS (Holst, et al. 2011). Thus, the number of pinnipeds counted as potentially affected during the current monitoring period was primarily based on criterion 3 above – the number that left the haul-out site, or exhibited prolonged movement or other behavioral changes relative to their behavior in the hours preceding the launch.

1.3 Missile Types Launched During the Monitoring Period

Standard Missile-3 Block IIA (SM-3)

The Standard Missile 3 (SM-3) is a ship-based missile system used by the United States Navy to intercept short-to intermediate-range ballistic missiles as a part of Aegis Ballistic Missile Defense System. The Block IIA missile is largely new sharing only the first-stage motor with the Block I and is being developed jointly for support of the Japanese Self Defense Forces. Land-based testing is required prior to deployment on ships.

The SM-3 missile uses a MK 72 booster. The SM-3 is 21.5 ft (6.5 m) long and 21 in (53 cm) in diameter, exclusive of its fins when deployed.

GQM-163A "Coyote" Supersonic Sea-Skimming Target (GQM)

The Navy/Orbital Sciences Corp. GQM-163A "Coyote" missile is an expendable target powered by a ducted-rocket ramjet. It is capable of flying at low altitudes (13 ft or 4 m cruise altitude) and supersonic speeds (Mach 2.5) over a flight range of 45 nautical miles (nm, 83 km) (Fig. 1.3). The GQM is designed to provide a ground launched aerial target system to simulate a supersonic, sea-skimming Anti-Ship Cruise Missile (ASCM) threat. The GQM was developed to replace the Vandal missile target.

The GQM missile assembly consists of two primary subsystems: MK 12 or MK 70 solid propellant booster, and the GQM-163A target missile. The solid-rocket booster is about 18 inches (in) (46 cm) in diameter and is of the type used to launch the Navy's Standard surface-to-air missile. The GQM-163A target missile is 18 ft (5.5 m) long and 14 in (36 cm) in diameter, exclusive of its air intakes. It consists of a solid-fuel Ducted Rocket (DR) ramjet subsystem, Control and Fairing Subassemblies, and the Front End Subsystem (FES). Included in the FES is an explosive destruct system to terminate flight if required.

SSM I (KAI)

The Type 88 Surface-to-Ship Missile (SSM-1 [KAI]) is a truck-mounted anti-ship missile developed by Japan's Mitsubishi Heavy Industries in the late 1980s. It is a land-based version of the air-launched Type 80 (ASM-1) missile; in turn it was developed into the ship-launched Type 90 (SSM-1B) missile. All are used by the Japan Self Defense Forces.

The KAI missile uses a turbo-jet engine with two solid rocket boosters. The KAI missile is 16.7 ft (5.08 m) long and 13.8 in (35 cm) wide.

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[4] Prolonged movement, for the purpose of the monitoring and this report, is defined as one or more animals moving in a directed manner either more than 10 m (33 ft) onshore or moving any distance from the shore and entering the ocean.

1.4 Launch Dates and Information

Between December 2015 and November 2016 there were nine missile launches from SNI on six separate days (Table 1.1). These launches all involved either single missiles or, in three cases, a dual launch of two missiles launched within a few seconds (s). Missiles launched included one SM-3, six GQM (three dual launches), and two KAI. All launches occurred during daylight hours (between 0600 and 1500 local time). Weather during the launches ranged 58° to 75° Fahrenheit (F) at the control room, with winds between 2 and 10 knots (kts) and skies ranging from clear and sunny to complete overcast or fog (Table 1.1).

SM-3

A single SM-3 missile was launched on 8 December 2015 at 06:00 local time. The SM-3 was launched from the B807 Launch Complex located approximately 35 ft (11 m) ASL on the western shoreline of SNI. The SM-3 was launched on an azimuth of 213º true at an elevation angle of 60º above horizontal. The missile crossed the shoreline at an altitude of approximately 442 ft (135 m) ASL (Table 1.1).

GQM

Dual GQM launch (2 missiles) occurred on 17 December 2015 at 14:00 local time, 4 February 2016 at 10:45 local time, and 7 April 2016 at 10:50 local time. All six GQMs were launched from the Alpha Launch Complex located approximately 625 ft (190.5 m) ASL on the west-central part of SNI. The GQMs were launched on azimuths of 335º true at an elevation angle of 14º above horizontal. The missiles crossed the west end of SNI at an altitude of approximately 1,850 ft (564 m) ASL (Table 1.1). The height above sea level for these launches was calculated based on elevation angle. Elevation angle, however, does not necessarily translate to a straight line for altitude change for GQM, as the missiles may actively alter the rate of climb achieving a higher than expected altitude for a given launch angle and distance from the launcher.

KAI

Single KAI missiles were launched on 19 and 27 October 2016 at 12:42, and 14:55 local time respectively. The KAI missiles were all launched from the B807 Launch Complex located approximately 35 ft (11 m) ASL on the western shoreline of SNI. The KAI missiles were launched on an azimuth of 265º true at an elevation angle of 35º above horizontal. The missiles crossed the shoreline at an altitude of approximately 291 ft (89 m) ASL (Table 1.1).

TABLE 1.1. Launch data for the December 2015 – November 2016 report period.

Launch Date	Launch Time (local)	Missile Type	Launch Complex	Launch Azimuth (true)	Elevation Angle / Altitude Over Beach (Feet)	Weather at Control Room (Max Wind speed in knots)[1]	Video Quality	Audio Quality
12/8/2015	6:00	SM-3	B807	213°	60° / 442	10 W / 57°	Good	Good
12/17/2015	14:00	GQM x 2	Alpha	335°	14° / 1,850	6 NW / 58°	Good	Good
2/4/2016	10:45	GQM x 2	Alpha	335°	14° / 1,850	5 NW / 62°	Good	Okay[2]
4/7/2016	10:50	GQM x 2	Alpha	335°	14° / 1,850	2 SE / 58°	Good	Good
10/19/2016	12:32	KAI	B807	265°	35° / 291	10 NE / 75°	Okay	Okay[3]
10/27/2016	14:55	KAI	B807	265°	35° / 291	4 NE / 71°	Good	Okay[3]

[1] The weather data were collected at the launch control room located between 2 and 5 kilometers from the missiles' closest point of approach to the shoreline or at the SNI Airfield approximately 10 kilometers from the missile's CPA; therefore weather conditions at pinniped haul-out sites near the closest point of approach may have marginally differed.

[2] Both channels of the recording at one site (B809) exhibited toggling in only the least significant bit (LSB) of the binary number representation of the acoustic measurement.

[3] The acoustic data from the recordings' left channel at Rock Crusher on 10/19 and both Redeye and Rock Crusher on 10/27 were faulty, a possible hardware problem with the microphone or cable.

2. ACOUSTIC MEASUREMENTS OF MISSILE LAUNCHES

2.1 Introduction

The acoustic measurement program for the monitoring period is consistent in approach and methodology with that used during the preceding years (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011). Recordings of each missile's sound, as well as background sounds, were attempted at up to three pinniped haulout sites as well as the launch pad during each missile flight. ATARs were developed for this purpose by the Navy's acoustical contractor, Greeneridge Sciences Inc. of Santa Barbara, California. The specific design of the ATARs was described previously (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011). Maps of the launch azimuths and monitoring locations are provided in Chapter 3 (Fig. 3.1). Twenty-eight recordings were obtained during the monitoring period, however on four recordings launch sounds were not properly recorded and the data were not analyzed (Tables 1.1 and 2.1).

Sound levels that might cause notable disturbance for each pinniped species are variable and context-dependent (Lawson et al. 1998). Lawson et al. (1998) estimated the minimum received level, on an A-weighted Sound Exposure Level (SEL-A, measuring the "loudness" of the sound) basis, that might elicit substantial disturbance as 100 A-weighted decibels (dBA) reference 20 micropascals squared second (re 20 $\mu Pa^2 \cdot s$) for all pinnipeds. The 100 dBA re 20 $\mu Pa^2 \cdot s$ SEL pertains to exposures to prolonged sounds, which were taken to last at least several seconds. Measured durations of sound from various types of missiles launched from SNI typically range from less than 1 s up to 21 s (Holst et al. 2008). In any event, the assumption that reactions might occur at distances up to those where received levels diminished to 100 dBA SEL (see Fig. 2.39 *in* Greene and Malme 2002) was one influencing factor in selecting acoustic (and video) monitoring sites during the first year of monitoring (2001). Sites at distances up to ~4 km from the launcher and/or launch trajectory are currently monitored, though closer sites are selected when animals are present.

After reviewing video recordings of pinnipeds during launches at SNI during 2001–2002 (Holst and Lawson 2002), the 100-dBA SEL is reasonable as a minimum received level that might elicit disturbance of California sea lions. However, 90 dBA SEL is more appropriate for Pacific harbor seals, as they showed a strong response to most launches, including a number of launches where received levels were <100 dBA SEL. In contrast, the majority of northern elephant seals usually exhibited little or no reaction to launch sounds. The received levels of sounds from the larger missiles, as measured in the first year of monitoring, indicated that levels at or above 90 dBA SEL could be expected out to distances of ~4 km from the launch trajectory (see Fig. 2.39 *in* Greene and Malme 2002). Thus, monitoring at sites located ~4 km from the launcher and/or launch trajectory continued during subsequent years. Continuing data collection and monitoring shows some behavioral responses may extend to received sound levels lower than 90 dBA SEL.

Southall et al. (2007) note that M_{pa}-weighted (i.e., frequency-weighted appropriately for pinnipeds in air) SELs of 100 dB re 20 $\mu Pa^2 \cdot s$ could result in takes by harassment for pinniped species (M-weighted values are greater than A-weighted SELs for launch sounds). Previous monitoring at SNI shows that California sea lions and Pacific harbor seals typically move along the beach and/or enter the water at M_{pa}-weighted SELs ≥100 dB re 20 $\mu Pa^2 \cdot s$. In fact, both species can be disturbed at lower levels. For example, Holst et al. (2008) noted that some Pacific harbor seals leave the haul out site and/or enter the water at SELs as low as 60 dB M_{pa}.

2.2 Field Methods

2.2.1 Deployment of ATARs

Prior to each launch, ATARs are positioned at the launch pad and near pinniped haul out sites at varying distances from the planned launch azimuth (Table 2.1). The recordings provide data for quantitative analysis of the levels and characteristics of the received flight sounds.

ATARs are set up between one and four hours prior to the launch and retrieved in the hour following the launch. The ATAR units are deployed at sites as close as practical to as many as three pinniped haul-out sites at various distances from the launch site and launch trajectory. The total number of sites monitored depends upon the presence of pinnipeds on beaches in the potentially impacted area.

In addition to providing information on the magnitude, characteristics, and duration of sounds to which pinnipeds are exposed, acoustic data and monitoring provide associated pinniped behavioral data. These data have contributed to a longer-term dataset, intended to help determine if there is a "dose-response" relationship between received sound levels and pinniped behavioral reactions. Measured sound levels at various microphone locations can be used to characterize sound exposure vs. distance downrange and laterally from the launch azimuth.

Analyses of acoustic data collected between August 2001 and October 2008 were reported by Holst et al. (2011). In those analyses, factors considered included missile type, launch azimuth, launch characteristics (e.g., low- vs. high-angle launch), as well as weather, which has important effects on the received sounds. Holst et al. reported that the majority of observed California sea lions startled and showed increased vigilance up to 2 min after each launch; responses often included movement on the beach or into the water and were significantly related to received sound level and distance from the vehicle's closest point of approach. Most observed northern elephant seals showed little reaction to launches and merely raised their heads briefly. Nonetheless, their responses were also related to received sound level and distance from vehicle trajectory. Pacific harbor seals were the most responsive with an average of 68% (range 7 to 100%) of observed harbor seals within ~4 km of the launch trajectory departing haul-out sites by entering the water. Within the range of conditions studied, there was no clear correlation between harbor seal response and received sound level or distance from the closest point of approach of the vehicle. Given the limited number of launches during the current monitoring period, no corresponding acoustic data analysis occurred for these launches.

TABLE 2.1. Monitored Missile launches and ATAR recording sites (also see Fig. 3.1).

Launch Date	Missile	ATAR Locations	Recording Status
12/8/2015	SCD	B807, Dos Coves, B809	3 of 3 OK
12/17/2015	GQM x 2	Alpha Pad, Dos Coves, B809	3 of 3 OK
2/4/2016	GQM x 2	Alpha Pad, Dos Coves, B809†	2 of 3 OK
4/7/2016	GQM x 2	Alpha Pad, Dos Coves, B809, Pirates	4 of 4 OK
10/19/2016	JDF - KAI	Rock Crusher*, Dos Coves, B809, Phoca Reef	2 of 4 OK
10/27/2016	JDF - KAI	Rock Crusher*, Dos Coves, B809, Redeye*	2 of 4 OK

† Both channels of the recording exhibited toggling in only the least significant bit (LSB) of the binary number representation of the acoustic measurement.
* The acoustic data from the recordings' left channel were faulty, a possible hardware problem with the microphone or cable.

