APPLICATION FOR AN INCIDENTAL HARASSMENT AUTHORIZATION UNDER THE MARINE MAMMAL PROTECTION ACT FOR MARINE MAMMALS FROM TARGET AND MISSILE LAUNCH ACTIVITIES AT SAN NICOLAS ISLAND, CALIFORNIA

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Acronyms and Abbreviations

Acronym	Definition
3-D	three-dimensional
ATARs	Autonomous Terrestrial Acoustic Recorders
CFR	Code of Federal Regulations
CPA	closest point of approach
dB	decibel
dBA	A-weighted decibels
dB re 20µPa	decibels referenced at 20 micropascals
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FLIR	Forward-Looking Infrared Radiometer
FR	Federal Register
HAPC	Habitat Areas of Particular Concern
Hz	hertz
IHA	Incidental Harassment Authorization
kg	kilograms
kHz	kilohertz
km	kilometer(s)
LOA	Letter of Authorization
m	meter(s)
µPa	micropascals
MMPA	Marine Mammal Protection Act
Mpa	Weighting function for pinnipeds in air
MSST	Multi-Stage Sea Skimming Target
N/A	not applicable, not available
NAWCWD	Naval Air Warfare Center Weapons Division
Navy	United States Navy
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PMSR	Point Mugu Sea Range
PTS	permanent threshold shift
RAM	Rolling Airframe Missile
s	second(s)
SCB	Southern California Bight
SEL	Sound Exposure Level
SEL-f	flat-weighted Sound Exposure Level
SM	Standard Missile
SNI	San Nicolas Island
SSST	Supersonic Sea-Skimming Target
SPL-A	A-weighted Sound Pressure Levels
SPL-f	flat-weighted Sound Pressure Levels
SWFSC	Southwest Fisheries Science Center
TTS	temporary threshold shift
U.S.	United States
VAFB	Vandenberg Air Force Base

Chapter 1 Description of Specified Activity

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 Introduction

The United States (U.S.) Navy's (Navy) Naval Air Warfare Center Weapons Division (NAWCWD) is submitting a request for an Incidental Harassment Authorization (IHA) for the incidental take of marine mammals resulting from proposed launch activities on San Nicolas Island (SNI), California. These activities are a continuation of the NAWCWD launch program for missiles and targets at SNI to support test and training activities associated with operations on the NAWCWD Point Mugu Sea Range (PMSR) (Figure 1-1). The PMSR is used by the United States and allied military services to test and evaluate sea, land, and air weapon systems; to provide realistic training opportunities; and to maintain operational readiness of these forces.

NAWCWD proposes to conduct up to 40 missile launch events from SNI per year, but the annual total may be less than 40 depending on operational requirements. Launch timing will be determined by operational, meteorological, and logistical factors. Up to 10 of the 40 launches per year may occur at night, but this is also dependent on operational requirements and only conducted when required by test objectives. Some launch events involve a single missile, while others involve the launch of multiple missiles in quick succession. The missiles are launched from one of several fixed locations on the western end of SNI and fly generally westward through the PMSR. The primary launch locations are the Alpha Launch Complex, located 190 meters (m) above sea level on the west-central part of SNI and the Building 807 Launch Complex, at the western end of SNI at approximately 11 m above sea level. Launch sites and pinniped haul-out areas on SNI are also shown in Figure 1-2. A description of the representative types of missiles that may be launched is provided in the sections below.

Aircraft and helicopter flights between the Point Mugu airfield on the mainland, the airfield on SNI, and the target sites in the PMSR will be a routine part of a planned launch operation. Aircraft and helicopters will maintain a minimum altitude of 305 m from pinniped haul-outs and rookeries, with some exceptions, like emergencies (Chapter 11). Movements of personnel are restricted near the launch sites at least several hours prior to a launch for safety reasons. No personnel are allowed on the western end of SNI during launches. Movements of personnel or missiles near pinniped haul-out sites and rookeries are also restricted at other times of the year.

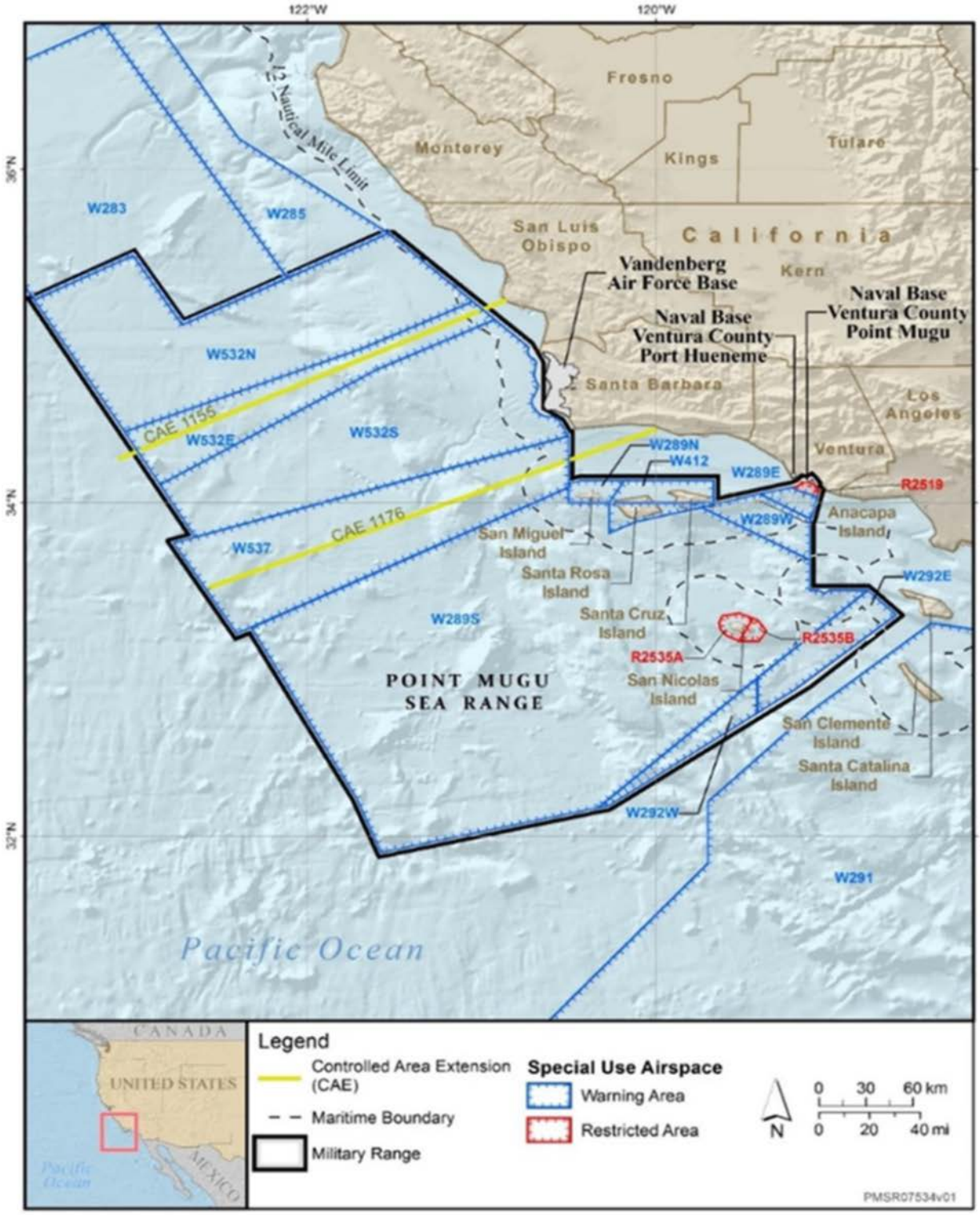

Figure 1-1. Regional site map of the Point Mugu Sea Range and SNI.

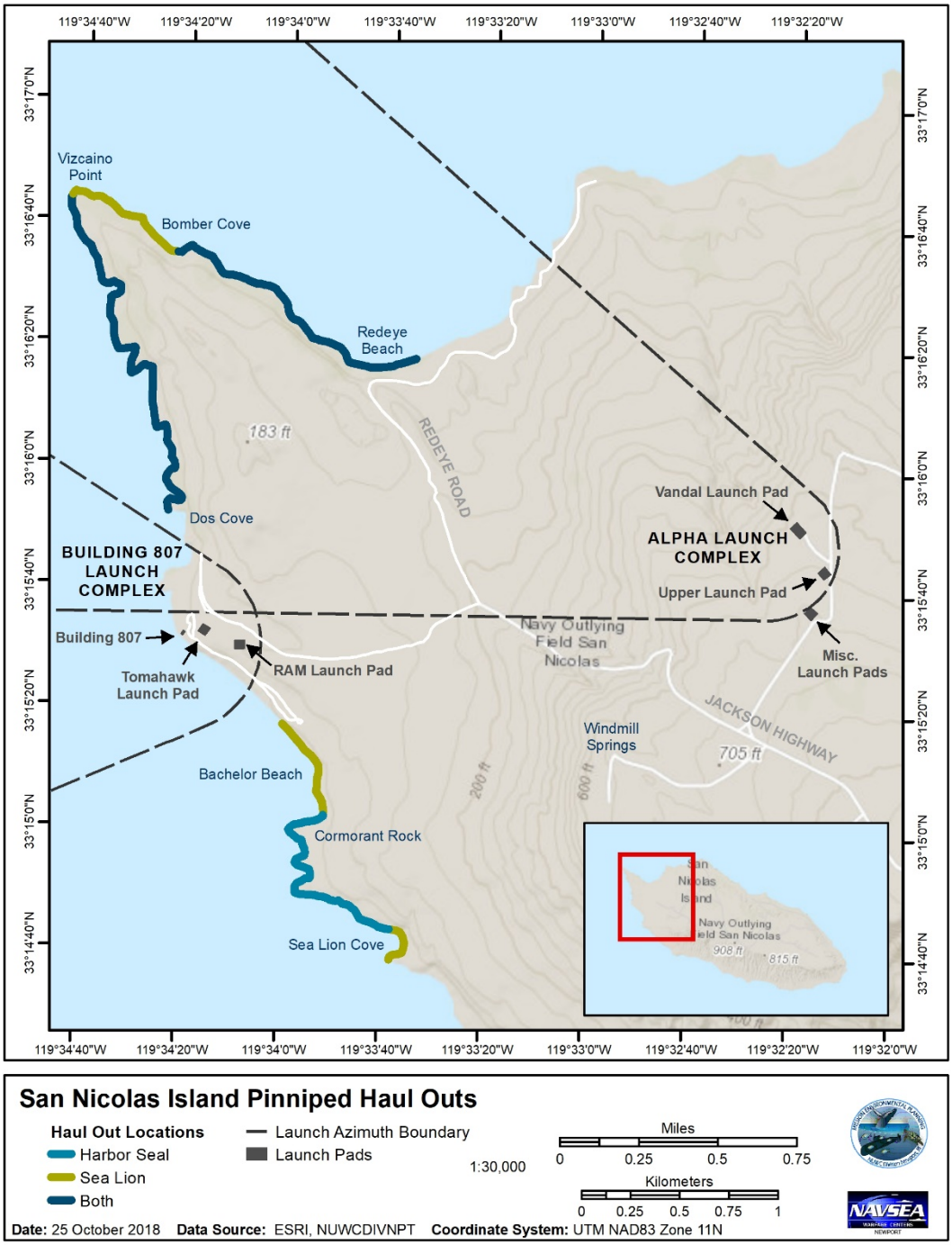

Figure 1-2. Map of SNI showing the Alpha Launch Complex, Building 807 Launch Complex, anticipated launch azimuths (dashed lines), and the names of adjacent beaches on which pinnipeds are known to haul out.

1.2 Missile Descriptions

Missiles are rocket-propelled weapons designed to deliver an explosive warhead with accuracy at high speed. Missiles vary from small tactical weapons that are effective out to only a few hundred feet to much larger strategic weapons that have ranges of several thousand miles. Almost all missiles contain some form of guidance and control mechanism and are therefore often referred to as guided missiles. Guided missiles have four system components: targeting or missile guidance, flight system, engine, and warhead. A guided missile powered along a low, level flight path by an air-breathing jet engine is called a cruise missile. An unguided military missile, as well as any launch vehicle is usually referred to as a rocket. Tactical guided missiles are generally categorized according to the location of the launch platform and target. There are five types: air-to-air, air-to-surface, surface-to-air, anti-ship, and anti-tank, or assault.

Missiles can be propelled by either liquid-fueled or solid-fueled rocket engines; however, solid fuel is preferred for military uses. Such engines commonly propel tactical guided missiles (i.e., missiles intended for use within the immediate area) toward their targets at twice the speed of sound. Cruise or ballistic missiles are designed to strike targets far beyond the immediate area, and are therefore also known as strategic missiles. Cruise missiles are jet-propelled at subsonic speeds throughout their flights, while ballistic missiles are rocket-powered only in the initial (boost) phase of flight, after which they follow an arcing trajectory to the target. As gravity pulls the ballistic warhead back to Earth, speeds of several times the speed of sound are reached. Ballistic missiles are most often categorized as short-range, medium-range, intermediate-range, and intercontinental ballistic missiles. Missiles weights range between 54-2,900 kilograms (kg), but total weight is dependent on fuel or boosters. The following missile descriptions are representative of some of the types of missiles typically launched from SNI. While, this list is not inclusive of all potential missiles that could be launched annually, the descriptions and the sound profiles, are representative of the diversity of the types of missiles typically launched.

1.2.1 Rolling Airframe Missile (RAM)

At SNI, RAMs are launched from the Building 807 Launch Complex, near the shoreline. Previous RAM launches have resulted in flat-weighted sound pressure levels (SPL-f) up to 126 decibels referenced at 20 microPascal (dB re 20 µPa[1]) near the launcher and 99 dB re 20 µPa at a nearshore site located 1.6 kilometers (km) from the three-dimensional (3-D) closest point of approach (CPA) (Holst et al. 2005a; Holst et al. 2008). Flat-weighted Sound Exposure Level (SEL-f) ranged from 84 to 97 dB re 20 $\mu Pa^2 \cdot s$, and Sound Exposure Levels (SELs) M-weighted for pinnipeds in air (Mpa; acoustic weighting function specific to pinniped hearing ability in air) were 76 to 96 dB re 20 $\mu Pa^2 \cdot s$. Peak pressure ranged from 104 to 117 dB re 20 µPa.

1.2.2 GQM-163A "Coyote"

The Coyote, designated GQM-163A, is an expendable Supersonic Sea-Skimming Target (SSST) powered by a ducted-rocket ramjet (Figure 1-3). This missile is designed to provide a ground-launched, aerial target system to simulate a supersonic, sea-skimming Anti-Ship Cruise missile threat.

[1] The reference sound pressure (20 µPa) is standard for airborne sounds.

The Coyote utilizes a previously installed launcher at the Alpha Launch Complex on SNI with a Launcher Interface Kit (Figure 1-3). Previous Coyote launches produced SPL-f of 113–118 dB re 20 $\mu Pa^2 \cdot s$ at distances of 0.8–1.7 km from the CPA of the vehicle (Ugoretz 2016; Ugoretz and Greene Jr. 2012), and 82–93 dB at CPAs of 2.4–3.2 km (Holst et al. 2005a; Holst et al. 2008). SEL-f ranged from 87 to 119 dB re 20 $\mu Pa^2 \cdot s$. M-weighted SELs ranged from 60 to 114 dB re 20 $\mu Pa^2 \cdot s$, and peak pressures ranged from 100 to 144 dB re 20 µPa.