2.3 Audio Data Analysis Methods

Both time-series and frequency-domain analyses are performed on the acoustic data. Time-series results included signal waveform and duration, peak pressure level (peak), root mean square (rms) sound pressure level (SPL), and SEL. SPL and SEL were determined with three alternative frequency weightings: flat-weighted (SPL-f and SEL-f), A-weighted (SPL-A and SEL-A), and M_{pa}-weighted (SPL-M and SEL-M) basis. The M_{pa}-weighting procedure, appropriate for pinnipeds in air, is described in Southall et al. (2007) and in past monitoring reports (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011). Frequency-domain results included estimation of SPLs in one-third octave bands for center frequencies from 4 to 16,000 kHz. The following subsection describes how these values are defined

2.3.1 Frequency Weighting

Frequency weighting is a form of filtering that serves to measure sounds over a broad frequency band with various schemes for de-emphasizing sounds at frequencies not heard well and retaining sounds at frequencies that animals hear well. The concept is that sound at frequencies not heard by animals is less likely to injure or disturb them, and therefore such sounds should not be included in measurements relevant to those animals. Time-series results for the full 3 to 20,000 Hz bandwidth are calculated for flat-, A-, and M_{pa}-weightings.

Flat-weighting leaves the signal spectrum unchanged. For instantaneous peak pressure, where the highest instantaneous pressure is of interest, it is not useful to diminish the level with filtering, so only the flat-weighted instantaneous peak pressure is relevant. Also, non-uniform weighting is not useful when reporting results for specific frequencies or narrow frequency bands. Therefore, only flat-weighting is used for frequency-domain analyses.

A-weighting shapes the signal's spectrum based on the standard A-weighting curve (Kinsler et al. 1982, p. 280; Richardson et al. 1995, p. 99). This slightly amplifies signal energy at frequencies between 1 and 5 kHz and attenuates signal energy at frequencies outside this band. This process is designed to

mimic the frequency response of the human ear to sounds at moderate levels. It is a standard method of presenting data on airborne sounds. The relative sensitivity of pinnipeds listening in air to different frequencies is more-or-less similar to that of humans (Richardson et al. 1995), so A-weighting may be relevant to pinnipeds listening to moderate-level sounds , as a first approximation,.

M_{pa}-weighting arose from the ongoing effort to develop science-based guidelines for regulating sound exposures (Gentry et al. 2004; Southall et al. 2007). During this process, separate weighting functions were developed for five categories of marine mammals, with these functions being appropriate in relation to the hearing abilities of those groups of mammals (Gentry et al. 2004; Southall et al. 2007). Two of these categories are pinnipeds hearing in water and in air, for which the weighting functions were designated M_{pw} and M_{pa}, respectively. The five "M-weighting" functions are almost flat between the known or inferred limits of functional hearing for the species in each group, but down-weight ("attenuate") sounds at higher and lower frequencies. As such, they are analogous to the C-weighting function that is often applied in human noise exposure analyses where the concern is about potential effects of high-level sounds. With M_{pa}-weighting, the lower and upper "inflection points" are 75 Hz and 30 kHz[5]. For each launch whose sounds are reported here, we include the M_{pa}-weighted results as well as flat- and A-weighted results. Acoustic data based on M_{pa}-weighting are included because these values are likely to be needed in the future for purposes of assessing impacts on pinnipeds of sounds with high received levels, such as those during some missile overflights.

Measurement data from each launch are presented by one-third octave band in Appendix B. Thus, other weighting methods (e.g., C-weighting or species-specific weighting functions) could be applied to these data in the future if needed.

2.3.2 Closest Point of Approach by the Missile

To relate missile sounds to the proximity of the missile's trajectory, the 3-dimensional (3-D) distance from the recording site to the closest point of approach (CPA) of the missile is calculated for each launch date and sound monitoring site. In some cases, the CPA is at the launch pad, depending upon monitoring location and missile trajectory.

2.4 Acoustic Monitoring Results

2.4.1 Missile Flight Sounds

Acoustic monitoring results for all six monitored launches are presented in Table 2.2. Four parameters are reported for the missile flight sounds: peak pressure level, SPL, SEL, and duration. The last three parameters are based on flat-, A-, and M_{pa}-weighting. These values are similar to sound levels recorded during previous launches from SNI (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011). It was expected that A- and M_{pa}-weighted levels would be less than flat-weighted levels, consistent with the greater de-emphasis of low frequency components by A-weighting.

Two graphs are presented in Appendix B for each location where the missile launch sounds were recorded. Both graphs are based on flat-weighted data; no graphs are presented for A- or M_{pa}-weighted waveforms. One graph presents the pressure signature (pressure vs. time waveform). The second presents the SELs by one-third octave band for each of three signals: (1) the missile sounds; (2) the background

[5] The data obtained during the current monitoring period were only recorded at frequencies up to 20 kHz, so the (probably negligible) energy at 20–30 kHz is not included in calculating the M_{pa} (or other) measures.

instrumentation noise from the low-sensitivity channel (the same sensor used to measure the missile sounds but using data recorded before the missile sounds); and (3) the background noise levels from the high-sensitivity channel (i.e., the ambient SPLs). Because the ambient sounds are continuous, expressing them as SELs is unconventional. However, for purposes of comparison with the transient missile sounds, one can consider the SPLs for ambient noise to be the SELs in a 1-s period.

TABLE 2.2. Pulse parameters for flat-, A-, and M_{pa}-weighted sound from SNI missile launches, December 2015 – November 2016. No values exceeded the level at which TTS onset might Occur[1]

Launch Date & Monitoring Site	CPA (km)	Flat-weighted sound				A-weighted sound			M_{pa}-weighted sound		
		Pk	SPL	SEL	Dur	SPL	SEL	Dur	SPL	SEL	Dur
8 December 2015: SM-3 Block IIA											
Dos Coves		113.0	97.0	105.2	6.6	87.1	95.2	6.5	94.1	102.3	6.6
B809		129.1	115.5	122.2	4.8	107.9	114.2	4.3	112.7	119.4	4.7
B807		143.2	128.2	129.7	1.4	122.2	123.5	1.4	126.8	128.0	1.3
17 December 2015: GQM x 2											
Dos Coves (1/2)		96.7	82.4	88.2	3.9	75.1	81.2	4.1	80.2	86.2	3.9
Dos Coves (2/2)		98.4	84.1	84.2	1.0	74.7	76.4	1.5	78.4	83.3	3.1
B809 (1/2)		102.8	89.0	91.7	1.9	78.7	81.4	1.9	84.9	87.5	1.8
B809 (2/2)		102.7	89.6	93.0	2.2	79.5	83.3	2.4	85.6	89.3	2.3
Alpha Pad (1/2)		138.0	115.6	118.6	2.0	93.8	97.5	2.3	104.5	108.1	2.3
Alpha Pad (2/2)		135.4	114.0	115.9	1.5	92.4	95.5	2.0	98.2	101.8	2.3
4 February 2016: GQM x 2											
Vizcaino Point		105.2	91.0	101.4	11.1	N/A	N/A	N/A	N/A	N/A	N/A
B809		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alpha Pad (1/2)		137.9	115.7	118.8	2.1	95.1	98.6	2.3	107.3	110.6	2.1
Alpha Pad (2/2)		135.3	113.7	117.4	2.3	91.1	95.5	2.7	100.7	105.4	2.9
7 April 2016: GQM x 2											
Pirates Cove (1/2)		105.6	88.5	94.9	4.4	79.7	85.4	3.7	86.2	92.0	3.9
Pirates Cove (2/2)		101.6	87.7	93.8	4.0	77.8	83.4	3.7	84.9	90.8	3.9
Dos Coves		106.6	92.7	101.7	7.9	72.5	81.5	7.9	82.4	91.7	8.6
B809 (1/2)		107.9	91.5	96.4	3.1	82.0	87.1	3.2	88.6	93.6	3.2
B809 (2/2)		109.5	92.0	97.2	3.3	83.0	88.3	3.4	89.5	94.6	3.2
Alpha Pad (1/2)		138.9	115.8	118.9	2.1	94.0	97.7	2.3	105.7	109.2	2.3
Alpha Pad (2/2)		139.1	115.1	117.8	1.9	97.4	100.8	2.2	104.1	107.8	2.4
19 October 2016: JDF – KAI											
B809		109.6	90.8	93.8	2.0	82.1	84.8	1.9	87.4	90.4	2.0
Dos Coves		124.0	110.8	112.6	1.5	104.3	106.2	1.5	109.7	111.4	1.5
Phoca Reef		106.7	99.4	93.1	0.2	57.3	53.9	0.5	80.2	73.9	0.2
Rock Crusher		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27 October 2016: JDF – KAI											
Redeye South		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dos Coves		140.0	125.1	126.8	1.5	118.9	120.8	1.5	124.4	126.2	1.5
B809		117.0	93.3	97.0	2.3	87.8	91.1	2.1	91.4	95.1	2.3
Rock Crusher		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

[1] Assumed TTS onset at a received SEL-M of >129 dB re 20 µPa2•s (see Section 4.2.1)

Note: Peak levels (Pk) and SPLs are in dB relative to 20 µPa. SELs or energy levels are in dB re 20 μPa^2•s. Durations (Dur) are in seconds.
N/A = data not available.

2.4.2 Ambient Noise Levels

Background sounds are recorded on the second channel of each ATAR using a higher sensitivity microphone. As expected, this channel overloaded during the brief time while the missile flight sounds were received, but at other times reliably recorded the background sounds (i.e., at levels above the self-noise [instrumentation noise] of the sensing and recording electronics). The sound levels for the 10-20,000 Hz band are determined using an averaging time of 4.0 s. Flat-, M_{pa}-, and A-weighted ambient noise levels for the missile launches are presented in Table 2.3. The measured A-weighted values are low and comparable to sound levels expected in quiet residential areas. Much of the background sound is infrasonic energy in the 10-20 Hz band, mainly attributable to wind noise. When the 10-20 Hz components are excluded, broadband levels are typically 10 dB lower than those quoted for the 10-20,000 Hz band.

TABLE 2.3. Ambient broadband (10-20,000 Hz) sound levels (in dB re 20 µPa) as recorded before launches.

Date	Missile	Site	Flat-weighted	A-weighted	M_{pa}-weighted
8 December 2015	SM-3 Block IIA	B809	73.3	55.3	64.7
		Dos Coves	67.7	48.6	58.9
		B809	69.3	48.3	58.9
17 December 2015	GOM x 2	Dos Coves (1/2)	70.8	54.4	61.5
		Dos Coves (2/2)	72.5	55.6	62.6
		B809 (1/2)	61.6	43.4	52.6
		B809 (2/2)	61.4	43.3	52.5
		Alpha Pad (1/2)	52.4	21.0	29.8
		Alpha Pad (2/2)	52.4	21.1	30.0
4 February 2016	GOM x 2	Vizcaino Point	71.9	N/A	N/A
		B809	N/A	N/A	N/A
		Alpha Pad (1/2)	49.9	24.8	36.1
		Alpha Pad (2/2)	49.9	24.8	36.1
7 April 2016	GOM x 2	Pirates Cove (1/2)	48.8	32.1	41.0
		Pirates Cove (2/2)	48.8	32.1	40.9
		Dos Coves	74.7	51.5	62.8
		B809 (1/2)	53.4	37.6	42.0
		B809 (2/2)	53.2	37.6	42.0
		Alpha Pad (1/2)	46.9	25.9	37.2
		Alpha Pad (2/2)	46.9	26.0	37.3
19 October 2016	JDF – KAI	B809	61.0	49.4	55.2
		Dos Coves	65.5	52.2	58.7
		Phoca Reef	52.2	35.1	43.6
		Rock Crusher	N/A	N/A	N/A
27 October 2016	JDF – KAI	Redeye South	N/A	N/A	N/A
		Dos Coves	68.3	45.5	56.2
		B809	66.0	40.1	49.6
		Rock Crusher	N/A	N/A	N/A

N/A = data not available.

2.5 Discussion and Summary

During the December 2015 to November 2016 period, the sound levels received from the nine monitored missile launches were comparable or less than those recorded from previous launches at SNI (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011). The highest measured sound levels (flat-weighted) at or near monitored pinniped haul-out beaches were all recorded at the launch site (B807) on 08 December, 2015. These measurements were all below the level at which TTS onset may occur in the Pacific harbor seal (Southall et al. 2007, see Section 4.2.1). The sound levels measured on this date were 143.2 dB re 20 µPa peak pressure (flat weighting), 128.2 dB re 20 µPa sound pressure level (SPL; flat weighting), and 129.7 dB re 20 µPa2-s sound exposure level (SEL; flat weighting). No measured sound levels exceeded the SEL-M or peak pressure levels (flat weighting) criterion for permanent threshold shift (144 dB and 149 dB respectively - Southall et al. 2007). Therefore, it is unlikely that any pinnipeds experienced launch sounds that could have caused TTS or PTS. The possibility of TTS and PTS occurring in pinnipeds hauled out on SNI during missile launches is further discussed in Chapter 4.

3. PINNIPED BEHAVIOR DURING MISSILE LAUNCHES

3.1 Introduction

Three species of pinnipeds are common on SNI beaches – California sea lion, Pacific harbor seal, and northern elephant seal. Northern elephant seals have shown little reaction to previous missile launches and directed monitoring of elephant seals is not required by the current LOA. Therefore this report only details reactions of Pacific harbor seals and California sea lions. Elephant seals were present on some of the monitored haul-outs along the other species and were included in the camera's FOV. On most occasions, reactions were similar to those in the past (generally no movement or very minor movement down the beach) reconfirming their lack of reaction to missile launches. During the 19 October 2016 GQM launches a small number of elephant seals reacted (see below). No other pinniped species were recorded during this or previous monitoring since August 2001 (Ugoretz 2015, Ugoretz 2014, Holst et al. 2011).

California sea lions often show startle responses to launches and movement along the beach. In most cases, sea lion behavior returns to pre-launch levels within seconds or minutes following the launches (Holst et al. 2011). Behavior as well as numbers of sea lions hauled-out several hours after a launch appears similar to the behavior and numbers observed before a launch. In contrast, when Pacific harbor seals react to launches, they commonly leave their haul-out sites to enter the water and do not return for several hours or the next tide cycle (Holst et al. 2011). Nonetheless, Holst and Lawson (2002) noted that the behavior and numbers of Pacific harbor seals hauled out on the day following a launch were similar to those on the day of the launch. This pattern was confirmed by launch monitoring on multiple days by Navy biologists.

Due to operational needs, two dual launches occurred during Pacific harbor seal pupping/nursing season. On one day, no harbor seals were present on beaches within the audible range of the launch. No evidence of injury, mortality, or pup abandonment was observed on the day of any launch during the monitoring period, nor was any launch-related injury or mortality expected based on prior monitoring results.

3.2 Field Methods

The launch monitoring program is based primarily on remote video recordings and later analysis. Remote cameras are essential because, during missile launches, safety requirements prevent personnel from being present in many of the areas of interest. Video data are obtained via portable cameras that are set up temporarily at the monitoring locations. In addition, trained staff make notes on the status of pinnipeds on monitored beaches as well as other locations around the island prior to and following launches.

3.2.1 Visual Observations

Video recordings are obtained before, during, and after each missile launch. Navy biologists also make direct visual observations of the pinniped groups prior to deployment of the cameras and ATARs as well as after the launch when collecting equipment. Records from these visual observations include the local weather conditions, the type of launch activity planned, types and locations of any pinnipeds hauled out and notable impacts if any, as well as notes on tidal changes or other confounding factors.

Video recordings continue for approximately 15-60 min or more after the launch. If reactions to the launch occur, recordings during the after-launch period determine how quickly animals returned to pre-

launch behaviors. These recordings also help determine whether the relative number of pinnipeds at the haul-out site have changed, and if there was obvious evidence of recent injury or mortality. In addition, Navy biologists perform visual scans while retrieving video equipment to determine the relative number of hauled-out pinnipeds as compared to pre-launch numbers.

During the launches described in this report, use of video methods allowed for observations of up to three pinniped species during the same launch. The actual number of species observed depends on the number of video systems deployed during each launch and on the number of species hauled out at those sampling sites (Table 3.1).

Cameras were placed at locations overlooking haul-out sites prior to each launch. Cameras were placed in a manner to minimize disturbance to pinnipeds. The entire haul-out aggregation at a given site cannot be recorded, as the wide-angle view necessary to encompass an entire beach generally will not allow detailed behavioral observations. Thus, cameras are set to record a focal subgroup within the haul-out aggregation. Prior to selecting a focal subgroup, however, video pans of the entire area are made to allow computation of total animals in the area. Video pans are repeated after the launch to provide information on changes in total numbers of animals present. The number of animals affected at a given location is calculated based on the percentage of the total group monitored and the percentage of the focal group affected.

Video and audio recordings are usually attempted at locations with varying distances from the missile flight path, depending upon the presence of pinnipeds at haul-outs. Figure 3.1 shows the monitoring locations relative to the launch azimuths.

3.2.2 Digital Video Cameras

To monitor daytime launches, Navy biologists place up to three portable Sony high definition digital video cameras (HDR-CX160) on tripods overlooking haul-out sites. Missile and other sounds detected by the microphones built into these cameras are also recorded. The audio data are used during behavioral analyses (e.g., to confirm the exact time when the missile passed), but are not calibrated and not of sufficient quality to provide launch sound information.

TABLE 3.1. Video monitoring locations and pinniped species present.

	Video Recording Location By Species					
	California Sea Lion				Pacific Harbor Seal	
Launch Date	Dos Coves	B809	Redeye Beach	Vizcaino Point	Phoca Reef	Pirates Cove
12/8/2015	X			X		
12/17/2015	X	X		X		
2/4/2016	X	X		X		
4/7/2016	X	X				X
10/19/2016	X	X			X*	
10/27/2016	X	X	X			

X - Focal group videotaped
* - No animals present at time of launch

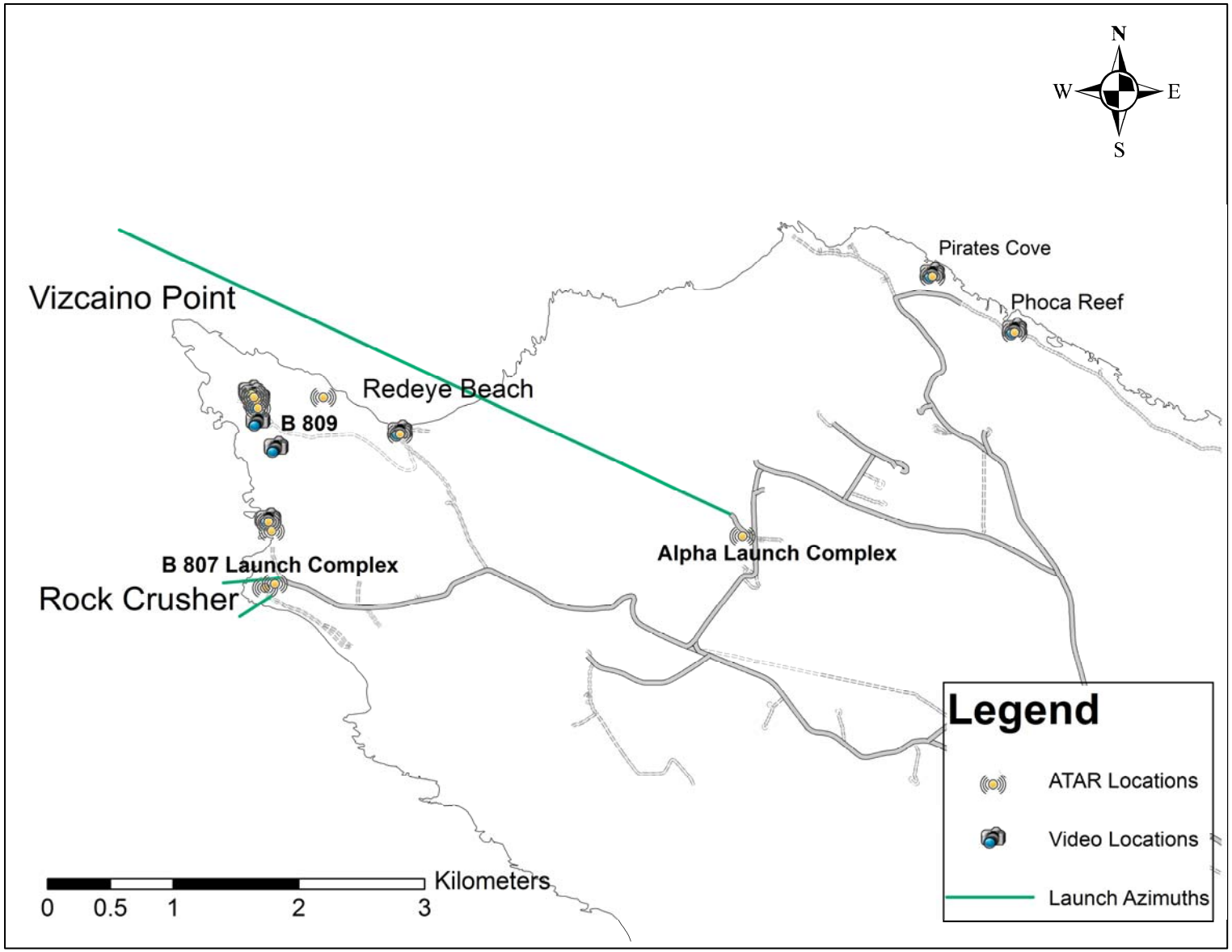

FIGURE 3.1. Launch azimuths, acoustic recording sites (ATARs), and video recording sites.

3.3 Video Monitoring Analysis

Digital video recordings are reviewed by an experienced biologist on a high-resolution color monitor. The recordings before, during, and up to 60 min after each launch are reviewed to document the types and numbers of pinnipeds present, the nature of any overt responses to the launch, and the number of pinnipeds that overtly responded. The number, proportion and age class (adult or pup - where determinable) of the individuals that responded in various ways is determined from the video, along with comparable data for those that did not respond. Following NMFS [2002], subtle behavioral reactions persisting for only a few minutes are considered unlikely to have biologically significant consequences for the pinnipeds. Pinnipeds that move into the water or greater than 10 m (33 ft) along the beach are considered to have been affected. To relate pinniped behavior to the proximity of the missile launch, the 3-D distance from the recording site to the CPA of the missile is calculated.

3.4 Descriptions of Pinniped Behavior during Specific Launches

Video recordings of pinniped behavior during launches from December 2015 to November 2016 were successfully collected on all six dates for California sea lions and on one date for Pacific harbor seals (Table 3.1). Harbor seals were not present on beaches within audible range of launches on other launch dates. California sea lions were monitored at three separate haul-outs and Pacific harbor seals were monitored at one haul-out. The video recordings generally provided data on the responses of a focal portion of the total pinnipeds present on a given beach, though on some occasions all animals in the area were recorded.

3.4.1 SM-3 Launch, 8 December 2015

Video recordings of California sea lions were made at Vizcaino Point (CPA ≈ 1.6 km), Dos Coves (CPA ≈ 0.6 km), and B809. (CPA ≈ 1.6 km) (Figure 3.1).

California sea lions. Approximately 500 sea lions were in the vicinity of Vizcaino Point with 150 in the camera's FOV. One hundred of these reacted to the launch with movement along the slope but not into the water. Of those, 70 moved more than 10 m and were considered to have been impacted. From this, approximately 233 of the sea lions could have been impacted in the area [(70/150)*500]. Approximately 190 sea lions were in the vicinity of B809 with 100 in the camera's FOV. Ninety of the 100 animals reacted, with movement along the slope but not into the water. Of those, 50 moved more than 10 m and were considered to have been affected. From this, approximately 95 of the sea lions could have been impacted in the area [(90/100)*190]. At both Vizcaino Point and B809 animals returned to normal resting behaviors after less than five minutes. Approximately 175 sea lions were in the vicinity of Dos Coves during the dual launch with 75 in the camera's FOV. Most of the animals on the beach moved in response to the launches with the majority only moving a short distance along the beach. Thirteen pups entered the water and were considered to have been impacted by the launch. From this, an estimated 30 sea lions could have been impacted in the area [(13/75)*175]. Sea Lions were not present on unmonitored beaches within the area of potential impact of the launch. Therefore a total of 358 sea lions are estimated to have been impacted by the dual launch.

Pacific harbor seals. No harbor seals were observed in the area potentially affected prior to the launches.

3.4.2 GQM Dual Launch, 17 December 2015

Video recordings of California sea lions were made at Dos Coves (CPA ≈ 1.8 km), Building 809 (CPA ≈ 1.6 km) and Vizcaino Pt. (CPA ≈ 1.6 km) (Figure 3.1).