Figure 1-3. Coyote missile with booster and launcher at the Alpha Launch Complex on SNI (photograph by U.S. Navy).

1.2.3 Multi-Stage Sea Skimming Target (MSST)

The Multi-Stage Sea Skimming Target (MSST) is a subsonic cruise missile with a supersonic terminal stage that approaches its target at low-level at Mach 2.8. The MSST is launched from the Alpha Launch Complex on SNI. Previous MSST Launches had SPL-f values of 78.7–96.6 dB re 20 µPa and SEL-M values of 62.3–83.3 re 20 $\mu Pa^2 \cdot s$ at sites 1.3-2.7 km from the CPA (Holst et al. 2011; Ugoretz and Greene Jr. 2012).

1.2.4 Standard Missile (SM-2, SM-3, SM-6)

The Standard family of missiles consists of a range of air defense missiles including supersonic, medium, and extended range surface-to-air and surface-to-surface missiles. The Standard Missile 3 Block IIA (SM-3) is a ship-based missile system used to intercept short- to intermediate-range ballistic missiles as a part of Aegis Ballistic Missile Defense System. Although primarily designed as an antiballistic missile defensive weapon, the SM-3 has also been employed in an anti-satellite capacity against a satellite at the lower end of low Earth orbit. Similarly, the SM-6 is a vertically launched, extended range missile compatible with the Aegis Weapon System to be used against extended range threats. The SM-6 Block I/IA combines the tested legacy of the SM-2 propulsion system and warhead with an active radio frequency seeker modified from the AIM-120 Advanced Medium Range Air-to-Air Missile. The new features allow for over-the-horizon engagements, enhanced capability at extended ranges and

increased firepower. To date, only the SM-3 has been launched from SNI, with recorded SPL-f values of 128.1-143.3 dB re 20 µPa and SEL-M values of 124.3-126.2 dB re 20 $\mu Pa^2 \cdot s$ at sites 1.3-2.7 km from the CPA (Ugoretz J. 2015).

1.2.5 Other Missiles That May Be Used During Launch Events

The Navy may also launch other missiles to simulate various types of threat missiles and aircraft and to test other systems. For example, on 23 August 2002, a Tactical Tomahawk was launched from Building 807 Launch Complex. The Tomahawk produced an SPL-f of 93 dB re 20 µPa, an SEL-f of 107 dB re 20 µPa2·s, and an Mpa-weighted SEL of 105 dB re 20 µPa2·s at a distance of 539 m from the CPA; the peak pressure was 111 dB re 20 µPa. A Falcon was launched from the Alpha Launch Complex on 6 April 2006; it produced an SPL-f of 84 dB re 20 µPa, an SEL-f of 88 dB re 20 µPa, and a Mpa-weighted SEL of 82 dB re 20 µPa. Near the launcher, the SPL-f was 128 dB re 20 µPa, SEL-f was 126 dB re 20 µPa, and Mpa-weighted SEL was 125 dB re 20 µPa.

Missiles of the BQM-34, BQM-74, or BQM-177 aerial target type could also be launched. These are small, unmanned aircraft that are launched using jet-assisted take-off rocket bottles; they then continue offshore powered by small turbojet engines. Burgess and Greene (1998) reported that A-weighted SPLs (SPL-A) ranged from 92 A-weighted decibels (dBA) re 20 µPa at a CPA of 370 m to 145 dB at 15 m for a launch on 18 November 1997. If launches of other missile types occur, they would be included within the total of 40 launches anticipated per year. It is possible that launch trajectories could include a wider range of angles than shown on Figure 1-2; however, it should not influence the number of animals expected to be incidentally taken under this IHA request as no additional pinniped haul out sites would be impacted (see Chapter 6 for take estimates).

Chapter 2 Dates, Duration, and Specified Geographical Region

The date(s) and duration of such activity and the specified geographical region where it will occur.

2.1 Dates

NAWCWD seeks an incidental take authorization for specific launch activities at SNI for a minimum of one year, commencing in June 4, 2019[2].

2.2 Duration

The timing of launch activities is variable and subject to test and training requirements, and meteorological and logistical limitations. To meet the Navy's operational testing and training requirements, launches may be required at any time of year and at any time during the day or night.

Although no more than 25 launches have occurred in any single year since 2001, it is anticipated that there could be up to 40 missile launch events from SNI in one year, depending on operational requirements. On occasion, two or more missiles may be launched in quick succession during a single launch event. Table 2-1 provides the total number of launches that have occurred since 2001.

Given the launch acceleration and flight speed of the missiles, most launch events are of extremely short duration. Strong launch sounds are typically detectable near the beaches at western SNI for no more than a few seconds per launch (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2005b). All flights over SNI would be subsonic; therefore, there would be no sonic booms impacting the haul out sites on SNI.

Table 2-1. Historical number of launches at SNI.

Time Period	*Number of Launches*
August 2001 to October 2005	69
February 2006 to December 2009	11
January 2010 to December 2014	36
December 2015 to November 2018	30

References: (Burke 2017; Holst et al. 2005a; Holst et al. 2005b; Holst et al. 2008; Holst et al. 2010; Ugoretz and Greene Jr. 2012; Ugoretz 2014; Ugoretz 2016; Sanders 2018 (pers. comm.)

[2] 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 SNI, California. This LOA spans the period of June 4, 2014 through June 3, 2019.

2.3 Region of Activity

Figure 1-1 provides a regional site map of the PMSR, SNI, and launch locations. A more detailed description of the island and proposed launch activities are provided later in this section, in the PMSR Final Environmental Impact Statement/Overseas Environmental Impact Statement (Department of the Navy 2002), and in reports on previous missile launch monitoring periods from 2001 through 2017. The primary launch locations are the Alpha Launch Complex located 190 m above sea level on the west-central part of SNI, the Building 807 Launch Complex at the western end of SNI at approximately 11 m above sea level, as well as other launch pads nearby these locations.

As described in Chapter 1, the launches will occur from the western part of SNI and the specific location (activity area) where "take" of marine mammals, specifically pinnipeds, may occur is on and around the western side of SNI (Figure 1-2). SNI is one of the eight Channel Islands in the Southern California Bight (SCB), located approximately 105 km southwest of Point Mugu (Figure 1-1). Missiles launched from SNI fly generally southwest, west, or northwest through the PMSR.

Chapter 3 Species and Numbers of Marine Mammals

The species and numbers of marine mammals likely to be found within the activity area.

Many of the beaches and rocky outcroppings around the perimeter of SNI are pinniped resting, molting, or breeding sites. The activity area, specifically the Alpha Launch Complex is approximately 2 km from the nearest beach where pinnipeds are known to routinely haul out (Figure 1-2). The Building 807 Launch Complex accommodates several fixed and mobile launchers, where the nearest is 30 m from the shoreline and the farthest is 150 m. However, few pinnipeds are known to haul out on the shoreline immediately adjacent to this launch site.

Six species, stocks, or Distinct Population Segments (DPSs) of pinnipeds have been observed on SNI (Table 3-1). Marine mammal species likelihood of occurrence is designated as “unlikely,” “potential” or “likely,” based on a review of National Marine Fisheries Service (NMFS) Stock Assessment Reports, species-specific literature research, and SNI monitoring reports. “Unlikely” means occurrence is not expected, “potential” means the species may occur or there is casual occurrence history, and “likely” means there is a strong possibility of or regular occurrence on SNI.

The three marine mammal species likely to occur on shore in the activity area either regularly or in large numbers during certain times of the year are California sea lions (*Zalophus californianus*), northern elephant seals (*Mirounga angustirostris*), and Pacific harbor seals (*Phoca vitulina richardii*). An additional three pinniped species haul out rarely or occasionally on SNI. These include the northern fur seal (*Callorhinus ursinus*), the Guadalupe fur seal (*Arctocephalus townsendi*), and the Steller sea lion (*Eumetopias jubatus*). Table 3-1 summarizes the status of marine mammal stocks potentially on SNI.

An IHA is being sought for California sea lions and harbor seals (see Chapter 4). Past monitoring has shown that northern elephant seals on SNI beaches showed little response to missile launch events (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2005b); therefore, northern elephant seals are not included in this IHA request (Section 3.1.1). Northern fur seals (Section 3.1.2), Guadalupe fur seals (Section 3.1.3), and Steller sea lions (Section 3.1.4) are unlikely to occur on shore in the activity area and are highly unlikely to be affected by launch activities (Section 3.1).

Table 3-1. Marine Mammal Species That May Occur On San Nicolas Island

Common Name	***Scientific Name***	***Endangered Species Act Status***	***Stock or Distinct Population Segment***	***Population Abundance***	***Potential Biological Removal (PBR)***	***Occurrence At San Nicolas Island***
Pacific harbor seal	*Phoca vitulina richardii*	N/A	California	30,968	1,641	Likely Year-round occurrence, numerous haul out sites for resting and pupping on SNI (Lowry et al. 2017b)
Northern elephant seal	*Mirounga angustirostris*	N/A	California breeding	179,000	4,882	Likely Year-round occurrence, numerous haul out sites for resting and pupping on SNI (Lowry et al. 2017b)
California sea lion	*Zalophus californianus*	N/A	United States	296,750	9,200	Likely Year-round occurrence, numerous haul out sites for resting and pupping on SNI (Lowry et al. 2017b)
Steller sea lion	*Eumetopias jubatus*	N/A	Eastern stock	41,638	2,498	Unlikely Rare on northern Channel Islands, nearest breeding rookery is in Northern California
Northern fur seal	*Callorhinus ursinus*	N/A	California	14,050	451	Unlikely Hauls out on the northwestern most Channel Island, San Miguel, migrates and forages north of San Miguel Island (Antonelis et al. 1990; Lea et al. 2009; Melin et al. 2012)
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened	Mexico to California	20,000	542	Potential Hauls out to rest and occasionally pups on San Miguel Island, forages and migrates through SCB

3.1 Marine Mammals That May Occur in the Area, But Will Not Be Impacted by the Specified Activity

3.1.1 Northern elephant seal

The northern elephant seal (*Mirounga angustirostris*) is not listed under the Endangered Species Act (ESA), and the California breeding stock, which occurs on SNI, is not considered a strategic stock under the Marine Mammal Protection Act (MMPA). Northern elephant seals breed and give birth in California and Baja California (Mexico), primarily on offshore islands (Stewart et al. 1994), from December to March (Stewart and Huber 1993). Adults return to land between March and August to molt, with males returning later than females. Adults return to their feeding areas again between their spring/summer molting and their winter breeding seasons. Although movement and genetic exchange continues between rookeries, most elephant seals return to natal rookeries when they start breeding (Huber 1991). The California breeding population is now demographically isolated from the Baja California population.

Populations of northern elephant seals have recovered after being nearly hunted to extinction (Stewart et al. 1994). Lowry et al. (2014), using total pup counts, calculated a U.S. population estimate of approximately 179,000 elephant seals. An annual growth rate of 17 percent for elephant seals in the U.S. from 1958 to 1987 (Figure 3-1) is reported by Lowry et al. (2014), but some of this growth is likely due to immigration of animals from Mexico and the consequences of a small population recovering from past exploitation (Carretta et al. 2017). From 1988 to 2010, the U.S. population is estimated to have grown 3.8 percent annually (Lowry et al. 2014).

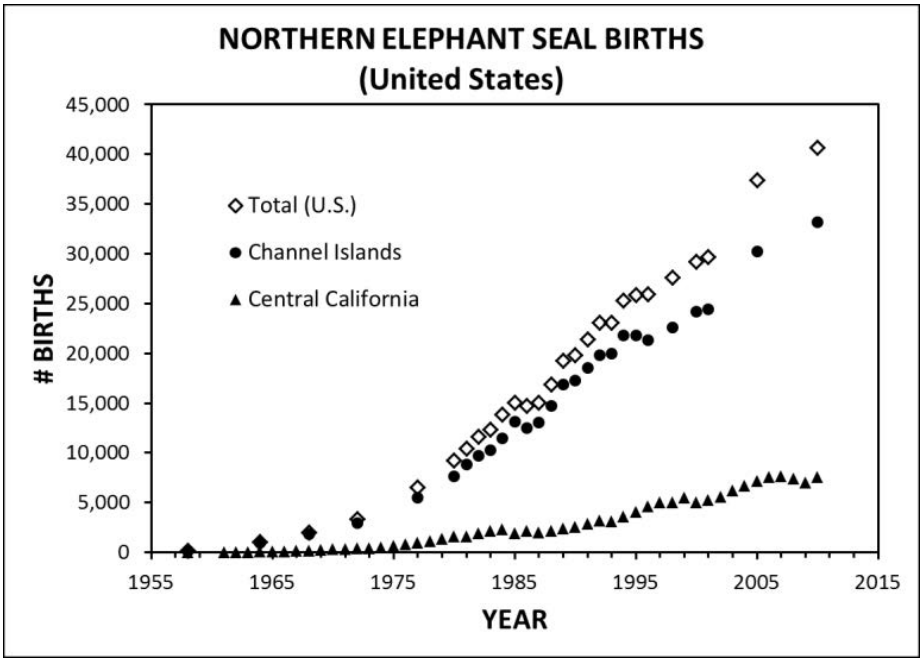

Figure 3-1. Estimated number of northern elephant seal births in California 1958–2010. Multiple independent estimates are presented for the Channel Islands 1988-91.
Reference: Estimates are from Lowry et al. (2014) in Carretta et al. (2017).

Increasing numbers of elephant seals haul out at various sites around SNI, including the western part of the island. SNI is currently the second largest elephant seal rookery and haul-out in Southern California (Lowry et al. 2017b). In July 2015, when all of the Channel Islands were surveyed for elephant seals, approximately 62 percent of elephant seals hauled out on San Miguel Island, approximately 20.5 percent on SNI, and 17 percent on Santa Rosa Island. The timing of haul out by various age and sex categories of seals is reflected in the bi-modal peak pattern in the counts of hauled-out elephant seals on the island (Stewart and Yochem 1984).

The breeding season starts in early December with the arrival of adult males. Older bulls tend to arrive the earliest. By the end of December, all bulls are hauled out at the rookeries. Younger adult males begin to leave the rookery in late February, but some of the older males remain there until late March (Clinton 1994). Pregnant females begin to arrive in mid-December and peak numbers are present at the end of January and in early February. Females have their pups shortly after arriving at the rookery. Numbers of females then begin to decline the first week in March when they have left the rookery to return to sea to feed. Pupping occurs on beaches at SNI from January to early February, and pups are typically weaned through March. During this period, they undergo their first molt (Le Boeuf and Laws 1994). By the end of April, 80 percent of pups have left the rookery, and the remainder leave in May.

The female and juvenile molt period starts in mid-March and extends through May. Most females that weaned their pups 6–8 weeks earlier return from northern feeding areas to molt. However, some females and juveniles from SNI rookeries apparently molt farther north (i.e., at Año Nuevo, CA) rather than return to their natal rookeries (Le Boeuf and Laws 1994). The molt takes approximately 1 month to complete, after which time the animals return to northern feeding areas until the next pupping/breeding season. Juveniles (1–4 years old) also molt at this time.

The male molt period occurs from June through August, when only adult males are present at haul-out sites. These are the same animals that were present at the rookeries during December to March. They return to their breeding rookeries to molt after feeding at sea for 3 to 4 months. Unlike the sequence during the breeding season, the younger males arrive at the molting sites first, and the older males arrive later in the summer (Clinton 1994). The juvenile haulout phase extends from September through November with pubertal subadult males arriving in November and remaining until December. The peak of juvenile haulout is in October and most (except for pubertal subadult males) have left by the time that adult males arrive in early December (Lowry et al. 2014).