California sea lions. Approximately 90 sea lions were in the vicinity of Dos Coves during the dual launch with 61 in the camera's FOV. None of the animals on the beach moved in response to the launches, though 25 on the reef beyond the beach within the camera's FOV moved a short distance and only two into the water. Based on this, it is estimated that three of the sea lions in the area were affected by the launches [(2/61)*90]. Approximately 48 sea lions were in the vicinity of B809 with 40 in the camera's FOV. Most of the animals (34) moved into the water and did not return prior to the post launch scan. Based on this, it is estimated that 41 of the sea lions in the area were affected by the launches [(34/40)*48]. Approximately 160 sea lions were in the vicinity of Vizcaino Pt. with 40 in the camera's FOV. Most animals moved in response to the launches, with 34 of the 40 entering the water and not returning prior to the post launch scan. Based on this, it is estimated that 136 of the sea lions in the area were affected by the launches [(34/40)*160]. Sea Lions were not present on unmonitored beaches within the area of potential impact of the launch. Therefore a total of 180 sea lions are estimated to have been impacted by the dual launch.

Pacific harbor seals. No harbor seals were observed in the area potentially affected during the launches.

3.4.3 GQM Dual Launch, 4 February 2016

Video recordings of California sea lions were made at Dos Coves (CPA ≈ 1.8 km), Building 809 (CPA ≈ 1.6 km) and Vizcaino Pt. (CPA ≈ 1.6 km) (Figure 3.1).

California sea lions. Approximately 100 sea lions were in the vicinity of Dos Coves during the launch with 60 in the camera's FOV. None of the animals moved in response to the launch. Based on this, it is assumed that no sea lions at Dos Coves were affected by the launch. Approximately 35 sea lions were present in the vicinity of B809 all within the camera's FOV at the time of the launch. Most of the animals moved slowly in response to the launch, with generally mild reactions. None entered the water but 29 moved more than 10 m. Based on this, it is estimated that 29 sea lions at B809 were affected by the launch. Approximately 200 sea lions were in the vicinity of Vizcaino Pt. All sea lions in the area were in the camera's FOV at the time of the launch. About 75% of the animals moved in response to the launch, with none entering the water but approximately 100 moving more than 10 m. Based on this, it is estimated that 100 sea lions at Vizcaino Pt. were affected by the launch. Based on relatively low counts of sea lions at unmonitored beaches on days prior to and following the launch, it is estimated that an additional 20 sea lions were impacted by the launch. Therefore a total of 149 sea lions are estimated to have been impacted by the dual launch.

Pacific harbor seals. No harbor seals were observed in the area potentially affected during the launches.

3.4.4 GQM Dual Launch, 7 April 2016

Video recordings of California sea lions were made at Dos Coves (CPA ≈ 1.8 km) and Vizcaino Pt. (CPA ≈ 1.6 km) and recordings of Pacific harbor seals at Pirates Cove (CPA ≈ 2.3 km) (Figure 3.1).

California sea lions. Approximately 50 sea lions were in the vicinity of Dos Coves during the launch with 20 in the camera's FOV. None of the animals moved in response to the launch. Based on this, it is assumed that no sea lions at Dos Coves were affected by the launch. Approximately 100 sea lions

were in the vicinity of Vizcaino Pt. with 30 in the FOV. All animals in the FOV startled in response to the launch, but only 19 moved and only 12 more than 10 m. All movements were slow and deliberate. Based on this, it is estimated that 40 sea lions at Vizcaino Pt. were affected by the launch [(12/30)*100]. Based on relatively low counts of sea lions at unmonitored beaches on days prior to and following the launch, it is estimated that an additional 10 sea lions were impacted by the launch. Therefore a total of 50 sea lions are estimated to have been impacted by the launch.

Pacific harbor seals. Ten harbor seals were present on Pirates Cove beach and in the water adjacent prior to the launch. One mother and pup pair and two other adults moved into the water in response to the launch, but not departed the immediate vicinity. All animals were present on the beach and in the water adjacent during the post launch scan. Harbor seals were not hauled out at other beaches within the area of potential impact during the launch. Therefore a total of 4 harbor seals are estimated to have been impacted by the dual launch.

3.4.5 KAI Launch, 19 October 2016

Video recordings of California sea lions were made at Dos Coves (CPA ≈ 0.5 km) and Vizcaino Pt. (CPA ≈ 1.2 km) and recordings were attempted at Pirates Cove (CPA ≈ 5.3 km) (Figure 3.1).

California sea lions. Pre-launch counts of sea lions were hindered by safety needs which required setup prior to dawn. Based on days prior and following the launch, an estimated 200 sea lions were in the vicinity of Dos Coves with approximately 100 in the camera's FOV. All of the animals moved in response to the launch initially with 29 animals moving into the water. A secondary wave of movement into the water by 15 animals yielded a total of 41 of the 100 focal animals affected. Based on this, it is estimated that 82 of the sea lions in the area were affected by the launch [(41/100)*200]. Approximately 250 sea lions were in the vicinity of Vizcaino Pt., with approximately 100 in the camera's FOV prior to the launch. Forty sea lions moved along the slope more than 10 m in response to the launch, with none entering the water. Based on this, it is estimated that 100 sea lions in the area was affected by the launch [(40/100)*250]. Sea Lions were not present on unmonitored beaches within the area of potential impact of the launch. Therefore a total of 182 sea lions are estimated to have been affected by the launch.

Pacific harbor seals. No harbor seals were present at Phoca reef or observed at other unmonitored beaches due to high tides prior to the launch. Therefore, no harbor seals are assumed to have been affected.

Northern elephant seals. Approximately 100 elephant seals were in the vicinity of Dos Coves, all within the camera's FOV prior to the launch. 10 moved in response to the launch and only one of those exhibited a deliberate continued movement into the water after a brief delay. Given the greater distance from the launch to other beaches occupied by elephant seals, it is estimated that one elephant seal was affected by the launch.

3.4.6 KAI Launch, 27 October 2016

Video recordings of California sea lions were attempted at Dos Coves (CPA ≈ 0.5 km), Building 809 (CPA ≈ 1.2 km), and Redeye Beach (CPA ≈ 1.5 km) (Figure 3.1).

California sea lions. Approximately 300 sea lions were in the vicinity of Dos Coves during the launch with 155 in the camera's FOV. Juveniles appeared to react more strongly, with most adults startling but not moving in response to the launch. After a brief delay, a prolonged directed movement of juveniles occurred with 130 entering the water both from the focal group and others entering the FOV. Based on this, it is estimated that 252 sea lions in the area were affected [(130/155)*300]. Approximately

370 sea lions were in the vicinity of Building 809, with 37 in the camera's FOV prior to the launch. Most adults showed little to no reaction, while 26 juveniles reacted by moving towards the water. Of those that moved, 16 entered the water but others all moved more than 10 m. Based on this, it is estimated that 260 sea lions in the area were affected by the launch [(26/37)*370]. Approximately 100 sea lions were in the vicinity of Redeye Beach, with 10 in the camera's FOV prior to the launch. A few sea lions raised their heads in response to the launch, but none moved from their positions. Therefore, it is estimated that no sea lions in the area were affected by the launch. Based on low numbers of sea lions at unmonitored beaches and the limited reaction at Redeye beach, it is assumed that no other sea lions were affected. Therefore a total of 512 sea lions are estimated to have been affected by the launch.

Pacific harbor seals. No harbor seals were observed in the area potentially affected during the launch.

3.5 Implementation of Mitigation Measures

Table 3.2 shows a summary of the mitigation measures that were specified by NMFS in the LOA, and how they were implemented during the December 2015 - November 2016 monitoring period.

TABLE 3.2. Implementation of mitigation measures.

Mitigation Measure	Implementation
No personnel at haul-out sites 2 hr before launch	Personnel were prohibited from accessing the haul-out sites at least 2 hr before all launches.
Avoid launches during Pacific harbor seal pupping season	One Dual launch occurred during Pacific harbor seal pupping season (4 February 2016). No harbor seal pups were present on affected beaches during this launch and no evidence of pup abandonment was noted.
Limit launch activities during other pinniped pupping season	One launch and one Dual launch occurred early in northern elephant seal pupping season (8 and 17 December 2015). The launches had to occur on these dates due to operational needs. No impacts were noted to elephant seals during either launch and no pups were abandoned.
No launches of missiles at low elevation from Alpha Launch Complex	The six missiles launched from the Alpha Launch Complex passed over the shoreline at an elevation of approximately 1,850 ft.
Avoid multiple launches in quick succession, especially when pups present	Three dual launches occurred (17 December 2015, 4 February and 7 April 2016). The December launches were early in northern elephant seal pupping season and the February launches were during harbor seal pupping season The launches had to occur on these dates due to operational needs. As noted above, no impacts to pups of either species were observed.
Limit launches during nighttime	No night launches occurred.
Ensure aircraft maintain an altitude of 1000 ft from haul outs	No aircraft were flown near haul-out areas during or immediately following launch operations.
Review launch procedure and monitoring methods with NMFS if pinniped injury or mortality are discovered.	No injured or dead pinnipeds were seen in post launch observations during the monitoring period.

4. TOTAL ESTIMATED NUMBERS OF PINNIPEDS AFFECTED

4.1 Pinniped Behavioral Reactions to Noise and Disturbance

Some of the pinnipeds on the beaches at SNI exhibit disturbance reactions to missile launches, but others do not. The levels, frequencies, and types of noise that elicit a response are known or expected to vary between and within species, individuals, locations, and seasons. Reactions to the same missile types also varied from one launch to the next, possibly due to weather conditions, ambient noise or other factors. It is possible that pinnipeds hauled out on land may react to the sight (light at night), or the combined sight plus sound, of a missile launch. Furthermore, pinnipeds, at times, react to the sight and sound of seabirds reacting to a launch. Thus, responses are not expected to be a direct function of received sound level. However, some correlation between pinniped responses and received sound level has been shown, at least for California sea lions and elephant seals, based on data from previous monitoring periods (Holst et al. 2011).

For pinnipeds hauled out on land, behavioral changes ranged from a momentary alert reaction or an upright posture to movement – either abrupt or deliberate – into the water. Previous studies indicate that the reaction threshold and degree of response are related to the activity of the pinniped at the time of the disturbance. In general, there is much variability and pinnipeds often show considerable tolerance of noise and other forms of human-induced disturbance, though at other times certain pinnipeds can be quite responsive (Richardson et al. 1995; Reeves et al. 1996; Lawson et al. 1998).

Although it is possible that pinnipeds exposed to launch noise might "stampede" from the haul-out sites in a manner that causes injury or mortality, this was judged unlikely prior to the monitoring program. Review of video records of pinnipeds during launches at SNI indicates that this assumption was generally correct. However, monitoring conducted during 2002-2003 showed that, in some cases, several Pacific harbor seal pups were knocked over by adult seals as both pups and adults moved toward the water in response to the launch though no injuries were observed (Holst 2008). Similarly, during the 2004-2005 monitoring period, several California sea lion pups were knocked over by adult sea lions as the adults moved along the beach in response to a launch (Holst and Greene 2008). The pups were momentarily startled, but did not appear to be injured.

Since no injuries or deaths were observed and no pups were abandoned during the monitored launches in either this monitoring period or earlier monitoring dating back to August 2001, determining disturbance level, rather than injury or mortality, is the primary monitoring objective. The numbers of pinnipeds on the monitored beaches that might have been affected significantly by the launches was estimated. Estimates were always conservative, assuming the highest possible level of impact. The Navy, consistent with NMFS (2002), assumes that a pinniped blinking its eyes, lifting or turning its head, or moving a few feet along the beach as a result of a human activity is not significantly affected (i.e., not harassed).

In this report, consistent with previous related reports (Holst et al., 2008, 2011; Ugoretz and Greene 2012, Ugoretz, 2013, Ugoretz 2015, Ugoretz 2014, and Ugoretz 2015), it is assumed that only those animals meeting either of the following criteria are affected by launches:

1. Pinnipeds exposed to launch sounds strong enough to cause TTS; and
2. Pinnipeds that left the haul-out site, or exhibited prolonged movement (> 10 m) or prolonged behavioral changes (such as pups separated from mothers) relative to their behavior immediately prior to the launch.

In practice, since August 2001, no pinnipeds have received sounds strong enough to elicit PTS, and few, if any, are believed to have received sounds strong enough to elicit TTS (see §4.2, below). Thus, the number of pinnipeds counted as potentially affected during the monitoring period was based on criterion (2) – the number that left the haul-out site, or exhibited prolonged movement.

The numbers of such affected pinnipeds were calculated for both observed animals and animals on unobserved beaches in the area of potential affect for each launch during the December 2015 to November 2016 period. Disturbance reactions were short-lived for California sea lions and did not appear to extend into subsequent days. Pacific harbor seals were only present during one launch in this monitoring period. Those that reacted moved into the water, but did not depart the protected cove adjacent to the beach they had been on prior to the launch. Based on this and past monitoring, it is assumed that no long-term affects occurred.