Rationale for Exclusion

The NAWCWD's holds a Letter of Authorization (LOA) issued by NMFS allowing non-lethal takes of pinnipeds incidental to the Navy's missile launch operations on SNI. The LOA was issued pursuant to small take regulations found in 50 Code of Federal Regulations (CFR) 216.151–158 and §101(a)(5)(A) of the 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. In the Navy's previous LOA and Petition for Regulations that led to promulgation of 50 CFR 216.151–158, a Pinniped Monitoring Plan and subsequent report was proposed to NMFS. The Pinniped Monitoring Plan included 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 (IHAs were issued prior to the issuance of the first LOA). Pinniped species monitored on SNI during that period included the northern elephant seal as well as California sea lions and harbor seals.

NMFS defined 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 (65 Federal Register [FR] 34013; May 25, 2000)." As a corollary of that, NMFS stated 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 (67 FR 56271; September 3, 2002)." Based on previous monitoring and review of video recordings of pinnipeds at SNI during launch events, most elephant seals usually exhibited little (e.g., raised their heads briefly) to no reaction to launch events and those few that did exhibit a behavioral reaction, returned to pre-launch behavior within minutes after the launch (Holst et al. 2008; LGL Ltd. and Greenridge Sciences Inc. 2002). For example, northern elephant seals were observed at 2 sites during eight of 14 launch dates between 2001 and 2002 and most individuals raised their heads briefly upon hearing the launch sounds and then quickly returned to their previous activity pattern, usually sleeping or resting (LGL Ltd. and Greenridge Sciences Inc. 2002). During some launches, a small proportion of northern elephant seals on the beach repositioned or moved a short distance away from their resting site, but usually settled within minutes (Holst et al. 2004; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2005b; LGL Ltd. and Greenridge Sciences Inc. 2002).

Based on the result of previous monitoring efforts (Holst et al. 2004; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2005b; LGL Ltd. and Greenridge Sciences Inc. 2002), in June 2010, a revised Pinniped 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 (75 FR 28587; June 4, 2010) and issued the new LOA to

acknowledge the change. The Proposed Action described in Chapter 1 of this IHA request is similar to the Proposed Action described in the previous LOA (Department of the Navy 2014), where NMFS acknowledged the change in the Pinniped Monitoring Plan and acknowledged that elephant seals showed little to no reaction, i.e., no "take by harassment" from missile launch events.

As mentioned previously, peak abundance for northern elephant seals at SNI is during January and February (breeding season) and northern elephant seals also haul out during the molting periods in the spring and summer, and smaller numbers haul out at other times of year. The population of northern elephant seals on SNI is likely increasing, based on recent counts (Lowry, the National Oceanic and Atmospheric Administration [NOAA], pers. comm. 2018) and therefore, does not appear to be impacted by Navy activities, including launch events, that have been conducted at SNI. Given that elephant seals forage in areas that are a great distance from SNI and the PMSR, with adult males foraging as far north as the Aleutian Islands, and adult females in the north-central Pacific Ocean, it is unlikely that large numbers are present outside of the breeding season at PMSR at any one time. Taking into consideration the NMFS definition of a biologically significant response (65 FR 34013; May 25, 2000) and further clarification of what constitutes "take" under the MMPA (National Marine Fisheries Service 2002), no "take by harassment" of elephant seals is anticipated from launch events at SNI. Further, the National Defense Authorization Act (Public Law 108–136) removed the ''small numbers'' and ''specified geographical region'' limitations and amended the definition of ''harassment'' as it applies to a ''military readiness activity'' to read as follows (Section 3(18)(B) of the MMPA): (i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment]. Missile launch events conducted at SNI are considered a military readiness activity. NMFS has also defined ''negligible impact'' in 50 CFR 216.103 as: an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival. Because past monitoring has shown that northern elephant seals on SNI beaches showed little response to missile overflights as a result of the Proposed Action and would therefore be considered negligible, and that no take by harassment as defined under the MMPA or as it applies to a military readiness activity, an incidental take authorization is not being sought for northern elephant seals.

3.1.2 Northern fur seal

There are two stocks of northern fur seals (*Callorhinus ursinus*) recognized in the United States: The California stock (formally the San Miguel Island stock) and the Eastern Pacific stock, which primarily breeds on the Pribilof Islands in the Bering Sea. The California stock is not listed as threatened or endangered under the ESA, and it is not considered depleted under the MMPA. The California stock has an estimated population of 14,050 fur seals (13,384 from San Miguel Island and 666 from the Farallon Islands) (Carretta et al. 2017). The Eastern Pacific stock is not listed as threatened or endangered under the ESA but has been declining; it is considered depleted and designated a strategic stock (Muto et al. 2018). Adult females and pups migrate from the Bering Sea to California (Ream et al. 2005; Sterling et al. 2014). Thus, both stocks occur in the PMSR during autumn and winter, but only the California stock is found there during the May to November period. In winter, there may be as many as 44,641 northern fur seals in the waters of the PMSR, with most seen in offshore locations (Koski et al. 1998).

San Miguel Island and the adjacent Castle Rock are the only known rookeries of northern fur seals in California. Declines of the San Miguel Island population over the last 25 years have been associated with severe El Niño events in 1982–83 and 1997–98 (DeLong and Antonelis 1991; Melin et al. 2005). Although the number of pups decreased by 80 percent from 1997 to 1998 (Melin et al. 2005), the population began to recover in 1999. Based on 2013 pup counts, the most recent population estimate for San Miguel Island is 13,384 (Carretta et al. 2017).

The northern fur seal colonies at San Miguel Island are occupied from early May to late November with different age and sex classes being present at different times. Adult males are the first animals to arrive; upon arrival, they establish territories that they defend from other males. Females arrive several weeks later and give birth within one to two days of their arrival. After nursing their pups for an average of 8.3 days, the females alternate between periods of 6.9 (±1.4 Standard Deviation [SD]) days at sea feeding and 2.1 (±0.3 SD) days nursing. Pups are weaned at four to five months of age and go to sea immediately (Antonelis et al. 1990; Gentry 2009; Gentry and Holt 1986). Adult males leave the haul-out sites in early August and go to sea to feed until the following May (Gentry 2009; Gentry and Holt 1986). Juveniles and other non-breeding animals haul out from mid-August to early October to molt. Although the northern fur seal is not a regular breeding species on SNI, a few individuals hauled out at SNI in summer during the 1990s (Stewart and Yochem 2000), and a single female with a pup was sighted on the island in July of 2007 (G. Smith, NAWCWD, pers. comm.).

Rationale for Exclusion

Given the limited sightings of northern fur seal on SNI, it is unlikely that northern fur seals would be impacted by missile launches. Missile launches are not expected to impact San Miguel Island where northern fur seals would be expected. Therefore, incidental take authorization is not being sought for northern fur seals.

3.1.3 Guadalupe fur seal

Prior to the historical commercial sealing, the Guadalupe fur seal (*Arctocephalus townsendi*) ranged from Monterey Bay, California, to the Revillagigedo Islands, Mexico (Fleischer 1987; Hanni et al. 1997; Repenning et al. 1971). The Guadalupe fur seal is listed as threatened under the ESA (50 FR 51252; December 12, 1985) and depleted under the MMPA. Surveys conducted between 2008 and 2010 resulted in a total estimated population size of approximately 20,000 animals, with approximately 17,500 at Isla Guadalupe and approximately 2,500 at Isla San Benito (Aurioles-Gamboa and Trillmich 2015; García-Capitanachi 2011). These estimates are corrected for animals not seen during the surveys. Guadalupe fur seals are not common along the West Coast of the United States as they are primarily seen at Guadalupe Island, Mexico. However, their presence along the West Coast has increased, and over the last several years, more and more pups are born on the Channel Islands off of Southern California. Given the increase in population and distribution, NMFS initiated a new status review (Fahy 2015). Guadalupe fur seals mainly breed and pup on Isla de Guadalupe in Mexico (Aurioles-Gamboa 2015; Gallo-Reynoso et al. 2008), which is approximately 463 km south of the PMSR. In 1997, a second rookery was discovered at Isla Benito del Este, Baja California (Aurioles-Gamboa et al. 2010; Maravilla-Chavez and Lowry 1999), and a pup was born and reared successfully to weaning at San Miguel Island (Melin and DeLong 1999). Since 2008, individual adult females, subadult males, and between one and three pups have been observed annually on San Miguel Island (Jeff Harris, pers comm.). Females give birth from early June through early July, with a peak in late June.

The Guadalupe fur seal is an occasional visitor to the Channel Islands. Adult and juvenile male Guadalupe fur seals have been observed at San Miguel Island, California, since the mid-1960s (Melin and DeLong 1999), and sightings have also occurred at Santa Barbara, San Nicolas, and San Clemente Islands in the Channel Islands (Bartholomew 1950; Stewart 1981b; Stewart et al. 1993). Increased strandings of Guadalupe fur seals have occurred along the entire coast of California. Guadalupe fur seal strandings beginning in January 2015 were eight times higher than the historical average. Strandings have continued since 2015 and have remained well above average through 2018. Strandings are seasonal and generally peak in April through June of each year. Those stranding are mostly weaned pups and juveniles (1-2 years old). The majority of stranded animals showed signs of malnutrition with secondary bacterial and parasitic infections. Guadalupe fur seals that stranded in central California and treated at rehabilitation centers were fitted with satellite tags and documented to travel as far north as Graham Island and Vancouver Island, British Columbia, Canada (Norris et al. 2015). Some satellite-tagged animals traveled far offshore outside the U.S. EEZ to areas 700 nautical miles (nm) west of the California/Oregon border. Although Guadalupe fur seal strandings have continued in California, there have no recorded stranded Guadalupe fur seals on SNI.

Twenty-one sightings of Guadalupe fur seals were made on SNI from 1949 to 1986 (Bartholomew 1950; Stewart 1981b; Stewart et al. 1987; G. Smith, NAWCWD, pers. comm.). Most sightings were either juveniles of undetermined sex or adult males. One male was observed in six consecutive years from 1981 to 1986: it was defending a territory amongst breeding California sea lions along the south shore approximately 6.9 km from the western tip of the island. A lone female was observed on the south side of SNI in the summer of 1997 (G. Smith, NAWCWD, pers. comm.). A lone male Guadalupe fur seal was again seen defending a territory on the south shore of SNI between 2006 and 2009 and again in 2012 (J. Laake, NOAA, pers. comm.).

Rationale for Exclusion

Observations suggest that Guadalupe fur seals are capable of obtaining space for breeding amongst California sea lions, and that they may successfully recolonize the Channel Islands once they are abundant enough to establish a breeding population (Stewart et al. 1987). However, since only single individuals of this species have been seen on SNI since 1981 and most recent observations were on the south shore far from launch operations, it is unlikely any Guadalupe fur seals would occur ashore during the proposed activities during the period of the regulations or be in the area impacted by missile launch sounds. Therefore, incidental take authorization is not being sought for Guadalupe fur seals.

3.1.4 Steller sea lion

Steller sea lions (*Eumetopias jubatus*) range along the North Pacific Rim from northern Japan to California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands. Large numbers of individuals disperse widely outside of the breeding season (late May to early July), probably to access seasonally important prey resources. This results in marked seasonal patterns of abundance in some parts of the range and potential for intermixing in foraging areas of animals that were born in different areas (Sease and York 2003). Despite the wide-ranging movements of juveniles, and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) is low, although males have a higher tendency to disperse than females (Hoffman et al. 2006; National Marine Fisheries Service 1995; Trujillo et al. 2004). There are two distinct population segments (DPSs) identified in U.S. waters for the Steller sea lion: the

Eastern U.S. stock, which includes animals born east of Cape Suckling, Alaska (at 144 degrees West longitude), and the Western U.S. stock, which includes animals born at and west of Cape Suckling (Loughlin 1998). Jemison et al. (2013) summarized that there is regular movement of Steller sea lions from the western DPS (males and females equally) and eastern DPS (almost exclusively males) across the DPS boundary. Steller sea lions do not migrate, but they often disperse widely outside of the breeding season. A northward shift in the overall breeding distribution has occurred, with a contraction of the range in southern California and new rookeries established in Southeast Alaska (Pitcher et al. 2007).

The Eastern U.S. stock of Steller sea lion is not listed under the ESA (78 FR 66140; November 4, 2013), and is not considered "depleted" under the MMPA. The 2015 estimated total eastern stock pup count is 19,423, and the non-pup count is 52,139; this estimate does not account for animals at sea (Muto et al. 2018). The estimated U.S. total count of the eastern stock of Steller sea lions is 41,638. The size of the colony closest to SNI, on Año Nuevo Island (494 km northwest of SNI), has been declining since 1970, resulting in an 85 percent reduction in the breeding population by 1987 (Le Boeuf et al. 1991). From 1990 to 1993, the number of pups declined by 9.9 percent, and non-pups declined by 31.5 percent (Westlake et al. 1997). Non-pup counts increased slightly from 1989 to 2015, ranging from approximately 2,000 to 3,100.

Rationale for Exclusion

The Steller sea lion was once abundant in the waters off Southern California, but numbers have declined since 1938. At San Miguel Island, formerly the southern extent of the species' breeding range, Steller sea lions are no longer known to breed; the last mature Steller sea lion was seen there in 1983 (DeLong and Melin 1999). Historically, Steller sea lions were sighted occasionally at SNI (Bartholomew and Boolootian 1960). A sub-adult male Steller sea lion was sighted at San Clemente Island on April 27, 2013 and individuals have been sighted at San Miguel Island and one adult male at SNI in 2010 (M. Lowry, NOAA, pers. comm.). However, while these few Steller sea lion adults have been sighted at the Channel Islands recently, they are very rare and it is unlikely any would be hauled out on SNI during launch events. In addition, Steller sea lions do not pup on SNI. Therefore, incidental take authorization is not being sought for Steller sea lions.

Chapter 4 Affected Species Status and Distribution

A description of the status and distribution, including seasonal distribution (when applicable), of the affected species or stocks of marine mammals likely to be affected by such activities.

Only the Pacific harbor seal and California sea lion are likely to be affected by launch activities on SNI.

4.1 Pacific Harbor Seal

4.1.1 Status

Two subspecies of harbor seals exist in the Pacific: *P. v. stejnegeri* in the western North Pacific, near Japan, and *P. v. richardii* in the eastern North Pacific (Burns 2002; Jefferson et al. 2015). The eastern North Pacific subspecies inhabits near-shore coastal and estuarine areas from Baja California, Mexico, to the Pribilof Islands in Alaska. They haul out on rocks, reefs, beaches, and drifting glacial ice and feed in marine, estuarine, and occasionally fresh waters. Harbor seals generally are non-migratory, with local movements associated with such factors as tides, weather, season, food availability, and reproduction (Bigg 1969, 1981; Boveng et al. 2012; Burns 2002; Fisher 1952; Hastings et al. 2004; Lowry et al. 2001; Scheffer and Slipp 1944; Small et al. 2003; Swain et al. 1996). The Pacific harbor seal (*P v. richardii*) is not listed under the ESA, and the California stock, which occurs on SNI, is not considered a strategic stock under the MMPA. Harbor seals haul out year-round at various sites around SNI, including the western part of the island where launches occur. They are also found on the south side and east end of the island, as well as other sites.

4.1.2 Distribution

Harbor seals have the broadest range of any pinniped, inhabiting both the Atlantic and Pacific oceans. In the Pacific, they are found in near-shore coastal and estuarine habitats from Baja California to Alaska, and from Russia to Japan; they are rarely found more than 10.8 nm from shore (Baird 2001). Pacific harbor seals generally do not migrate annually (Burns 2002; Jefferson et al. 2015) and remain solitary while at sea. They display year-round site fidelity; although, they have been known to swim several hundred miles to find food or suitable breeding habitat. Harbor seals are considered abundant throughout most of their range from Baja California to the eastern Aleutian Islands. Approximately 400–600 haul-out sites are widely distributed along the mainland and offshore islands of California, including sandbars, rocky shores, and beaches (Hanan 1996; Lowry et al. 2008; Lowry et al. 2017b). The harbor seal haul-out sites include mainland beaches and all of the Channel Islands, including Santa Barbara, Santa Catalina, and San Nicolas Islands (Lowry et al. 2008). Harbor seals have not been observed on the mainland coast of Los Angeles, Orange, and northern San Diego Counties (Lowry et al. 2008). Harbor seals haul out and breed on all of the California Channel Islands (Lowry et al. 2017b) and on islands within Baja California, Mexico (Lubinsky-Jinich et al. 2017).

The California population of harbor seals increased between 1981 and 2004 (Figure 4-1), but this increase has slowed since 1995 with a decrease after 2005 (Carretta et al. 2017). This indicates that either harbor seal populations may be approaching the carrying capacity of the environment (Carretta et

al. 2017; Hanan 1996), or harbor seals are being displaced by northern elephant seals (Mortenson and Follis 1997). Populations of elephant seals and sea lions are expanding into areas that were previously occupied solely by harbor seals. Hanan (1996) noted that, on islands where elephant seal populations had increased, harbor seal populations remained stable or declined; until 1996, reproductive rates were -1.2 percent per year at San Miguel Island, 0.02 percent at SNI, and -1.0 percent at Santa Barbara Island. On islands where elephant seals were not found, harbor seal populations continued to grow; until 1996, reproductive rates were +11.2 percent per year at Santa Catalina Island and +5.7 percent at Santa Cruz Island.

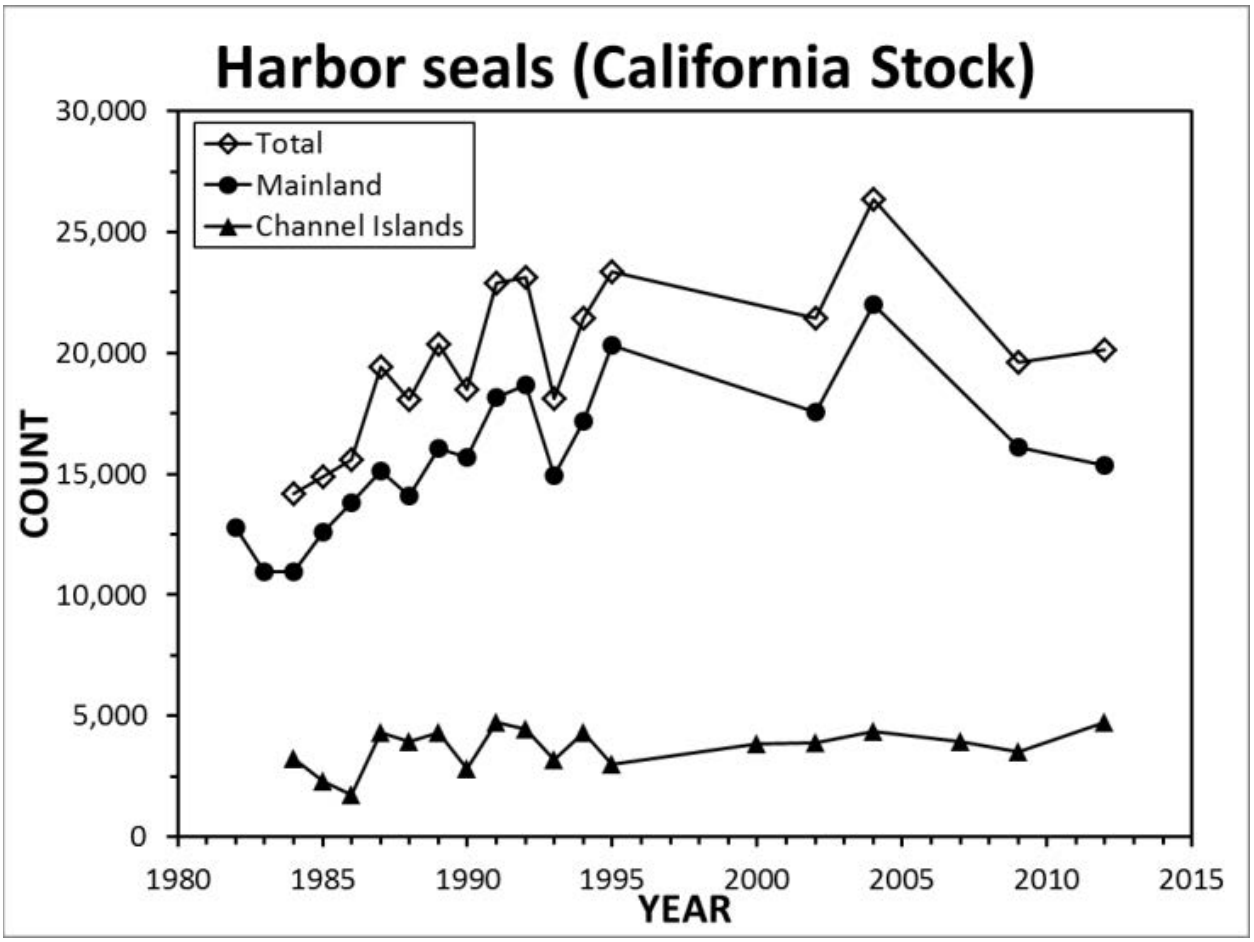

Figure 4-1. Harbor seal haulout counts in California during May/June.
References: (Hanan 1996); R. Read, CDFG unpubl. data; (Lowry et al. 2008); NMFS unpubl. data from 2009-2012 surveys) in Carretta et al. (2017).

As with most seals, a complete count of all harbor seals in California is impossible because some are always away from the survey haul-out sites. A complete pup count (as is done for other pinnipeds in California) is also not possible because harbor seals are precocial, with pups entering the water almost immediately after birth. Population size is estimated by counting the number of seals ashore during the peak haul-out period (May to July) and by multiplying this count by a correction factor equal to the inverse of the estimated fraction of seals on land. Based on the most recent harbor seal counts during May–July of 2012 (20,109 animals; NMFS unpublished data) and the Harvey and Goley (2011) correction

factor, the harbor seal population in California in 2012 is estimated to number 30,968 seals (coefficient of variation = 0.157); this estimate was determined by applying Harvey and Goley (2011) correction factor to the most recent harbor seal counts on shore (Figure 4-1) (Carretta et al. 2017). In 2012, the total count for the Channel Islands was just under 5,000 individuals (Carretta et al. 2017). Koski et al. (1998) provided estimates of 914, 2,860, 927, and 2,065 harbor seals in the PMSR in winter, spring, summer, and autumn, respectively. Lowry et al. (2008) counted 3,878 and 4,344 harbor seals hauled out at the Channel Islands in 2002 and 2004, respectively, and just under 5,000 in 2012 (Figure 4-1).

Due to differences in timing of the molt by different age and sex groups, and due to differences in haul out patterns of different individual seals, not all seals are hauled out at the same time, even at the peak of the haul-out season. Thus, peak counts represent, at most, 65–83 percent of the individual seals that use a haul-out site (Hanan 1996; Harvey and Goley 2011; Huber et al. 2001). In late autumn and winter, harbor seals may be at sea continuously for several weeks or more, presumably feeding to recover body mass lost during the reproductive and molting season and to gain mass for the next breeding season. During winter, the number of seals hauled out at most haul-out sites is approximately 15 percent of the maximum count during peak use of the haul-out site (i.e., 10–12 percent of those using the site). This typical seasonal pattern is reflected in harbor seal counts on SNI (Yochem et al. 1987).

Studies using satellite linked transmitters (deployed on only a few seals) have confirmed their primarily nearshore distribution, as well as their tendency to remain near their terrestrial haul-out sites (Baird 2001; Harvey and Goley 2011; Manugian et al. 2016; Stewart and Yochem 1994) and frequently haul out on land throughout the year, at least for brief periods. However, at most haul-out sites, large numbers of seals are seen on land only during the pupping, nursing, and molting periods. A small number of seals (primarily juveniles) occasionally move between haul-out sites on different Channel Islands and on the mainland (Stewart and Yochem 1985; Stewart and Yochem 1994). In southern California, the harbor seal pupping period extends from late February to early April, with a peak in pupping in late March. Females nurse their pups from late February to early May, and all pups are weaned by May. The number of harbor seals typically increases during pupping (Stewart and Yochem 1994) and molting, as does the length of time seals spend hauled out (Figure 4-2). The molting period is in late May to June, and all ages and sexes of harbor seals haul out at this time. There are seasonal differences in the proportion of time that seals haul out and in the durations of foraging trips. Tides likely affect the maximum number of seals hauled out, but time of day and the season have the greatest influence on haul-out behavior (Patterson and Acevedo-Gutiérrez 2008; Stewart and Yochem 1994). There is age and sex segregation at haul-out sites, and this may be true while they are at sea as well. Data obtained from radio tagged seals from the mainland and San Miguel Island indicate that most adult harbor seals leave haul-out areas daily, even during the periods of peak haul out (Hanan 1996).

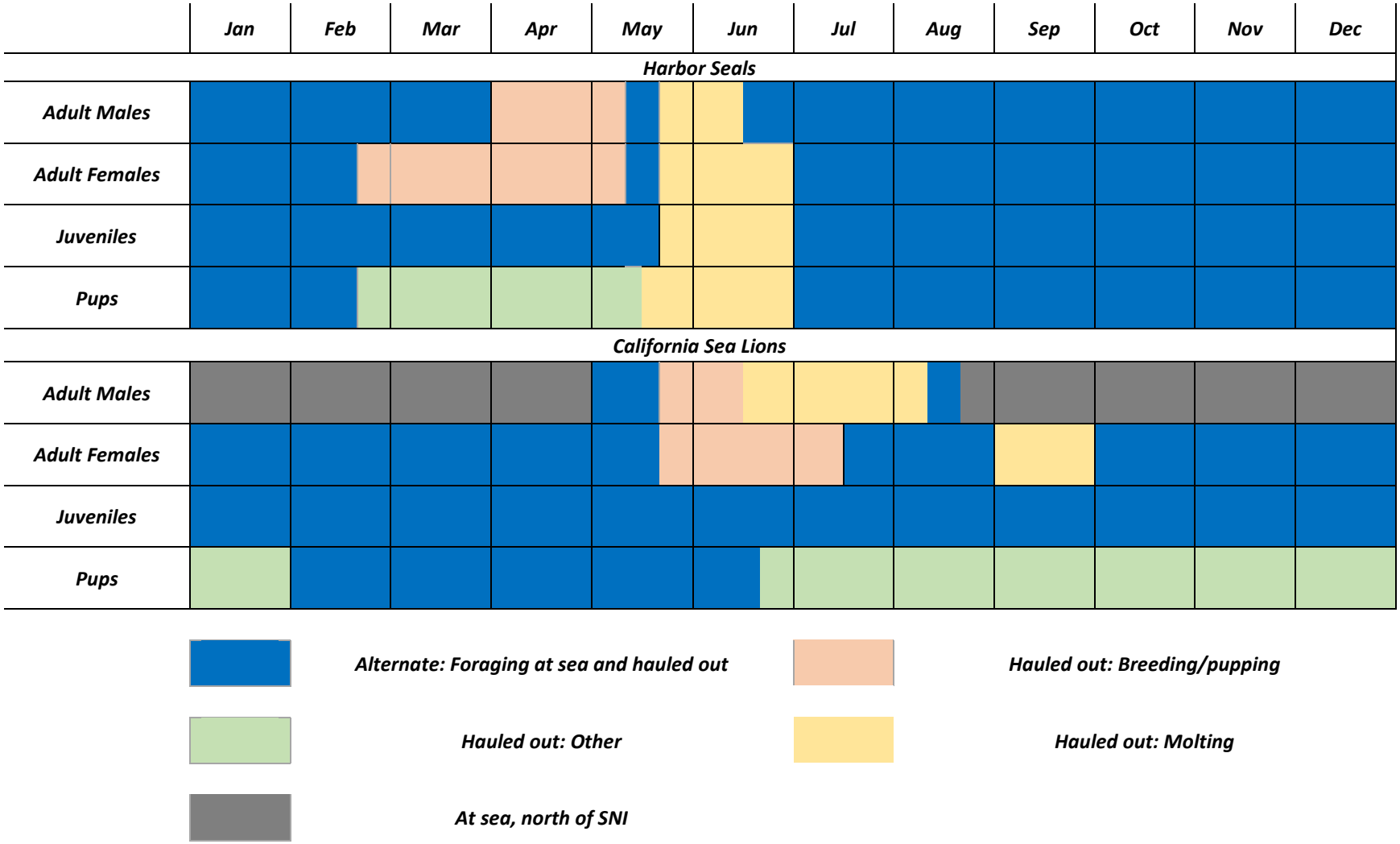

Figure 4-2. Annual activities of Pacific harbor seals and California sea lions on SNI.

Activities include hauling out on land for breeding, pupping, or molting, and feeding at sea. Gaps in the bars indicate that not all animals are engaged in that activity. The size of the gap indicates approximate proportions of animals or time not engaged in that activity (Department of the Navy 2002).

San Nicolas Island

At SNI, harbor seal abundance has shown a generally increasing trend since the early 1960's. Counts from 1975 to 2012 fluctuated between 128 and 858 harbor seals, based on peak counts (Figure 4-3) (Fluharty 1999; Le Boeuf et al. 1978; Lowry et al. 2008; Lowry pers. comm.). During May–July 2002, 2004, 2007, and 2009, 584, 784, 858 and 754 harbor seals were hauled out on SNI respectively, representing between about 15 and 18 percent of the harbor seals in the Channel Islands (Lowry et al. 2008). More recent harbor seal counts on SNI were variable, ranging from 229 to 673 during the period from 2011 to 2015 (Lowry et al. 2017b); although, Lowry et al. (2017b) only counted 259 harbor seals on SNI in 2015 (18.9 percent of harbor seals in the Channel Islands).