4.2 Possible Effects on Pinniped Hearing Sensitivity

Temporary or permanent hearing impairment is a possibility when pinnipeds are exposed to very strong sounds in air. Based on data from terrestrial mammals, the minimum sound level necessary to cause PTS is presumed to be higher, by a variable and generally unknown amount, than the level that induces barely-detectable TTS. Given what is known about the thresholds for TTS and PTS in terrestrial mammals and humans, the PTS threshold is expected to be well above the TTS threshold for non-impulsive sounds. For impulsive sounds, such as sonic booms and artillery shots, the difference may be smaller (Kryter 1985; Southall et al. 2007). As described below, missile launch sounds are sometimes impulsive.

4.2.1 Temporary Threshold Shift

There are few published data on TTS thresholds for pinnipeds in air exposed to impulsive or brief non-impulsive sounds. J. Francine, quoted in NMFS (2001, p. 41837), has mentioned evidence of mild TTS in captive California sea lions exposed to a 0.3 s transient sound with an SEL of 135 dBA re 20 $\mu Pa^2 \cdot s$ (see also Bowles et al. 1999). Katsak, et al. (2007) estimated TTS onset for California sea lions in air at 159 dB re 20 $\mu Pa^2 \cdot s$. However, mild TTS may occur in harbor seals exposed to received levels lower than 135 dB SEL (A. Bowles, pers. comm., 2003). Initial evidence from more prolonged (non-pulse) exposures suggests that the TTS threshold on an SEL basis may actually be around 129–131 dB re 20 $\mu Pa^2 \cdot s$ (M_{pa}-weighted) for harbor seals, within their frequency range of good hearing (Kastak et al. 2004; Southall et al. 2007). The same research teams have found that the TTS thresholds of California sea lions and northern elephant seals exposed to strong sounds are higher as compared to harbor seals (Kastak et al. 2005). Based on these studies and other available data, Southall et al. (2007) proposed that sounds may induce mild TTS if the received peak pressure is ~143 dB re 20 μPa, or if received SEL-M is ~129 dB re 20 $\mu Pa^2 \cdot s$ (for pulses) or 131 dB re 20 $\mu Pa^2 \cdot s$ (for non-pulses received in air). Those levels apply specifically to harbor seals and are not expected to elicit TTS in elephant seals or California sea lions (Southall et al. 2007). Thus, as a conservative estimate, it is assumed that all three species might have TTS onset at a received SEL-M of >129 dB re 20 $\mu Pa^2 \cdot s$.

The sounds received from missile launches on SNI are sometimes impulse sounds (e.g., when there is a sonic boom or near the launcher). At other times and locations they are non-impulsive. During past monitoring of missile launches from SNI during 2001-2015, few if any pinnipeds were exposed to sound levels above 122 dB SEL-M (Ugoretz 2015, Ugoretz 2015, Ugoretz 2014, Holst et al. 2008, 2011). In addition, peak pressure levels at pinniped haul-out beaches were generally <143 dB re 20 μPa, although for some launches that produced a sonic boom (impulse), peak pressure levels were as high as 150 dB

(Holst et al. 2008). Thus, it is possible that a few pinnipeds, particularly Pacific harbor seals, may incur TTS during some missile launches, especially larger missiles, from SNI. Because of their higher TTS thresholds, it is likely that fewer California sea lions and northern elephant seals may incur TTS as compared to Pacific harbor seals.

During the December 2015 to November 2016 monitoring period, no recorded sounds exceeded either the PTS or TTS thresholds. Therefore it is assumed that no pinnipeds were impacted by the sound levels received.

4.2.2 Permanent Threshold Shift

Southall et al. (2007) estimate that received SELs would need to exceed the TTS threshold by at least 15 dB for pulses and 13.5 dB for non-pulses in air for there to be risk of PTS. In the harbor seal, the SEL-M that is estimated to result in onset of PTS is 144 dB re 20 $\mu Pa^2 \cdot s$ (Southall et al. 2007). As already noted above, the SEL-M measurements nearshore did not exceed the SEL-based PTS threshold. Even SEL-M measurements taken close to the launcher were far less than 144 dB re 20 $\mu Pa^2 \cdot s$, with a maximum of 137.3 dB re 20 $\mu Pa^2 \cdot s$ (Table 2.2).

However, there is some possibility that a few pinnipeds at SNI might receive peak pressures exceeding those that elicit onset of TTS or perhaps even PTS. In animals (or humans) exposed to strong impulsive sound (e.g., close to an artillery shot), there is a possibility of PTS as a result of the high peak pressure even if the received energy did not exceed the SEL criterion for PTS onset. When considering peak pressures rather than energy levels, PTS onset may occur when the received level is as little as 6 dB higher than the TTS threshold, or 149 dB re 20 µPa in the case of the harbor seal (Southall et al. 2007). During the December 2015 - November 2016 monitoring period no measured sounds exceeded any levels for PTS or TTS onset and it is unlikely that the sounds were strong enough at pinniped haul-out sites to have induced PTS in any pinniped species.

4.2.3 Conclusions Regarding Effects on Pinniped Hearing Sensitivity

Overall, the results to date indicate that there is little potential for appreciable TTS or PTS in pinnipeds hauled out on SNI near the missile launch paths during launch operations. This conclusion is necessarily speculative given the limited TTS data (and lack of PTS data) for pinnipeds in air exposed to strong sounds for brief periods. In the event that levels are occasionally sufficiently high to cause TTS, these levels probably would be only slightly above the presumed thresholds for mild TTS. Thus, in the event that TTS did occur, it would typically be mild and reversible and thus PTS would necessarily not occur. Given the relatively infrequent launches from SNI, the low probability of TTS during any one launch, and the fact that a given pinniped is not always present on land, there appears to be no likelihood of PTS from the cumulative effects of multiple launches.

If there is any reason to be concerned about auditory effects, it would be during either of two types of launches: (1) When artillery shots occur at beach locations and pinnipeds are present nearby, and (2) When a large missile travels at supersonic speed over a pinniped beach at relatively low altitude. These types of events did not occur during the current monitoring period.

4.3 Estimated Numbers of Pinnipeds Affected by Launches

The approach to estimating the numbers of pinnipeds affected by launches between December 2015 and November 2016 was based on audio, video, and direct observations of pinnipeds, combined with estimates of the numbers of hauled out pinnipeds in the same general vicinity not videotaped but exposed to the same launches. The latter animals are presumed to have reacted in the same manner as

those whose responses were videotaped. For pinniped groups that extended farther along the beach than encompassed by the FOV of the video camera, an estimate of the total number of individuals that were hauled out was made based on a pre-launch video pan of the area. For pinnipeds on unobserved beaches, the percentage of animals affected on the nearest observed beaches were applied to the average counts of animals found on the unobserved beaches during peak breading season.

The proportions of animals in the focal subgroups affected during each launch (based on the disturbance criteria listed in §4.1) are extrapolated to the estimated total number of individuals hauled out in this area (Tables 4.1 and 4.2). It is not possible to extrapolate the proportions of animals affected on the monitored beaches to the entire island as not all beaches can be observed on the day of a launch. However, whenever possible surveys of surrounding beaches are conducted during monitoring set up to determine if additional pinnipeds are in the area. Additionally, individual pinnipeds may be affected on more than one occasion, but are counted here as separate individuals. Thus, while the overall estimate of pinnipeds affected may be over- or underestimated it is likely that the totals presented here are overestimates.

As noted in section 3.4.1, an unusually strong reaction was noted in a small group of northern elephant seals during the 19 October KAI launch. During this event, however, only one elephant seal exhibited prolonged movement and thus only one elephant seal is estimated to have been affected during the December 2015 - November 2016 monitoring period.

Northern fur seals (*Callorhinus ursinus*) and Guadalupe fur seals (*Arctocephalus townsendi*) were not observed on SNI during launches in the December 2015 - November 2016 monitoring period, and none were evident in the video segments that were analyzed.

Observations from 2001-2016 continue to show that all of the haul-out sites continue to be occupied on subsequent days following the launches. There was no evidence of injury or mortality during any of the launches.

TABLE 4.1. Estimated numbers of California sea lions affected by launches - December 2015 to November 2016.

Launch Date	Missile Type	Monitoring Site	# of Focal Animals Potentially Affected	Total # Estimated Affected in Area	Subtotals
8 December 2015	SM-3	Dos Coves	13	*30*	
		Building 809	50	95	
		Vizcaino Point	70	233	
		Unmonitored Beaches	N/A	0	358
17 December 2015	Dual GQM	Dos Coves	2	*3*	
		Building 809	34	*41*	
		Vizcaino Point	34	*136*	
		Unmonitored Beaches	N/A	0	180
4 February 2016	Dual GQM	Dos Coves	0	0	
		Building 809	29	29	
		Vizcaino Point	100	*100*	
		Unmonitored Beaches	N/A	*20*	149
7 April 2016	Dual GQM	Dos Coves	0	0	
		Vizcaino Point	12	*40*	
		Unmonitored Beaches	N/A	*10*	50
19 October 2016	KAI	Dos Coves	41	82	
		Vizcaino Point	40	*100*	
		Unmonitored Beaches	N/A	0	182
27 October 2016	KAI	Dos Coves	130	*252*	
		Building 809	26	*260*	
		Redeye Beach	0	0	
		Unmonitored Beaches	N/A	0	512
			Total number of sea lions potentially affected:		***1,431***

Note: Numbers in *italics* are estimates based upon the proportion of pinnipeds affected within a focal group and expanded to the entire number of animals present in the area.
N/A - Not Applicable

TABLE 4.2. Estimated numbers of Pacific harbor seals affected by launches - December 2015 to November 2016.

Launch Date	Missile Type	Monitoring Site	# of Focal Animals Potentially Affected	Total # Potentially Affected
8 December 2015	SM-3	All Areas	-	*0*
17 December 2015	Dual GQM	All Areas	-	*0*
4 February 2015	Dual GQM	All Areas	-	*0*
7 April 2016	Dual GQM	Pirates Cove	4	4
19 October 2016	KAI	Phoca Reef	0	0
27 October 2015	KAI	All Areas	-	*0*
		Total number of harbor seals potentially affected:		**4**

Note: Numbers in italics are estimates based upon the proportion of pinnipeds affected within a focal group and expanded to the entire number of animals present in the area.
Dash (-) - unknown number hauled out during the launch assumed to be zero based on observed beaches and/or tide.

4.4 Summary

No evidence of pinniped injuries or fatalities related to launch noises or other launch operations was evident, nor was it expected. It is also unlikely that any pinnipeds were exposed to received levels of sound energy above levels at which PTS or TTS would occur.

1,431 California sea lions, 4 Pacific harbor seals, and 1 northern elephant seal are estimated to have been affected during the December 2015 to November 2016 monitoring period. These figures are approximate, because they (a) include extrapolations for pinnipeds on beaches that were not monitored on any given launch day, (b) very likely count some of the same individuals more than once, and (c) may exclude pinnipeds on some beaches that were not monitored. The pinnipeds included in these estimates left the haul-out site in response to the launch, or exhibited prolonged movement or behavioral changes relative to their behavior immediately prior to the launch.

The results from the December 2015 to November 2016 monitoring period (and those from previous monitoring periods) suggest that any effects of the launch operations were minor, short-term, and localized. Some Pacific harbor seals left their haul-out site on land, but numbers occupying haul-out sites shortly after a launch or the next day are generally similar to pre-launch levels. It is not likely that any of the pinnipeds on SNI were adversely impacted by such behavioral reactions.

These results are supported by continuing population increases of pinnipeds on San Nicolas Island. Counts of all three species of pinnipeds have significantly increased on SNI over the past three decades (Barlow, et al., 1997, Fluharty, 1999, Le Boeuf, et al., 1978, Lowry 2002, Lowry and Maravilla, 2005, Lowry, et al., 1996 and 2008 and Lowry, Pers. Comm.). This includes increases in pinniped counts in the portions of the island closest to the missile launch trajectories.

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We are grateful to all concerned.

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APPENDIX A:
SMAL TAKE REGULATIONS
3 JUNE 2014 – 3 JUNE 2019

Title 50: Wildlife and Fisheries
Subpart F—Taking of Marine Mammals Incidental To Target and Missile Launch Activities From San Nicolas Island, CA

Source: 79 FR 32684, June 3, 2014, unless otherwise noted.

Effective Date Note: At 79 FR 32684, June 3, 2014, subpart F was added, effective June 3, 2014, through June 3, 2019.