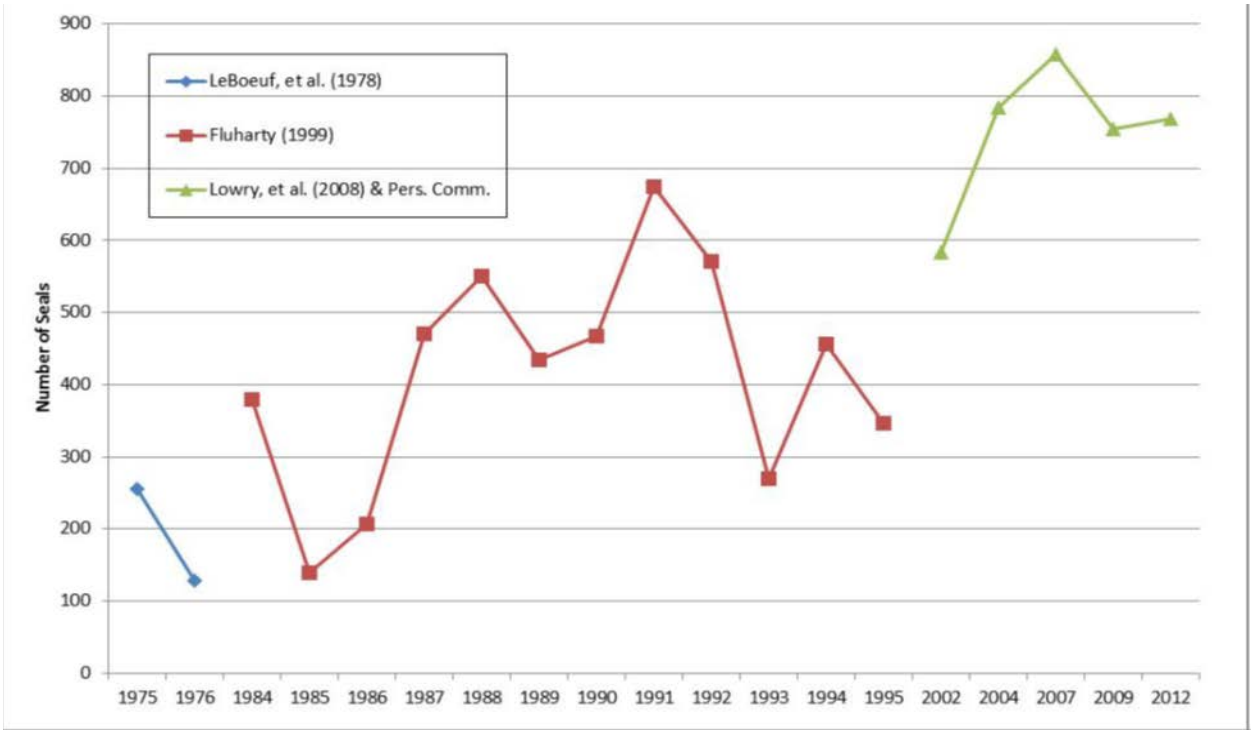

Figure 4-3. Counts of harbor seals at SNI, 1975–2012.

Reference: Data from 2009 and 2012 aerial counts are from Lowry, pers. comm.

There is sex and age segregation at many of the sites, although there are no specific data of this type for western SNI sites. Some sites are used primarily by adult females and pups, others by weaned pups and juveniles, and still others by adult and sub-adult males. Unlike locations farther north where many factors contribute to the daily pattern of haul-out behavior, highest numbers of harbor seals haul out on the Channel Islands during the late afternoon (1500–1600 hours) and during the molting season, with other environmental factors apparently causing little variation in haul-out behavior (Stewart and Yochem 1994).

4.2 California Sea Lion

4.2.1 Status

California sea lions in the United States are not listed as endangered or threatened under ESA or as depleted or strategic under the MMPA. The California sea lion is a distinct species, separated from the Galapagos sea lion (*Z. wollebaeki*) and the extinct Japanese sea lion (*Z. japonicus*) (Brunner 2003; Schramm et al. 2009; Wolf et al. 2007). The California sea lion is subdivided into three stocks (U.S., Western Baja California, and Gulf of California) based on genetic differences and geographic separation. Although there has been some interchange between the U.S. and Western Baja California populations, the breeding locations are far apart, and they are considered separate stocks for management purposes. Most of the U.S. stock (more than 95 percent) breeds and gives birth to pups on the Channel Islands, specifically, San Miguel, San Nicolas, and Santa Barbara islands. Smaller numbers of pups are born on San Clemente Island (southeast of SNI), the Farallon Islands, and Año Nuevo Island (north of SNI) (Carretta et al. 2017). Sea lions from the U.S. stock haul out at various sites around SNI, including the western part of the island where launches occur (Figure 1-2) and along the south side of the island.

The U.S. stock of California sea lions is estimated to be 296,750 sea lions (Carretta et al. 2017). The California sea lion is the most abundant pinniped along the California coast. Over the years, there have been declines in population abundance attributed to (1) El Niño impacts, such as reduced number of reproductive adult females being incorporated into the population; (2) domoic acid poisoning (Lefebvre et al. 1999; Scholin et al. 2000); and (3) lower survivorship of pups due to hookworm infestations (Lyons et al. 2000). Large numbers of emaciated sea lion pups stranded in early 2013 in California, and pup weight indices at the San Miguel Island rookery were significantly lower in 2012 compared with previous years (Wells et al. 2013). As a result of the large numbers of sea lion strandings in 2013, NOAA declared an unusual mortality event[3]. Overall, the California sea lion population is abundant and generally increasing (Carretta et al. 2017).

The entire population cannot be counted directly because different age and sex classes do not come ashore at the same time or at the same location. In lieu of counting all sea lions, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. Population size is then estimated from the number of births and the proportion of pups in the population. Surveys are conducted in July after all pups have been born.

In 2008, 59,774 pups were counted in California; this number was adjusted for a 15 percent mortality rate and the percentage of pups in the population to come up with an estimate of 296,750 (Carretta et al. 2017). California sea lion populations have increased steadily since 1950 (Carretta et al. 2017). For the U.S. stock of California sea lions, the number of pups showed an annual increase of 5.4 percent between 1975 and 2008, when pup counts for El Niño years (1983, 1984, 1992, 1993, 1998, and 2003)—which caused substantial reductions in numbers of pups produced and in counts of non-pups at the rookeries—were removed from the 1975–2014 time series (Figure 4-4) (Carretta et al. 2017). In contrast, the population on SNI increased at nearly 6.8 percent per year during 1975–2011 (M. Lowry, pers. comm.). From 1992–2014, the largest California sea lion rookeries in the United States were SNI and San Miguel Island with similar annual counts of 5,000–33,000 pups at each island (Lowry et al. 2017a). More recent pup counts made in 2011 totaled 61,943 animals, the highest recorded to date

[3] http://www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm

(Carretta et al. 2017). Estimates of total population size based on these counts are currently being developed, along with new estimates of the fraction of newborn pups in the population. Laake et al. (2018) suggested that the U.S. stock of California sea lion has stopped growing and at its optimal sustainable population (i.e., the range of abundance from the maximum net productivity level to carrying capacity). However, the optimum sustainable population status has not been formally determined.

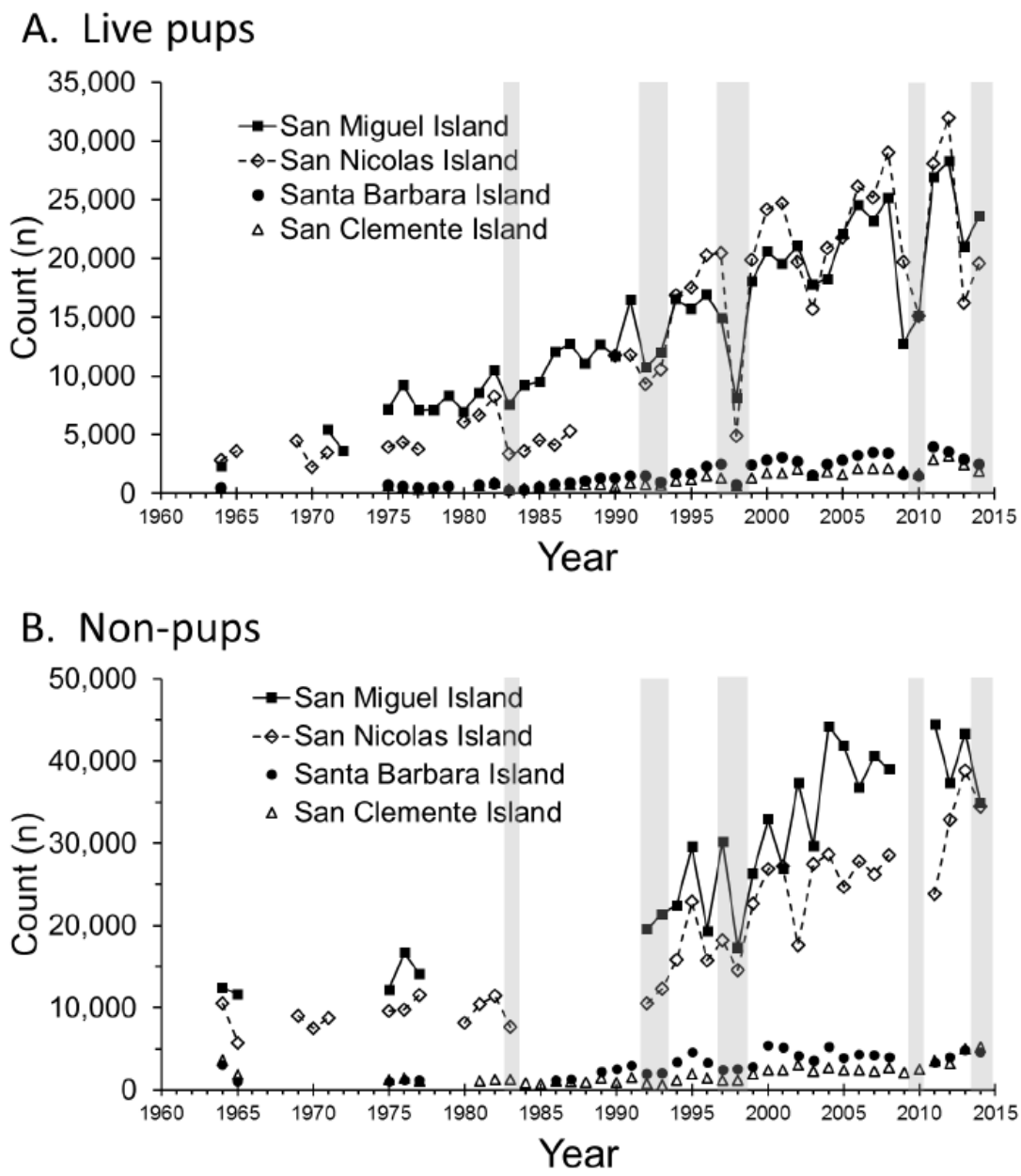

Figure 4-4. California sea lion (A) counts of live-pups and (B) counts of non-pups at the four Main Channel Islands rookeries, including San Nicolas Island.

Reference: SNI counts from 1964–2014 (Lowry et al. 2017a).

4.2.2 Distribution

California sea lions occur in the eastern north Pacific from Puerto Vallarta, Mexico, through the Gulf of California and north along the west coast of North America, to the Gulf of Alaska (Barlow et al. 2008; Jefferson et al. 2008; Maniscalco et al. 2004). California sea lions occupy shallow ocean waters, sea caves, rocks, and beaches. They will also congregate in marinas, bays, and on manmade objects such as buoys, boats, or offshore oil rigs. The breeding areas of the California sea lion are on islands located in southern California, western Baja California, and the Gulf of California. Animals from the U.S. stock generally range into Canadian waters, and movement of animals between U.S. waters and Baja California waters occurs. Males from western Baja California rookeries may spend most of the year in the United States. Survey data from California shows the seasonal shifts in the offshore distribution of California sea lions, most likely due to changes in the distribution of the prey species (Bonnell and Ford 1987; Lowry and Forney 2005).

Sea lions have been sighted during all seasons and in all areas during survey efforts from nearshore to offshore areas. The distribution and habitat use of California sea lions vary with the sex of the animals and their reproductive phase. Adult males haul out on land to defend territories and breed from mid-to-late May until late July. Individual males remain on territories for 27–45 days without going to sea to feed (Heath 1989; Peterson and Bartholomew 1967).

In the non-breeding season, from September to December and after the mating season, most adult and sub-adult males migrate northward along the coast to feed in areas as far as Washington (Puget Sound) and British Columbia (Lowry et al. 1992a). They remain there until spring (March to May), when they migrate back to the breeding colonies (Lowry and Forney 2005). Thus, adult males are present in areas offshore of SNI only briefly as they move to and from rookeries. Although the distribution of immature California sea lions is poorly known, northward migrations are likely shorter in length than the migrations of adult males, even though many spend months away from the Channel Islands (Huber 1991; Lowry and Forney 2005; McHuron et al. 2017). Some immature animals are presumed to remain near the rookeries or move up from Mexico, and thus remain in or near the Channel Islands (Lowry et al. 1992b; Lowry and Forney 2005; Melin and DeLong 1999; Thomas et al. 2010).

Adult females with pups remain near the rookeries throughout the year, although some females may disperse northward, as well. They return to the rookery to give birth to their pups and breed. Most births occur from mid-May to mid-July (peak in late June). Females nurse their pups for about eight days before going to sea to feed for two days. At SNI, subsequent feeding trips range from 0.6–6.1 days in duration, and subsequent nursing periods are 0.6–2.2 days long (Kuhn and Costa 2014). Females mate two to four weeks postpartum, usually in the water or at the water's edge. Weaning has been reported to occur at 4–12 months, depending on environmental conditions (Heath 1989; Lowry et al. 1992b; Ono 1991), but there have been records of females nursing yearling pups. Pups begin to forage on their own when they are about seven months old, in order to supplement their mother's milk.

<u>San Nicolas Island</u>

Barlow et al. (1997) reported that 47 percent of the U.S. stock, or 49 percent of the PMSR population, used the shoreline of SNI to breed, pup, or haul out in 1994. The California sea lion is by far the most common pinniped on SNI. This species hauls out at many sites along the south side of SNI and at some sites on the western part of the island. Over the course of the year, over 100,000 sea lions use SNI.

Pupping occurs on the beaches from mid-May to mid-July. Similar to the description provided above, females nurse their pups for about eight days before coming into estrus and then begin an alternating pattern of foraging at sea and nursing the pup on land; this pattern may last for eight months (with some pups nursing up to one year after birth). Female California sea lions with pups haul out during most of the year at San Nicolas. Many juveniles move north to forage although some continue to periodically haul out at SNI.

The population of California sea lions at SNI generally grew from 1975–2014 with inter-annual variability due to intermittent El Niño events (Figure 4- and Table 4-1) (Lowry et al. 2017a). Sea lions continue to expand their range and occupy new areas on SNI (Lowry et al. 2017a; Lowry et al. 2017b). During the 1980s, California sea lions were rarely found east of Elephant Seal Beach, but now they are found on most beaches along the entire southern shore and east and west ends of the island (Figure 4-5). During 2001–2012 launch monitoring at SNI, the greatest number of sea lions seen at any one site exceeded 1,000 individuals towards the end of the breeding season (July–August) in 2005, in the area between Rock Crusher and Vizcaino Point (Holst et al. 2005a; Holst et al. 2008; Ugoretz and Greene Jr. 2012).

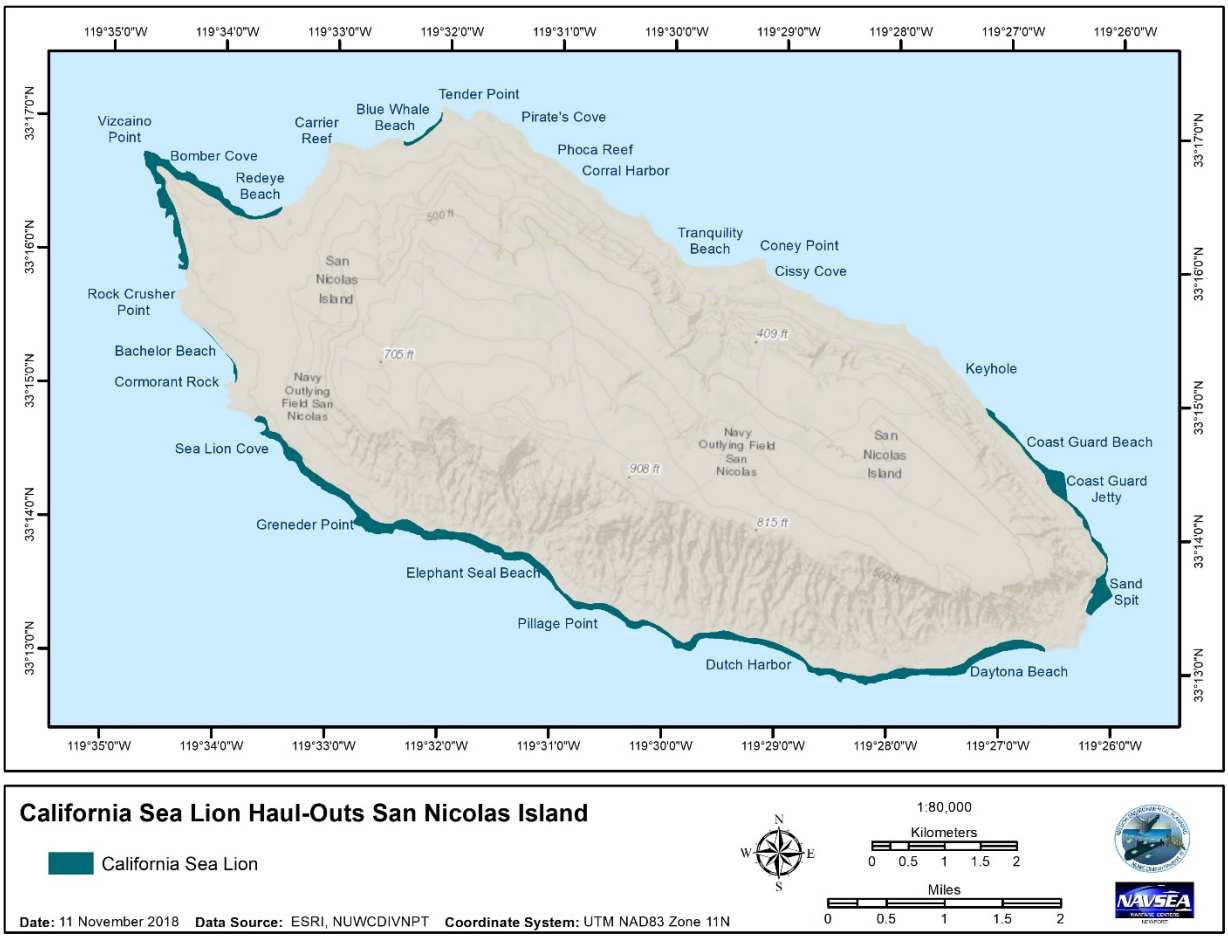

Figure 4-5. Map of SNI showing beaches on which California sea lions are known to haul out.
Reference: From Lowry et al. (1992a), (Ugoretz 2016), and (Ugoretz and Greene Jr. 2012)

Table 4-1. Counts of California sea lions at SNI in July (during late breeding season), 2001-2015.

Year	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2011*	*2012*	*2013*	*2014*	*2015*
Subdivision													
A	926	412	1,121	1,342	829	756	870	848	1,389	1,676	1,876	1,140	985
B	551	494	638	518	599	842	984	1017	1,115	1,382	1,179	1,418	681
C	1,547	1,121	1,613	1,543	903	1,304	1,537	1,338	1,478	1,539	2,084	1,857	1,401
D	5,529	4,702	5,108	7,080	7,369	8,049	8,028	8,289	7,409	8,660	6,332	6,150	3,024
E	2,165	1,409	1,691	2,035	1,734	2,143	2,164	2,377	2,443	2,933	2,301	2,555	1,412
F	5,900	4,532	4,561	5,033	4,530	5,572	5,131	5,396	4,741	5,701	4,048	4,495	2,323
G	874	691	974	1,140	832	1,182	1,306	1,473	1,069	1,469	1,328	1,360	810
H	9,881	7,206	7,326	8,406	7,893	9,282	8,865	9,504	8,066	9,190	6,000	6,642	3,948
I	3,829	2,864	3,131	3,415	2,850	3,236	2,968	3,253	2,572	3,253	2,443	2,220	1,316
J	7,027	5,076	5,889	6,264	6,123	7,054	6,384	7,059	5,975	7,081	5,557	5,765	3,803
K	683	376	625	518	255	480	426	545	289	469	405	469	472
L	7,607	5,541	5,759	7,655	8,599	9,461	8,205	9,967	8,843	11,118	8,429	9,043	6,091
M	2,860	1,580	2,414	2,971	3,030	3,699	3,339	4,284	3,764	4,560	4,285	4,440	3,434
N	0	0	0	0	0	0	2	2	6	0	1	22	8
O	0	0	0	0	0	0	0	0	0	0	0	1	0
P	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	2,584	1,315	2,320	1,603	9,54	895	1,188	2,260	2,743	5,819	8,795	6,456	7,618
Total	**51,963**	**37,319**	**43,170**	**49,523**	**46,500**	**53,955**	**51,397**	**51,612**	**51,902**	**64,850**	**55063**	**54,033**	**37,326**

*****Refer to Figure 6- for subdivision map

Chapter 5 Type of Incidental Take Authorization Requested

The type of incidental taking authorization that is being requested (i.e., takes by harassment only; takes by harassment, injury, and/or death) and the method of incidental taking.

5.1 Take Authorization Request

The NAWCWD requests an authorization from the NMFS for incidental take by Level B harassment of marine mammals, specifically California sea lions and Pacific harbor seals, during planned missile launch operations at SNI, California. With implementation of the mitigation measures outlined in Chapter 11, no serious injury (Level A harassment) is anticipated. NAWCWD will continue existing mitigation measures to reduce disturbance to marine mammals that might occur on the western end of the island. These measures are designed to eliminate the potential injury to marine mammals, especially pups. NAWCWD is currently reevaluating the need for another multi-year LOA based on the definition of level B harassment as defined by the National Defense Authorization Act (Public Law 108-136[4]) .

5.2 Method of Take

The activity, as outlined in Chapter 1 and Chapter 2, has the potential to result in incidental take of marine mammals from airborne noise from missile launches near pinniped haul-out sites, and/or any associated visual cues during launch activities. These activities have the potential to disturb or temporarily displace marine mammals.

[4] The National Defense Authorization Act (Public Law 108–136) removed the ‘‘small numbers’’ and ‘‘specified geographical region’’ limitations and amended the definition of ‘‘harassment’’ as it applies to a ‘‘military readiness activity’’ to read as follows (Section 3(18)(B) of the MMPA): (i) any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (ii) any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].

Chapter 6 Take Estimates for Marine Mammals

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking identified in Chapter 5, and the number of times such takings by each type of taking are likely to occur.

6.1 Estimating Numbers of Level B Harassment

Species for which authorization is sought are California sea lions and Pacific harbor seals. Take would most likely result from airborne noise from missile launches near pinniped haul-out sites, and/or any associated visual cues during launch activities. For purposes of this IHA request, pinnipeds are assumed to be "taken by harassment" if, as a result of a launch, Temporary Threshold Shift (TTS) occurs, or behavioral patterns of pinnipeds are altered. This section estimates take by harassment during the planned missile launch program at SNI, and describes the rationale for these take estimates.

6.2 Fundamentals of Sound

Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the pitch of a sound and is measured in the number of cycles per second, or hertz (Hz). Intensity describes the pressure per unit of area, (i.e., loudness) of a sound, expressed in decibels (dB). A dB is a unit of measurement describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. For airborne sound pressure, the reference amplitude is usually 20 µPa and is expressed as “dB re 20 µPa.” Sound levels in dB are calculated on a logarithmic basis. An increase of 10 dB represents a tenfold increase in acoustic energy, while 20 dB is 100 times more intense, 30 dB is 1,000 times more intense, etc.

Because animals are not equally sensitive to sounds across their hearing range, weighting functions are used to emphasize ranges of best hearing and de-emphasize ranges of less or no sensitivity. In air, sound levels are frequently “A-weighted” and seen in units of dBA, to account for sensitivity of the human ear to barely audible sounds. Many in-air sound measurements are A-weighted because the sound levels are most frequently used to determine the potential noise effect to humans. This method is less sensitive at low frequencies and extremely high frequencies than at the mid-range frequencies.

The SEL metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., vessel passages) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds and is the recommended metric for sleep disturbance analysis (DoD Noise Working Group 2009).

The highest A-weighted sound level measured during a single event where the sound level changes value with time is called the maximum A-weighted sound level. In this example, the noise level starts at the ambient or background noise level, rises to the maximum level as the sound source passes closest to the receiver, and returns to the background level as the sound source recedes into the distance. The maximum A-weighted sound level is measured only for a fraction of a second.

6.2.1 Ambient Noise

Ambient noise is background sound of physical and biological origin, excluding sounds from specific identifiable sources. Marine mammals are able to detect man-made noise and sounds from other mammals only if (as a first approximation) these signals exceed the ambient noise levels at corresponding frequencies. Natural ambient noise can mask weak sound signals of either natural or human origin. Marine mammals are adapted to the natural ambient noise levels that prevail in their environment. Ambient levels are thus important for understanding the natural environmental restraints on an animal's ability to detect mammal calls, anthropogenic sounds, and other relevant sounds. Ambient noise levels in air at SNI are dominated by breaking waves at the shoreline and the strong winds that are common on the west end of SNI, therefore ambient noise measurements are an important component of acoustic monitoring of missile launches on SNI.

Background sounds have been (and will be) recorded on a second audio channel of the Autonomous Terrestrial Acoustic Recorder (ATAR; see Chapter 13) using a higher sensitivity microphone and higher gain setting. This channel will overload during the brief periods when it receives missile launch sounds. At other times, including immediately before and after the launch, it can record the background environmental sounds.

The background sounds recorded before or after launches during 2001–2012 were generally relatively quiet, ranging from 22 to 72 dBA re 20 µPa or 23 to 91 dB re 20 µPa flat-weighted (Burke 2017; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2005b; Ugoretz 2016; Ugoretz and Greene Jr. 2012). These sounds are comparable to sound levels expected in residential areas.

6.2.2 Sound Propagation

In-air sound propagation from missile launch sources at SNI had not been well studied prior to the monitoring work during 2001–2007. Measured sound levels of several missile types as related to CPA distance are shown in Figure 6-1 and Figure 6-2. Additional data may be useful for a better characterization of the sounds produced by the launches; the monitoring program described in Chapter 13 will provide additional information. However, some relevant general principles are described Section 4.6 in Richardson et al. (1995).

In addition to normal spreading losses as a function of distance, atmospheric absorption is a natural phenomenon that will limit airborne sound propagation, especially at higher frequencies. Kinsler et al. (1982) present the physics of this topic. At middle frequencies, sound absorption has more influence on sound transmission in the atmosphere than in the ocean. Only low-frequency sound is transmitted well in air.

6.3 Applicable Noise Criteria

There are few published data on TTS thresholds for pinnipeds in air exposed to impulsive or brief non-impulsive sounds. As described in 66 FR 41834; August 9, 2001, there was evidence of mild TTS in captive Pacific harbor seals and California sea lions exposed to a 0.3-s transient sound with an SEL of 135 dBA re 20 $\mu Pa^2 \cdot s$ (Bowles et al. 1999). However, mild TTS may occur in harbor seals exposed to SELs lower than 135 dB SEL (A. Bowles, pers. comm., 2003). Data indicate that the TTS threshold using SEL may actually be around 129–131 dB re 20 $\mu Pa^2 \cdot s$ for harbor seals, within their frequency range of good hearing (Kastak et al. 2004; Kastelein et al. 2009a; Kastelein et al. 2009b; Reichmuth et al. 2013; Southall et al. 2007). Research also found that the TTS thresholds of California sea lions exposed to strong sounds are higher as compared to the harbor seal (Table 6-3) (Bowles et al. 1999; Kastak et al. 2005; Mulsow et al. 2012; Reichmuth et al. 2013; Reichmuth and Southall 2012; Wolski 1999). Based on these studies and other available data, Southall et al. (2007) propose that single impulsive sounds, such as those from a sonic boom, may induce mild TTS if the received peak pressure is approximately 143 dB re 20 µPa (peak) or if received Mpa-weighted SEL is approximately 129 dB re20 $\mu Pa^2 \cdot s$. Those levels apply specifically to harbor seals; those levels are not expected to elicit TTS in California sea lions (Southall et al. 2007). Less is known about levels that may cause Permanent Threshold Shift (PTS), but in order to elicit PTS, a single sound pulse would probably need to exceed the TTS threshold by at least 15 dB, on an SEL basis (Table 6-1) (Southall et al. 2007). Although, NMFS published guidance in 2018 for assessing the effects of anthropogenic sound on marine mammals for underwater thresholds for onset of PTS and TTS (National Marine Fisheries Service 2018c); the sounds produced by missile launch activities are not expected to penetrate the air-water interface. Therefore, only in air impacts are evaluated.

6.3.1 Behavioral Criteria

In general, if the received level of the noise stimulus exceeds both the background (ambient) noise level and the auditory threshold of the receiving animals, and especially if the stimulus is novel to them, then there may be a behavioral response. However, there can also be cases where the sound is audible but no overt response occurs. The probability and type of behavioral response will also depend on the season, the group composition of the pinnipeds, and the type of activity in which they are engaged. For example, in some cases, harbor seals at SNI appear to be more responsive during the pupping/breeding season (Holst et al. 2005a; Holst et al. 2008) while in others, mothers and pups seem to react less to launches than lone individuals (Ugoretz and Greene Jr. 2012), and California sea lions seem to be consistently less responsive during the pupping season (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Holst et al. 2005b; Ugoretz and Greene Jr. 2012).

It is difficult to derive unequivocal criteria to identify situations in which launch sounds are expected to cause disturbance responses to pinnipeds hauled out on SNI. 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 is not considered a "take'' under the MMPA definition of harassment (67 FR 56271; September 3, 2002).

Before the start of the monitoring work at SNI in 2001, the available data were quite limited in detail and highly variable (e.g., Table 6-3). Even with the monitoring results from 2001–2017, the available data are insufficient to establish direct correlations between sound levels and the specific response of each pinniped species. A greater proportion of California sea lions responded with increasing SELs; the relationship between harbor seal responses and SELs was less clear (Holst et al. 2010; Holst et al. 2008; Holst et al. 2011). Even though pinnipeds are disturbed at SNI during launches, no deaths due to

stampeding have been witnessed at SNI during the 2001–2017 monitoring period (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Holst et al. 2005b; LGL Ltd. and Greenridge Sciences Inc. 2002; Ugoretz 2016; Ugoretz and Greene Jr. 2012).

Table 6-1 shows the received sound levels at which "taking" may begin to occur for pinnipeds based on the Navy's Phase III criterion for PTS and TTS (U.S. Navy 2017). Based on the results of launch monitoring at SNI, harbor seals exhibited a response to launches with SELs <100 dBA and as a result Holst et al. (2005b) suggested a disturbance criterion of 90 dBA SEL for harbor seals and 100 dBA for California sea lions. Southall et al. (2007), based on the same data, but with different frequency-weighting, noted that Mpa-weighted (frequency weighting for pinnipeds in air) SELs of 100 dB re 20 $\mu Pa^2 \cdot s$ could result in significant behavioral changes by pinnipeds (Mpa-weighted values are greater than A-weighted SELs for launch sounds).

Table 6-1. Summary of Navy Phase III weighting function parameters and TTS/PTS thresholds at that hearing group's most sensitive frequency. Includes disturbance threshold measured at SNI.