§217.50 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the incidental taking of marine mammals specified in paragraph (b) of this section by the Naval Air Warfare Center Weapons Division, U.S. Navy, and those persons it authorizes to engage in target missile launch activities and associated aircraft and helicopter operations at the Naval Air Warfare Center Weapons Division facilities on San Nicolas Island, California.

(b) The incidental take of marine mammals under the activity identified in paragraph (a) of this section is limited to the following species: Northern elephant seals (*Mirounga angustirostris*), harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*).

(c) This Authorization is valid only for activities associated with the launching of a total of 40 vehicles (e.g., RAM, Coyote, MSST, Terrier, SM-3, or similar) from Alpha Launch Complex and smaller missiles and targets from Building 807 on San Nicolas Island, California.

§217.51 Effective dates.

Regulations in this subpart are effective from June 3, 2014, through June 3, 2019.

§217.52 Permissible methods of taking.

(a) Under Letters of Authorization issued pursuant to §216.106 and 217.57 of this chapter, the Holder of the Letter of Authorization may incidentally, but not intentionally, take marine mammals by harassment, within the area described in §217.50, provided the activity is in compliance with all terms, conditions, and requirements of the regulations and the appropriate Letter of Authorization.

(b) The activities identified in §217.50 must be conducted in a manner that minimizes, to the greatest extent practicable, any adverse impacts on marine mammals and their habitat.

(c) The incidental take of marine mammals is authorized for the species listed in §217.50(b) and is limited to Level B Harassment.

§217.53 Prohibitions.

Notwithstanding takings contemplated in §217.50 and authorized by a Letter of Authorization issued under §§216.106 and 217.57 of this chapter, no person in connection with the activities described in §217.50 may:

(a) Take any marine mammal not specified in §217.50(b);

(b) Take any marine mammal specified in §217.50(b) other than by incidental, unintentional harassment;

(c) Take a marine mammal specified in §217.50(b) if such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(d) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or a Letter of Authorization issued under §§216.106 and 217.57 of this chapter.

§217.54 Mitigation.

(a) When conducting operations identified in §217.50(c), the mitigation measures contained in the Letter of Authorization issued under §§216.106 and 217.57 must be implemented. These mitigation measures include, but are not limited to:

(1) The holder of the Letter of Authorization must not enter pinniped haul-out sites below the missile's predicted flight path for 2 hours prior to planned missile launches.

(2) The holder of the Letter of Authorization must avoid, whenever possible, launch activities during harbor seal pupping season (February to April), unless constrained by factors including, but not limited to, human safety, national security, or for vehicle launch trajectory necessary to meet mission objectives.

(3) The holder of the Letter of Authorization must limit, whenever possible, launch activities during other pinniped pupping seasons, unless constrained by factors including, but not limited to, human safety, national security, or for vehicle launch trajectory necessary to meet mission objectives.

(4) The holder of the Letter of Authorization must not launch vehicles from the Alpha Complex at low elevation (less than 1,000 feet (305 m)) on launch azimuths that pass close to pinniped haul-out sites when occupied.

(5) The holder of the Letter of Authorization must avoid, where practicable, launching multiple target missiles in quick succession over haul-out sites, especially when young pups are present.

(6) The holder of the Letter of Authorization must limit launch activities during nighttime hours, except when required by the test objectives.

(7) Aircraft and helicopter flight paths must maintain a minimum altitude of 1,000 feet (305 m) from pinniped haul-outs and rookeries, except in emergencies or for real-time security incidents (e.g., search-and-rescue, fire-fighting), which may require approaching pinniped haul-outs and rookeries closer than 1,000 feet (305 m).

(8) If post-launch surveys determine that an injurious or lethal take of a marine mammal has occurred or there is an indication that the distribution, size, or productivity of the potentially affected pinniped populations has been affected, the launch procedure and the monitoring methods must be reviewed, in cooperation with NMFS, and, if necessary, appropriate changes must be made through modification to a Letter of Authorization, prior to conducting the next launch of the same vehicle under that Letter of Authorization.

(9) Additional mitigation measures as contained in a Letter of Authorization.

(b) [Reserved]

§217.55 Requirements for monitoring and reporting.

(a) Unless specified otherwise in the Letter of Authorization, the Holder of the Letter of Authorization must notify the Administrator, West Coast Region, NMFS, by letter or telephone, at least 2 weeks prior to activities possibly involving the taking of marine mammals. If the authorized activity identified in §217.50 is thought to have resulted in the mortality or injury of any marine mammals or in any take of marine mammals not identified in §217.50(b), then the Holder of the Letter of Authorization must notify the Director, Office of Protected Resources, NMFS, or designee, by telephone (301-427-8401), and the Administrator, West Coast Region, NMFS, or designee, by telephone (562-980-3232), within 48 hours of the discovery of the injured or dead animal.

(b) The National Marine Fisheries Service must be informed immediately of any changes or deletions to any portions of the proposed monitoring plan submitted, in accordance with the Letter of Authorization.

(c) The holder of the Letter of Authorization must designate biologically trained, on-site individual(s), approved in advance by NMFS, to record the effects of the launch activities and the resulting noise on pinnipeds.

(d) The holder of the Letter of Authorization must implement the following monitoring measures:

(1) Visual land-based monitoring.

(i) Prior to each missile launch, an observer(s) will place three autonomous digital video cameras overlooking chosen haul-out sites located varying distances from the missile launch site. Each video camera will be set to record a focal subgroup within the larger haul-out aggregation for a maximum of 4 hours or as permitted by the videotape capacity.

(ii) Systematic visual observations, by those individuals, described in paragraph (c) of this section, of pinniped presence and activity will be conducted and recorded in a field logbook a minimum of 2 hours prior to the estimated launch time and for no less than 1 hour immediately following the launch of target missiles.

(iii) Systematic visual observations, by those individuals, described in paragraph (c) of this section, of pinniped presence and activity will be conducted and recorded in a field logbook a minimum of 2 hours prior to launch, during launch, and for no less than 1 hour after the launch of the BQM-34, BQM-74, Tomahawk, RAM target and similar types of missiles.

(iv) Documentation, both via autonomous video camera and human observer, will consist of:

(A) Numbers and sexes of each age class in focal subgroups;

(B) Description and timing of launch activities or other disruptive event(s);

(C) Movements of pinnipeds, including number and proportion moving, direction and distance moved, and pace of movement;

(D) Description of reactions;

(E) Minimum distances between interacting and reacting pinnipeds;

(F) Study location;

(G) Local time;

(H) Substratum type;

(I) Substratum slope;

(J) Weather condition;

(K) Horizontal visibility; and

(L) Tide state.

(2) Acoustic monitoring. (i) During all target missile launches, calibrated recordings of the levels and characteristics of the received launch sounds will be obtained from three different locations of varying distances from the target missile's flight path. To the extent practicable, these acoustic recording locations will correspond with the haul-out sites where video and human observer monitoring is done.

(ii) Acoustic recordings will be supplemented by the use of radar and telemetry systems to obtain the trajectory of target missiles in three dimensions.

(iii) Acoustic equipment used to record launch sounds will be suitable for collecting a wide range of parameters, including the magnitude, characteristics, and duration of each target missile.

(e) The holder of the Letter of Authorization must implement the following reporting requirements:

(1) For each target missile launch, the lead contractor or lead observer for the holder of the Letter of Authorization must provide a status report to NMFS, West Coast Regional Office, providing reporting items found under the Letter of Authorization, unless other arrangements for monitoring are agreed upon in writing.

(2) The Navy shall submit an annual report describing their activities and including the following information:

(i) Timing, number, and nature of launch operations;

(ii) Summary of mitigation and monitoring implementation;

(iii) Summary of pinniped behavioral observations; and

(iv) Estimate of the amount and nature of all takes by harassment or by other means.

(3) The Navy shall submit a draft comprehensive technical report to the Office of Protected Resources and West Coast Regional Office, NMFS, 180 days prior to the expiration of the regulations in this subpart, providing full documentation of the methods, results, and interpretation of all monitoring tasks for launches to date plus preliminary information for missile launches during the first 6 months of the regulations.

(4) A revised final comprehensive technical report, including all monitoring results during the entire period of validity of the Letter of Authorization, will be due 90 days after the end of the period of effectiveness of the regulations in this subpart.

(5) The final report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final comprehensive technical report prior to acceptance by NMFS.

(f) Activities related to the monitoring described in paragraphs (c) and (d) of this section, or in the Letter of Authorization issued under §§216.106 and 217.57 of this chapter, including the retention of marine mammals, may be conducted without the need for a separate scientific research permit.

(g) In coordination and compliance with appropriate Navy regulations, the NMFS may, at its discretion, place an observer on San Nicolas Island for any activity involved in marine mammal monitoring either prior to, during, or after a missile launch in order to monitor the impact on marine mammals.

§217.56 Applications for Letters of Authorization.

To incidentally take marine mammals pursuant to the regulations in this subpart, the U.S. citizen (as defined by §216.6 of this chapter) conducting the activity identified in §217.50 (the U.S. Navy) must apply for and obtain either an initial LOA in accordance with §217.57 or a renewal under §217.58.

§217.57 Letters of Authorization.

(a) A Letter of Authorization, unless suspended or revoked, will be valid for a period of time not to exceed the period of validity of this subpart.

(b) Each Letter of Authorization will set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact on the species, its habitat, and on the availability of the species for subsistence uses (i.e., mitigation); and

(3) Requirements for mitigation, monitoring, and reporting.

(c) Issuance and renewal of the Letter of Authorization will be based on a determination that the total number of marine mammals taken by the activity as a whole will have no more than a negligible impact on the affected species or stock of marine mammal(s).

§217.58 Renewals and Modifications of Letters of Authorization.

(a) A Letter of Authorization issued under §§216.106 and 217.57 of this chapter for the activity identified in §217.50 will be renewed or modified upon request of the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision of this chapter), and;

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For LOA modification or renewal requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting measures (excluding changes made pursuant to the adaptive management provision of this chapter) that do not change the findings made for the regulations or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the Federal Register, including the associated analysis illustrating the change, and solicit public comments before issuing the LOA.

(c) An LOA issued under §§216.106 and 217.57 of this chapter for the activity identified in §217.50 may be modified by NMFS under the following circumstances:

(1) Adaptive management. NMFS may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with the Navy regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations.

(i) Possible sources of data could contribute to the decision to modify the mitigation, monitoring, and reporting measures in an LOA:

(A) Results from the Navy's monitoring from the previous year(s);

(B) Results from other marine mammal and/or sound research or studies; or

(C) Any information that reveals marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOAs.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of proposed LOA in the Federal Register and solicit public comment.

(2) Emergencies. If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in §217.50(b), a Letter of Authorization may be modified without prior notice or opportunity for public comment. Notice would be published in the Federal Register within 30 days of the action

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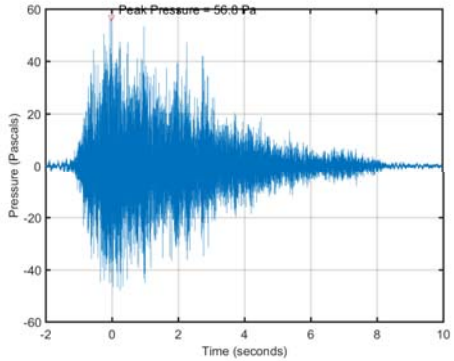
APPENDIX B:
ACOUSTIC DATA
FOR MISSILE LAUNCHES BETWEEN
DECEMBER 2015 – NOVEMBER 2016



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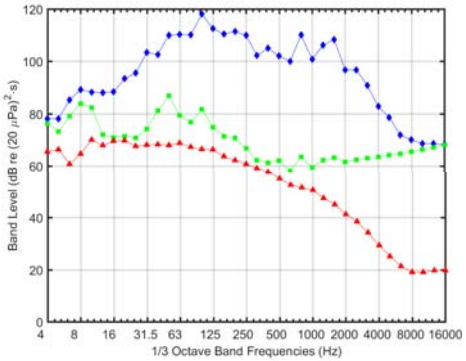
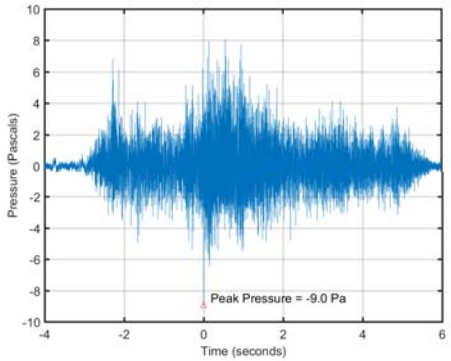