Group	*Non-impulsive*		*Impulsive*			
			TTS Threshold		*PTS threshold*	
	TTS threshold SEL[a] (weighted)	*PTS threshold SEL[a] (weighted)*	*SEL[a] (weighted)*	*Peak SPL[b] (unweighted)*	*SEL[b] (weighted)*	*Peak SPL[b] (unweighted)*
OA[c]	157	177	146	170	161	176
PA[d]	134	154	123	155	138	161

[a] SEL thresholds are in dB re $(20\ \mu Pa)^2 \cdot s$
[b] SPL thresholds in dB re 20 µPa in air
[c] OA-Otariid in air (includes California sea lion)
[d] PA-Phocid in air (includes Pacific harbor seal)

Previous monitoring at SNI has shown that sea lions and harbor seals move along the beach and/or enter the water at Mpa-weighted SELs above 100 dB re 20 $\mu Pa^2 \cdot s$ (Table 6-2). Some harbor seals have been shown to leave the haul-out site and/or enter the water at Mpa-weighted SELs as low as 60 dB re 20 $\mu Pa^2 \cdot s$, although the proportion of animals reacting is smaller when levels are lower (Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Holst et al. 2005b). Stampedes of California sea lions into the water occur infrequently during launches at SNI, especially when received sound levels are below 100 dB re 20 $\mu Pa^2 \cdot s$ (Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Holst et al. 2005b).

Table 6-2. Disturbance criterion for Pacific harbor seals and California sea lions

Disturbance criterion based on measurements from SNI	
Species	*SEL (weighted)*
Harbor seal	90[a]
Sea lion	100[b]

[a] Based on observations during the 2001–2007 SNI launch monitoring program (Holst et al. 2008).
[b] Based on a review of published and reported behavioral responses to prolonged sound (lasting several seconds) by pinnipeds hauled out in the PMSR (Lawson et al. 1998).

6.4 Estimate of Launch Noise

During the 2001–2017 period, the strongest sounds originating from a missile in flight over the beaches at SNI were produced by Vandal (no longer launched from SNI) and Coyote launches, with the exception of one SM-2 launched in 2015 (Table 6-3, Figure 6-1, and Figure 6-2). Coyote launches are expected to be the primary large missile launched from SNI over the next several years. SELs during Coyote launches ranged from 115 dBA re 20 µPa2·s (123 dB Mpa weighted) at 1,046 m from the CPA, to 96–107 dBA (105–114 dB Mpa-weighted) at beaches 0.8–1.7 km from the CPA, and 46–87 dBA (60–91 dB Mpa-weighted) at CPAs of 2.4–3.2 km (Figure 6-1; (Holst et al. 2008) (All dBA values are referenced to 20 µPa). Coyotes are launched from an inland location, so there would be no pinnipeds near the launcher. The pinnipeds closest to the Coyote launches are on the beaches directly below the flight trajectory, for which the CPA distance is about 0.9 km. SELs at the same locations were typically higher for Vandals (which will not be launched again from SNI) and lower for smaller missiles (Table 6-3, Figure 6-1, and Figure 6-2). Stronger sounds were also recorded at the launcher, but sound levels were dependent on the size of the missile launched. Launches of smaller missiles typically occur from the Building 807 Complex near the beach where the closest pinniped haul-outs (i.e., California sea lions) are located about 0.3 km from the CPA. Harbor seal haul-outs are located at least 1 km from the CPA from the Building 807 Complex.

In general, ambient noise levels would be exceeded, but only for a few seconds during each launch event. The noise from a launch event would be infrequent, no more than 40 times a year, and of short duration. The noise would be the same intensity as launches that have occurred over the past decade at SNI.

Table 6-3. The range of sound levels recorded near the launcher and at nearshore locations for missile types launched at SNI from 2001 through 2015 that are expected to be launched between June 2019-June 2020.

	CPA (m)	*Peak[a]*	*SPL-f[a]*	*SPL-A[a]*	*SPL-M[b]*	*SEL-f[b]*	*SEL-A[b]*	*SEL-M[b]*
Launcher[c]								
RAM	2-4	146-147	124-126	122-125	124-125	129-131	128-130	129-130
Coyote	72	142	126	113	122	128	115	123
Nearshore[d]								
RAM								
Min	581-2,013	104	86	72	83	84	64	76
Max	580-1,555	117	99	87	93	97	92	96
Coyote								
Min	2,413-3,236	100	82	54	60	87	46	60
Max	883-1,311	144	134	119	126	119	107	114
Tomahawk	529	111	93	92	92	107	102	105
BQM-34, -74, or -177	15-370	-	-	145	-	-	-	-
	370	-	-	92	-	-	-	-
MSST	1,300-2,700	-	78.7-96.6	-	-	-	-	62.3–83.3
SM-2, -3, or -6	700-1,600	107.0-134.2	97.9-146	87.9-122.4	94.9-128.5	106.1-137.8	95.7-129.1	103.1-135.5

Note: - means no launch sounds were recorded near the launcher.
[a] Units for peak pressure and SPL are in dB re 20 µPa

[b] Units for SEL are in dB re (20 µPa)^2·s
[c] No acoustic data were recorded near the launcher during Tomahawk launches. RAMs are launched from Building 807 Complex near the beach.
[d] Acoustic data were only recorded at a single nearshore site during Tomahawk launches.

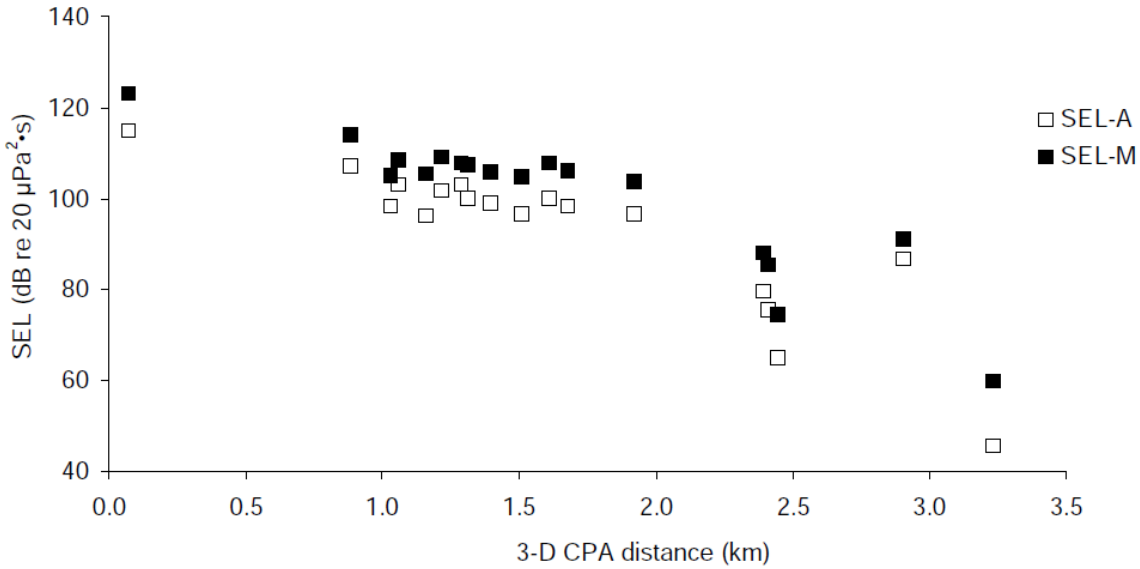

Figure 6-1. SELs (A- and Mpa-weighted) for Coyote launches at SNI relative to the 3-D CPA distance, 2003–2007.

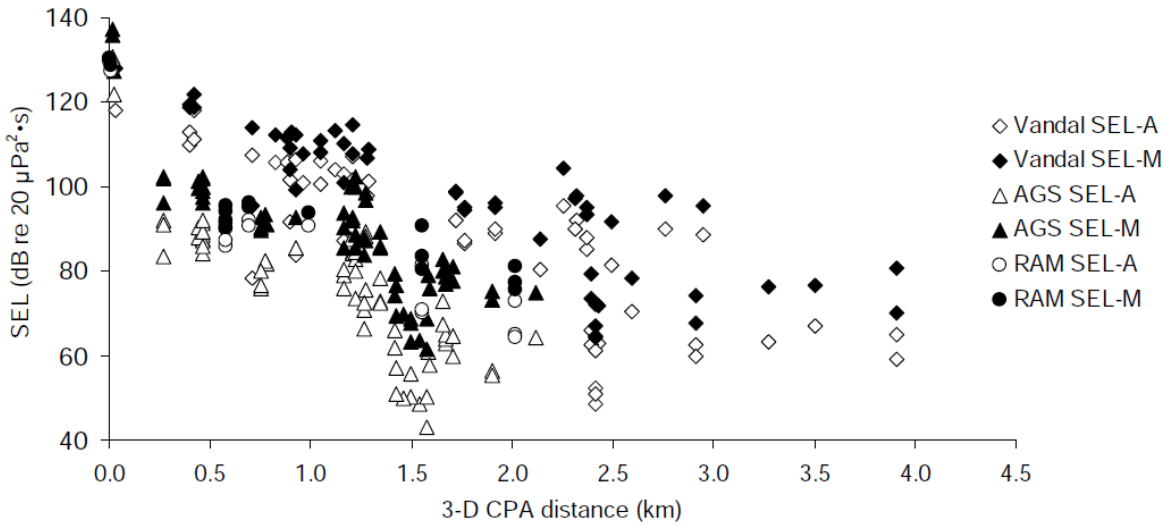

Figure 6-2. SELs (A- and Mpa-weighted) for Vandal (no longer launched from SNI), AGS (no longer launched from SNI), and RAM launches relative to the 3-D CPA distance, 2003–2007.

6.5 Pinniped Hearing Ability

In-air audiograms have been obtained using behavioral methods for the three common species of pinnipeds found on SNI, the harbor seal, California sea lion, and northern elephant seal (which is not included in this IHA request). In-air hearing of phocid seals (e.g., northern elephant and harbor seals) is less sensitive than underwater hearing, and the upper frequency limit is lower (Kastak and Schusterman 1999; Reichmuth et al. 2013). Phocid hearing limits are estimated to be 75 Hz–30 kilohertz (kHz) in air (Kastak and Schusterman 1998; Kastak and Schusterman 1999; National Marine Fisheries Service 2018b; Southall et al. 2007; Terhune 1988; Wolski et al. 2003). California sea lions are similar to phocid seals with regard to underwater hearing sensitivity at moderate frequencies (Kastak and Schusterman 1999; Reichmuth et al. 2013). In air, however, otariids apparently have slightly greater sensitivity and a higher high-frequency cutoff than do phocids – especially northern elephant seals. Otariid hearing ranges from 50 Hz–75 kHz in air based on studies done with California sea lions and northern fur seals (Kastak and Schusterman 1998; Moore and Schusterman 1987; National Marine Fisheries Service 2018a; Schusterman et al. 1972; Southall et al. 2005).

6.6 Description and Estimate of Take

Although launch sounds could be received for several seconds (conservatively), they are considered to be transient rather than prolonged sounds. Given the variety of responses documented previously for the sounds of man-made activities lasting several seconds, an SEL of 100 dB re 20 $\mu Pa^2 \cdot s$ (unweighted) is considered appropriate as a disturbance criterion for pinnipeds hauled out at the west end of SNI (U.S. Navy 2017).

Some pinnipeds that haul-out on the western end of SNI are expected to be within the area where Mpa-weighted SELs from launches reach above 100 dB re 20 µPa2·s. However, it is likely that far fewer pinnipeds occur within the area where sounds from smaller launch missiles, such as the BQM missiles, reach above 100 dB re 20 µPa2·s and none of the recorded SELs appear to be sufficiently strong to induce TTS. Based on the disturbance criterion (an SEL of 100 dB re 20 µPa2·s), the distance to which it is assumed to extend, and the estimated numbers of pinnipeds exposed to SELs ≥100 dB re 20 µPa2·s, estimates of the numbers of pinnipeds on the west end of SNI that might react strongly to the launch sounds are shown below in Table 6-4.

Table 6-4. Maximum Annual Number of Estimated Takes of California sea lions and Pacific harbor seals at SNI.

Species	*Requested Annual Take Maximum*
California sea lion	7,120
Harbor seal	480

Known haul-out sites where SELs were recorded above 100 dB re 20 $\mu Pa^2 \cdot s$ during past launches were identified (Naval Air Warfare Center Weapons Division 2017). The maximum total number of California sea lions and harbor seals expected to occur within these areas where the SELs were recorded above

100 dB re 20 µPa^2·s were calculated and the percentage of animals that exhibited a behavioral response, estimated from the most recent monitoring report (Naval Air Warfare Center Weapons Division 2017), was then applied. This resulted in the maximum number of animals that could potentially be taken by harassment (Table 6-4).

Previous monitoring during 2001–2017 showed that SELs above 100 dB re 20 µPa^2·s were measured in pinniped census areas K, L, and M (Cormorant Rock to Red Eye Beach; Figure 6-3). Aerial and ground-based census data provided by Mark Lowry, NOAA Southwest Fisheries Science Center (SWFSC), and in Carretta et al. (2017), provide the most recent counts available of harbor seals and California sea lions at SNI. For each species, censuses were typically conducted seasonally, when the maximum number of animals are known to occur on land. Harbor seals and California sea lions breed seasonally and are most abundant on land during their spring and summer breeding periods. In addition, other life history traits, such as foraging, reduce the proportion of time that individuals might be hauled out on SNI; these are discussed in the sub-sections for the individual species, below.

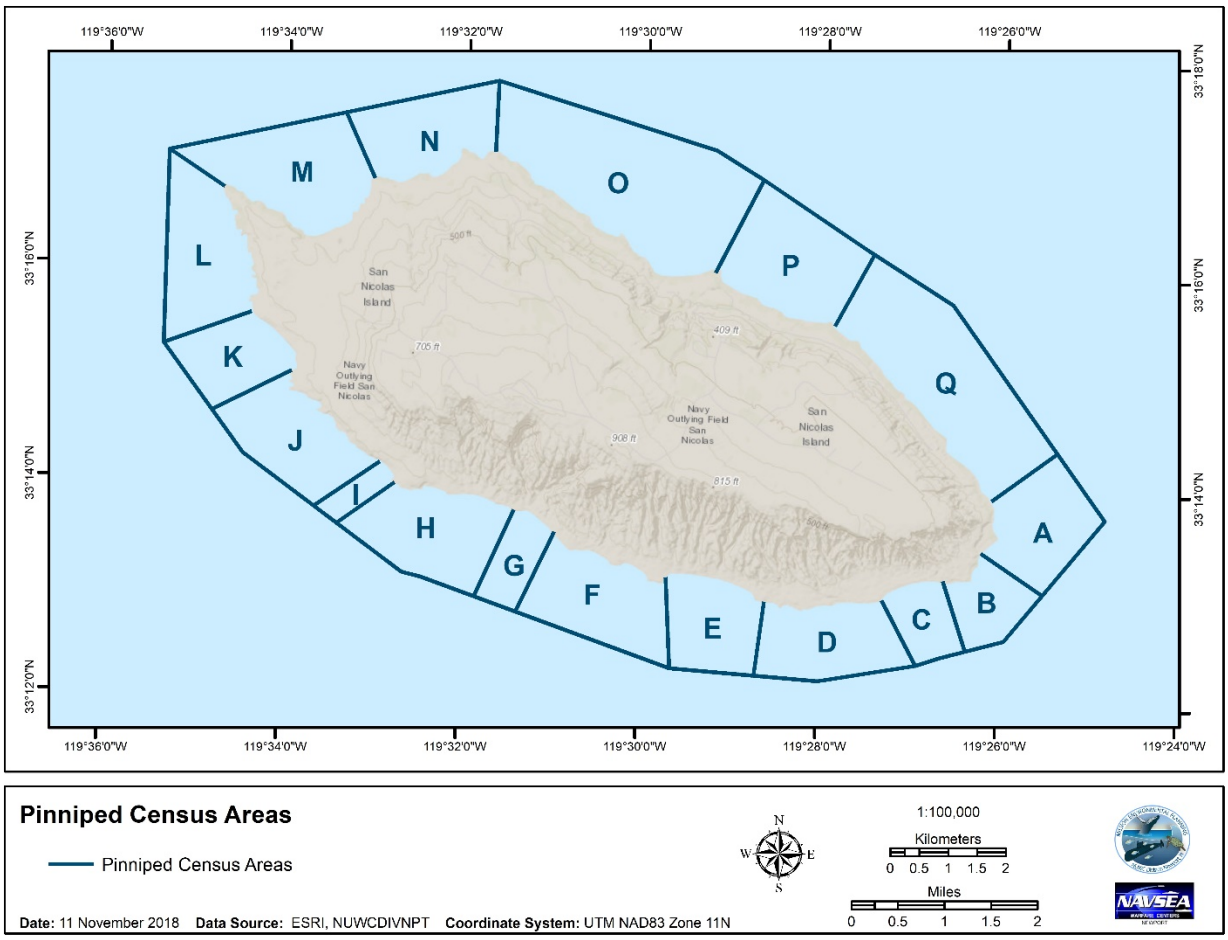

Figure 6-3. Census and monitoring areas on SNI and associated alphabetic codes used and provided by M. Lowry (NMFS-SWFSC) to identify census areas.