Vizcaino Point - B



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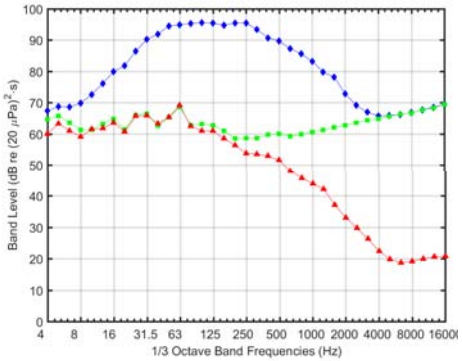

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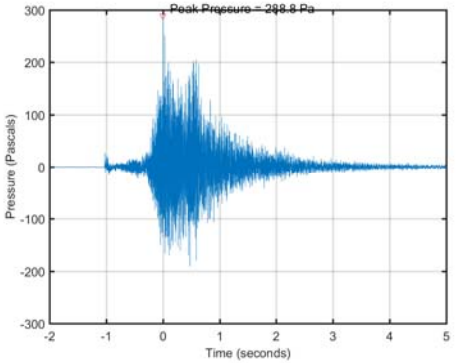
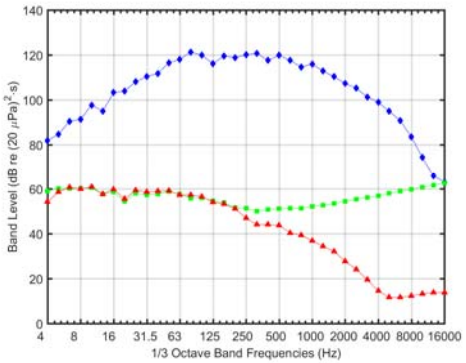
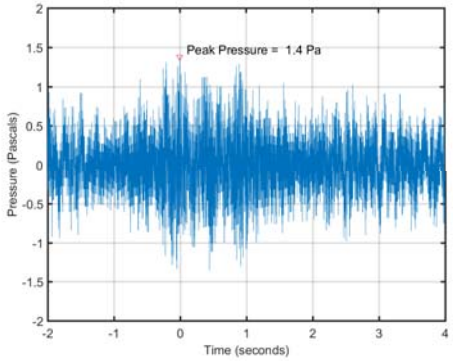


B809 - A



B809 - B

FIGURE 1. (A) Pressure waveform and (B) one-third octave band levels for an SM-3 Block IIA flight at 06:00:00 on 8 December 2015.
In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).



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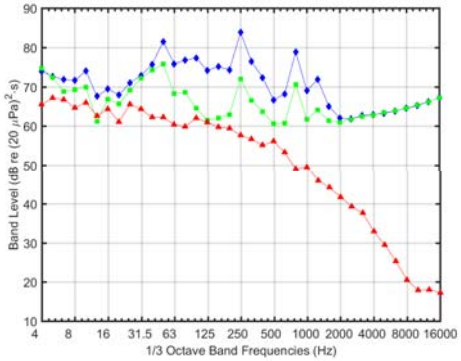

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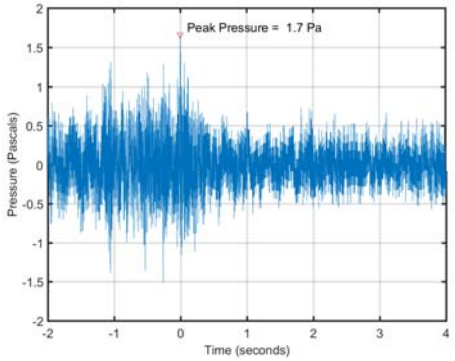

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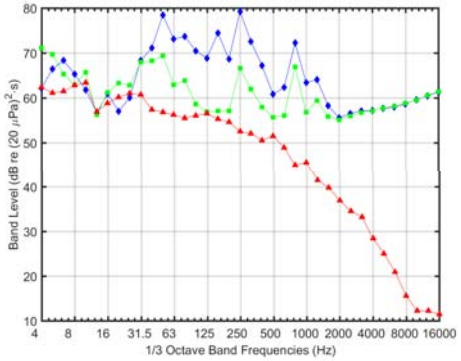

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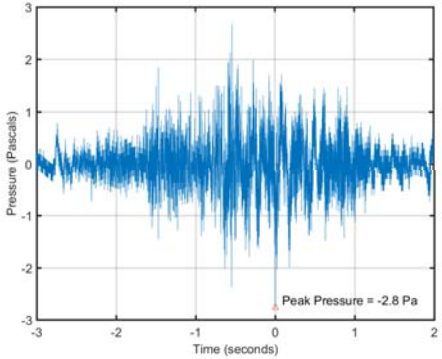

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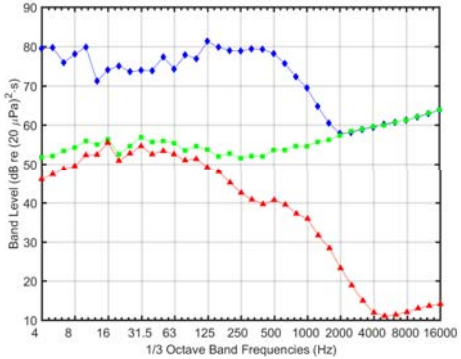

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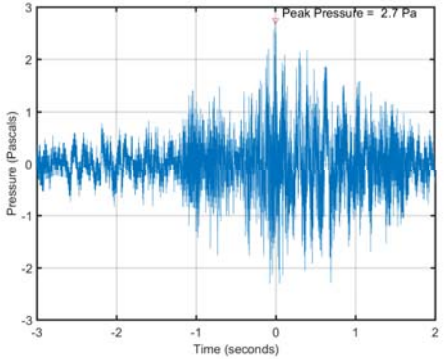

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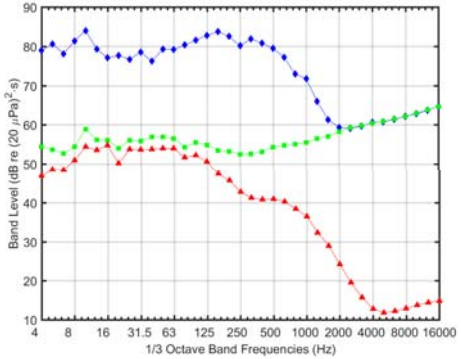

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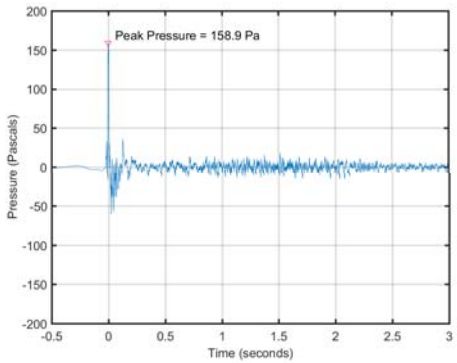

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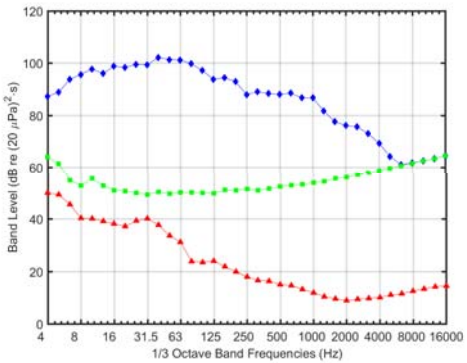

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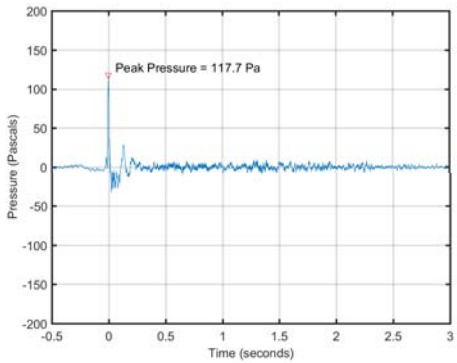

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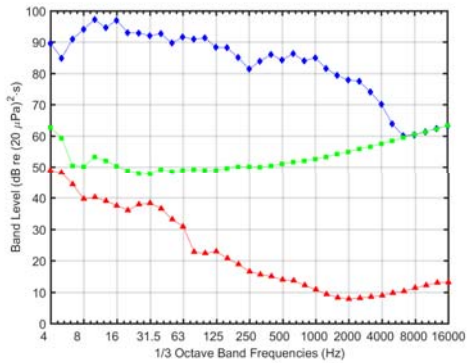
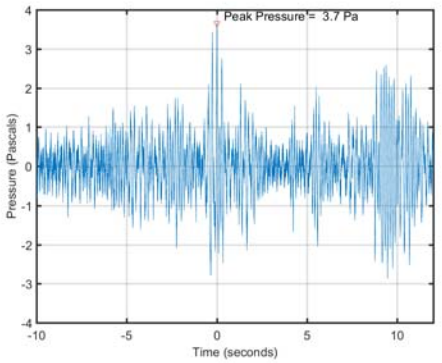


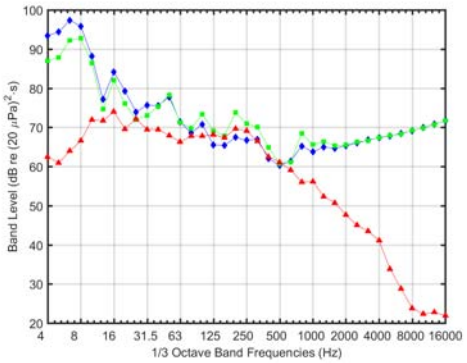
Alpha Pad (2/2) - B

FIGURE 2. (A) Pressure waveform and (B) one-third octave band levels for a GQM x 2 flight at 14:00:00 on 17 December 2015.

In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).



Vizcaino Point - A



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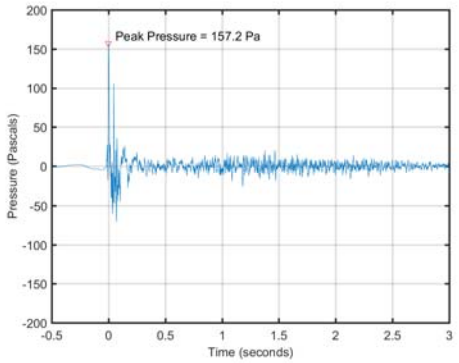

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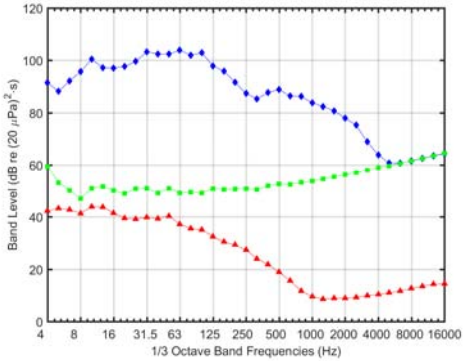

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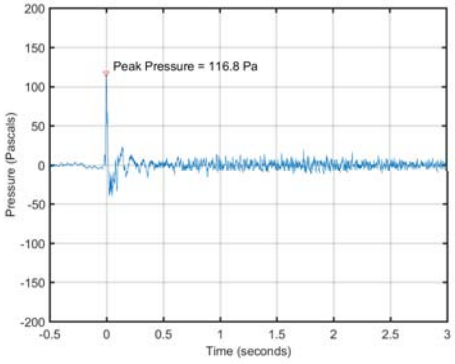

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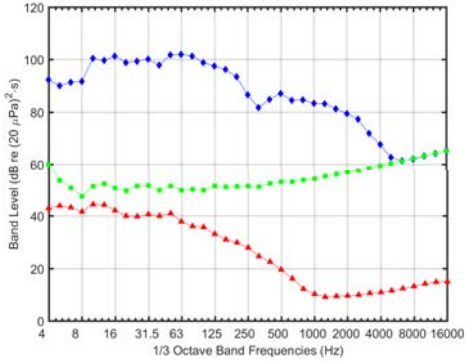
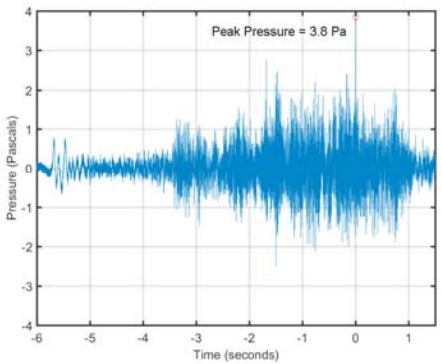


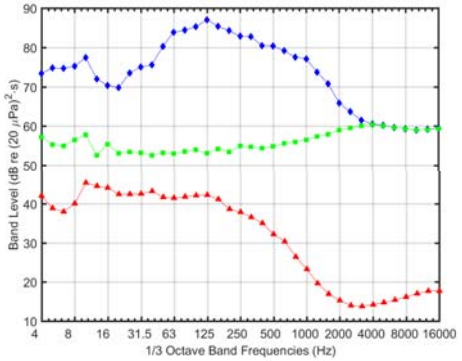
Alpha Pad (2/2) - B

FIGURE 3. (A) Pressure waveform and (B) one-third octave band levels for a GQM x 2 flight at 10:45:00 on 4 February 2016.

In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).



Pirates Cove (1/2) - A



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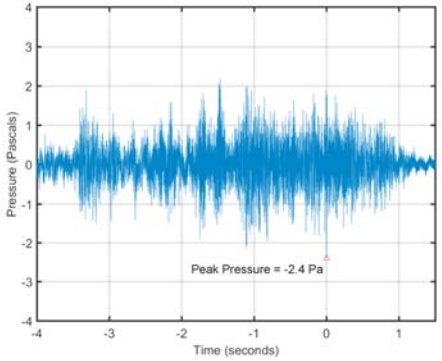

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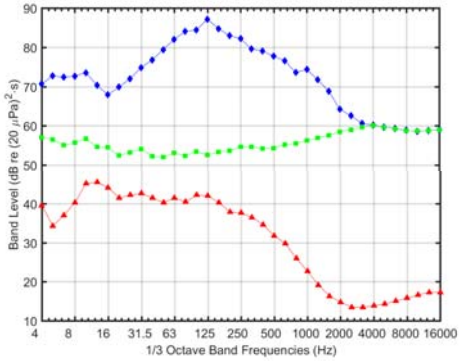
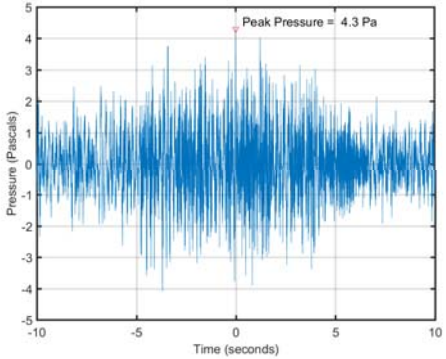
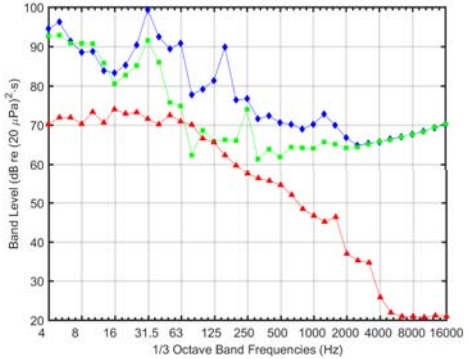


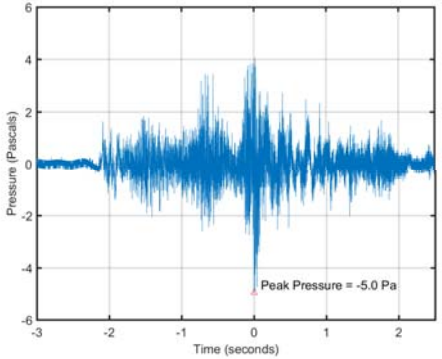
Pirates Cove (2/2) - B



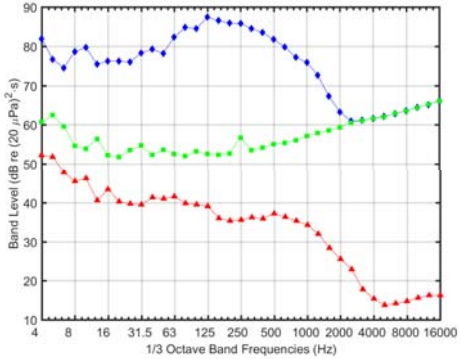
Dos Coves - A



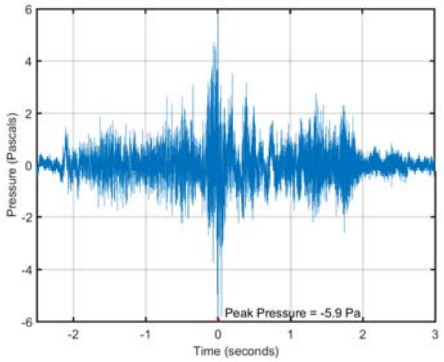
Dos Coves - B



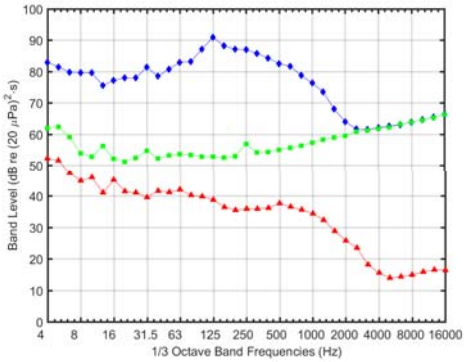
B809 (1/2) - A



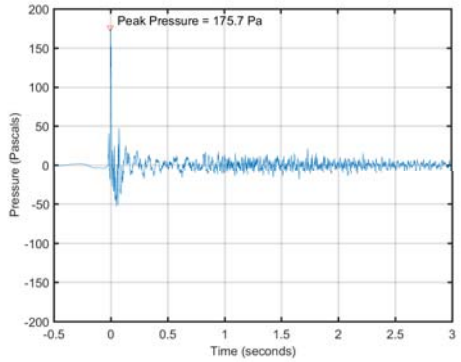
B809 (1/2) - B



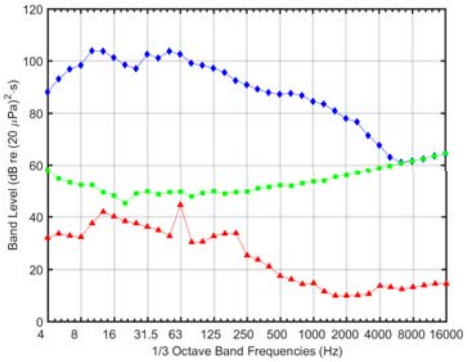
B809 (2/2) - A



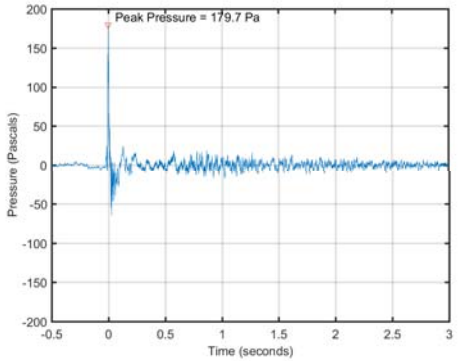
B809 (2/2) - B



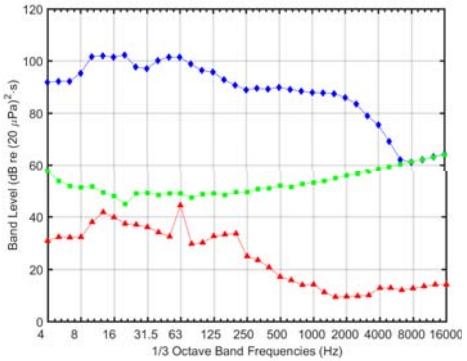
Alpha Pad (1/2) - A



Alpha Pad (1/2) - B

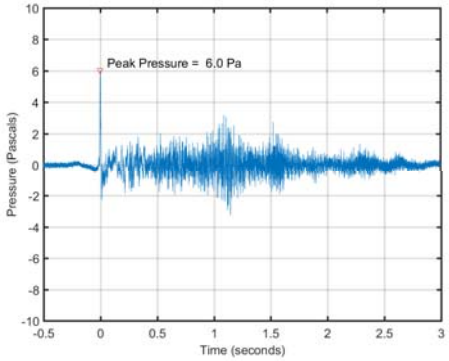


Alpha Pad (2/2) - A

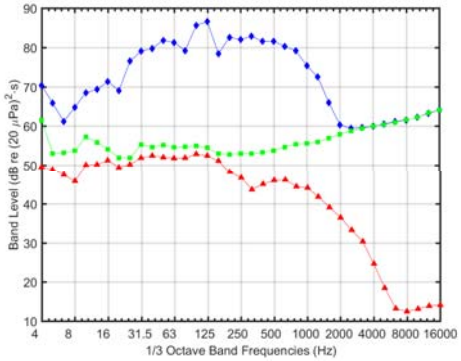


Alpha Pad (2/2) - B

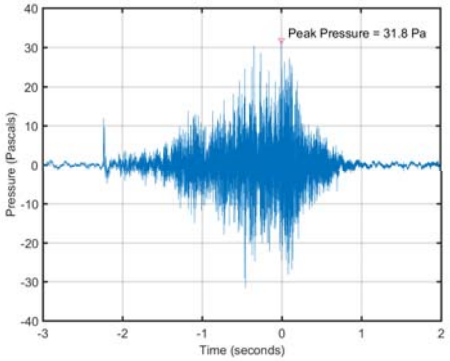
FIGURE 4 [continued]. (A) Pressure waveform and (B) one-third octave band levels for a GQM x 2 flight at 10:50:00 on 7 April 2016.
In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).



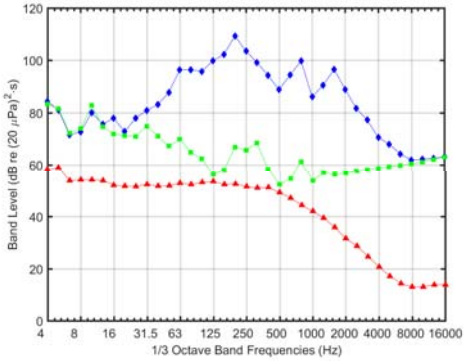
B809 - A



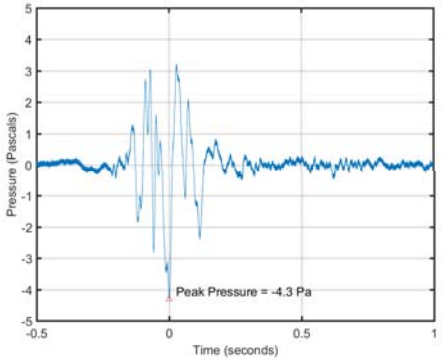
B809 - B



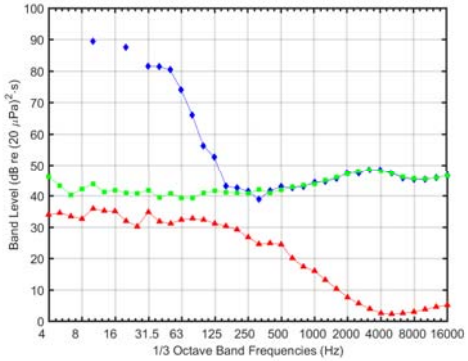
Dos Coves - A



Dos Coves - B



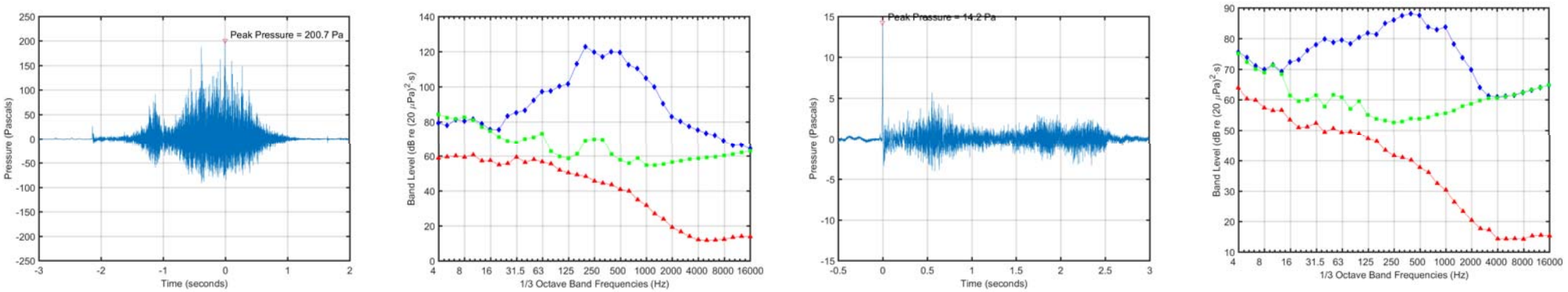
Phoca Reef - A



Phoca Reef - B

FIGURE 5. (A) Pressure waveform and (B) one-third octave band levels for a JDF – KAI flight at 12:35:00 on 19 October 2016.

In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).



Dos Coves – A Dos Coves - B B809 - A B809 - B

FIGURE 6. (A) Pressure waveform and (B) one-third octave band levels for a JDF – KAI flight at 14:55:00 on 27 October 2016.

In (B), ◊ = missile sound energy; □ = instrumentation noise energy; Δ = ambient noise power. Band frequencies in Hertz (Hz).