Past monitoring shows that the actual number of pinnipeds taken by harassment is likely to be far lower than previous maximum estimates provided in prior LOA applications because the actual number of launches were far less than the maximum number of 40 estimated launch events (Department of the Navy 2014). For example between 2001 and 2017, a maximum of 1,990 California sea lions and 395 harbor seals were estimated to have been potentially harassed in any single monitoring year incidental to missile launches at SNI (Burke 2017; Holst et al. 2010; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012). These estimates include animals that left the haul-out site in response to the launch and likely include multiple exposures to individual animals, as beaches were monitored repeatedly over the course of the year during numerous launches. However, some animals that displayed behavioral reactions may have been missed, as not all areas can be monitored during the launches. Pinnipeds that were potentially affected left the haul out site in response to the launch by entering the water, swimming nearshore and not returning immediate to the haul out, or exhibited other behavioral changes when compared to their behavior immediately prior to the launch. Of the California sea lions, many were young animals such as older pups (greater than 4 months in age) or juveniles. It is unlikely that any of the pinnipeds on SNI were adversely impacted by such behavioral reactions and no serious injury or mortality incidental to launch events was observed[5] (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012).

Although the effects of sounds from missiles proposed for launching from SNI on in-air hearing sensitivity of pinnipeds have not been measured, there is a possibility that some launch sounds, as received on beaches where pinnipeds haul out on SNI, may cause TTS. Although, the in-air hearing sensitivity to missile launch events at SNI have not been directly measured, it is assumed, for the purposes of this take request, that received levels from noise launch events do have a slight potential to cause TTS. However TTS sound levels are expected to be mild and reversible, and would not constitute injury to any exposed individual (Southall et al. 2007).

6.6.1 Harbor Seal

Both females and males of all age classes of harbor seals (including pregnant females) could be seasonally found on the beaches throughout the year, although in reduced numbers at certain times due to foraging patterns and adverse weather. Harbor seals are seasonal breeders and thus are slightly more abundant during their late winter and spring breeding and molting periods. The most recent harbor seal census surveys (2011-2015) estimated 229 (in 2011), 326 (in 2012), 605 (in 2013), 610 (in 2014), and 259 (in 2015). Lowry et al. (2008) estimated a total of 584 in 2002 and 784 in 2004 and approximately 850 in 2007, and 750 in 2009 (the latter two are estimates based on Lowry et al. (2008) in Figure 4-3). Previous monitoring during 2001–2017 showed that generally most, if not all monitored harbor seals, entered the water in response to launches, though occasionally smaller numbers or even no seals exhibited a response. However, a small proportion of harbor seals in area O, on the north side of SNI (Figure 6-3), reacted to levels below 100 dB re 20 $\mu Pa^2 \cdot s$ (as low as 60 dB) by entering the water. It was previously estimated in the most recent LOA (Department of the Navy 2014) that approximately 70 percent of harbor seals that hauled out on SNI used the beaches within areas K, L, and M (Figure 6-3). If harbor seals are expected to respond to launches with lower sound levels, it was also assumed that a small proportion of animals hauled out in areas I, J, N, and O (Figure 6-3) would also be affected. Therefore, a conservative estimate of 80 percent of harbor seals on SNI was used to estimate previous

[5] Naturally caused mortality or injury would be expected at a rookery/haul-out site such as SNI.

maximum number of animals that may be impacted (using 850 harbor seals from 2007 for a total take estimate of approximately 680 seals) and it was assumed that the population has remained relatively stable or was decreasing. In reviewing Lowry et al. (2017a), the most recent census surveys of harbor seal use on SNI: between 2.0 percent (in 2015) and 51 percent (in 2012) of harbor seals hauled out within areas K,L, and M (Figure 6-3) only which is significantly lower than the previous estimate of 70 percent; and, between 29 percent (in 2015) to 54 percent (in 2012) of harbor seals hauled out within areas I, J, K, L, M, N, and O (Figure 6-3) which is also lower than the conservative estimate of 80 percent that was used previously. The highest maximum estimate of harbor seals hauled out within areas I, J, K, L, M, N, and O (Figure 6-3) during the most recent 5-year census (2011-2015), was in 2014 with 283 animals (Lowry et al. 2017b). The most recent surveys did provide counts by subdivision (Figure 6-3), which previous surveys did not, including the 2007 estimate that was used to estimate the previous LOA's take estimate for harbor seals.

The proportion of harbor seals hauled out at any given time varies with time of day, date, tide height, and other factors. During the night, the number potentially affected would be greatly reduced as harbor seals usually go to sea to forage between 1900 and 1100 local time (Stewart and Yochem 1984). Thus, the average proportion of harbor seals ashore over the course of a 24-hour period might be less than one third of the peak numbers. Also, during August to February, it has been reported that the numbers hauled out might be only 65 to 83 percent of the maximum numbers ashore during the breeding season. During winter, the proportion hauled out relative to the peak season might be only 15 percent (Yochem et al. 1987). If we assume that, for all months except the breeding season, each seal might haul out for an average of only 8 hours between foraging bouts, then a given harbor seal would probably be present for only a few of the approximately 40 launches per year.

During the majority of launches from 2001-2017, most individuals left their haul-out sites on rocky ledges to enter the water and did not return during the duration of the video-recording period, which sometimes extended up to several hours after the launch time (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012). However, the field of view of the camera was fairly limited, so harbor seals could have returned to a different haul-out site that was just outside of the field of view, but there is no way with the current video monitoring to confirm this; therefore, it was assumed that they did not return. During follow-up monitoring the next day, harbor seals were usually hauled out again at their prelaunch haul-out sites (LGL Ltd. and Greenridge Sciences Inc. 2002). There was no evidence of mortality or injury to these seals.

Since there is considerable variability between census years and number of harbor seals estimated at SNI, and based on the most recent annual survey data, the maximum number of harbor seals hauled out during the most recent 5-year annual survey of 283 animals was rounded up to 300 animals for evaluation of take estimates. Based on monitoring from December 2015 to November 2017 (Burke 2017; Ugoretz 2016), a total of 12 harbor seals were taken by Level B harassment per launch. Using the maximum number of expected launches per year (40) and the total number of harbor seals taken by Level B harassment (12) approximately 480 harbor seals on SNI might be taken by harassment during a 1-year period of 40 missile launches. The Navy conservatively used the higher take estimate of 480 rather than 300 harbor seals to estimate take. Therefore, the Navy requests a maximum of 480 harbor seals on SNI may be taken by harassment during a 1-year period for a maximum of 40 launches. The Navy will continue monitoring activities to provide further information useful in determining whether harbor seals do react in any significant way to these launches. Any "take" is expected to be limited to Level B harassment.

6.6.2 California Sea Lion

Both females and males of all age classes of California sea lions are seasonally found on SNI. Adult female California sea lions and juvenile sea lions are found on the beaches throughout the year, although in reduced numbers at certain times due to foraging patterns and adverse weather. Males generally come ashore only briefly during the spring breeding period, but they can be found at other times as well.

To estimate the maximum potential numbers of sea lions that might be hauled out within areas exposed to sound levels ≥100 dB re 20 µPa2·s, the maximum number of sea lions occurring within map areas K, L, and M (Figure 6-3) in any year between 2001 and 2017 was calculated. During this period, a maximum of 14,963 sea lions were within areas K, L, and M. Using a population growth of 5.6 percent per year, a maximum of 20,749 sea lions of all ages and sexes may have been hauled out in 2014 within the area exposed to levels ≥100 dB (Figure 6-3). For most of the year, only females and pups (and then perhaps less than half of these) are expected to be ashore, so the number of animals exposed to these levels from any one launch will be significantly less than the estimated total number. Further, based on observations from video recordings of sea lions closest to the launch pad during launches, only a portion of the sea lions ashore flee into the water; many startle or move only a short distance on the beach (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012). An even smaller proportion of sea lions hauled out further away from the launch pad react to the launches (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012).

During 2001–2017, responses of California sea lions to the launches varied by individual, age group, season and missile type. Some sea lions exhibited brief startle responses and increased vigilance for a short period after each launch. Other sea lions, particularly pups that were previously playing in groups along the margin of the haul-out beaches, appeared to react more vigorously. Some pups rushed into the water, while other pups in the water rushed onto shore. Most adult sea lions already hauled out milled about on the beach for a short period before settling. Most sea lions in all age classes settled back to pre-launch behavior patterns within minutes of the launch time.

The Navy proposes to use the same methodology to estimate take of California sea lions that was presented in the previous LOA (Department of the Navy 2014). Based on monitoring from December 2015 to November 2017 (Burke 2017; Ugoretz 2016), an average of 178 sea lions were taken by Level B harassment per launch. Therefore, using the maximum number of expected launches per year, the Navy estimates that a maximum of 7,120 California sea lions on SNI might be taken by harassment during a 1-year period of 40 missile launches.

6.7 Summary of Estimated Take by Harassment

The Navy estimates that no more than the following numbers of pinnipeds are likely to be taken by Level B harassment as a result of the Proposed Action: 480 harbor seals and 7,120 California sea lions. The number of individuals that might stampede or make large-scale movements is difficult to estimate. However, monitoring results to date indicate that the reactions of many pinnipeds are no more than minor.

Based on the results of the marine mammal monitoring conducted by the Navy during the 2001–2017 launch program, annual take estimates likely represent an overestimate of the actual numbers of pinnipeds that are likely to show strong behavioral reactions (e.g., flush into the water). This is particularly the case for California sea lions which show little response to launch noise in comparison to harbor seals. The monitoring program described in Chapter 13 will provide data on “take” estimates, on the specific nature of the “taking”, and on the relationship between sound exposure and the nature and frequency of responses.

Chapter 7 Anticipated Impact of the Activity

The anticipated impact of the activity to the species or stock of marine mammal.

The likely or possible effects of the planned missile launch operations at SNI on marine mammals involve both acoustic and non-acoustic effects. Acoustic effects relate to sound produced by the missile engines and, in some cases, their booster rockets. Potential impacts to California sea lions and Pacific harbor seals could result from airborne noise associated with launch events.

Potential non-acoustic effects could result from the physical presence of personnel during placement of video and acoustical monitoring equipment. However, careful deployment of monitoring equipment is expected to minimize the potential for disturbance to pinnipeds hauled out nearby. Visual disturbance caused by the missile flying overhead is likely to be minor and brief as the missiles are relatively small, move at high speed, and are generally at high altitudes when crossing over haul-outs. There is a small chance that a pup might be injured or killed during a stampede of pinnipeds on the shore during a missile launch, but this has not been documented in videotaped records of pinniped groups during launches at SNI in 2001–2017 (Burke 2017; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2005b; Ugoretz 2016; Ugoretz and Greene Jr. 2012).

7.1 Noise Characteristics and Effects

The effects of noise on marine mammals are highly variable. As described in the following subsections, not all of these categories of effect (e.g., hearing damage, stress) will occur as a result of the planned missile launches; sound exposure levels are sufficiently low and transitory to make some of these effects unlikely. Some others (e.g., masking) are not expected to occur for sufficient time to cause biologically important effects. The following noise effect categories are based on Richardson et al. (1995):

(1) The noise may be too weak to be heard at the location of the pinniped, i.e., lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both.

(2) The noise may be audible but not strong enough to elicit any overt behavioral response.

(3) The noise may elicit reactions of variable conspicuousness and variable relevance to the well-being of the pinniped; these can range from temporary alert responses to active avoidance reactions such as stampedes into the sea from terrestrial haul-out sites. It is possible, although unlikely, that stampedes could result in injuries or deaths of some individuals, especially pups.

(4) Upon repeated exposure, pinnipeds may exhibit diminishing responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics, infrequent and unpredictable in occurrence (as are missile launches), and associated with situations that the pinniped perceives as a threat.

(5) Any man-made noise that is strong enough to be heard has the potential to reduce (mask) the ability of pinnipeds to hear natural sounds at similar frequencies, including calls from

conspecifics, and environmental sounds such as surf noise. Masking is of most concern when exposure to sound is continuous, or nearly so, and of less or no concern when exposure is brief and/or infrequent (as in the present situation).

(6) If mammals choose to remain in an area because it is important for feeding, breeding or some other biologically important purpose even though there is chronic exposure to noise, it is possible that there could be noise-induced physiological stress; this might (in turn) have negative effects on the well-being or reproduction of the animals involved. Such chronic physiological effects are highly unlikely due to the relatively infrequent and brief nature of the sounds from the planned launches (up to 40 launches per year, on varying azimuths; only a fraction of the animals hauled out during any one launch).

(7) Very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity (Section 7.5). Effects of non-explosive sounds on hearing thresholds of marine mammals are poorly known. Received sound levels must far exceed the animal's hearing threshold for there to be any TTS. Received levels must be even higher for there to be risk of PTS.

7.2 Pinnipeds and Sound

7.2.1 Pinniped Sound Production

With the exception of harbor seals, pinniped species present in the activity area are very vocal during their mating seasons. In air, harbor seals are not as vocal as California sea lions, for example, even during their breeding season. However, harbor seal pups do have a call that mothers can use to locate and perhaps identify their offspring (Renouf 1984, 1985). This call (and perhaps other low-frequency threat vocalizations) may be audibly recognizable up to 140 m away and detectable by the mother up to 1,000 m away under good conditions over water (Reiman and Terhune 1993). These values may be lower on land, but these data suggest that harbor seal mothers should be able to detect the calls of their pups despite higher ambient noise levels or when separated.

Unlike harbor seals, California sea lions make extensive use of in-air vocalizations to maintain mother-pup bonds and facilitate interactions between adult pinnipeds (Gisiner and Schusterman 1991; Peterson and Bartholomew 1967; Petrinovich 1974; Riedman 1990; Shipley et al. 1981, 1986; Shipley and Strecker 1986). These vocalizations can be of high amplitude and can propagate substantial distances across haul-out groups. Pup attraction calls of California sea lions, in particular, have evolved to facilitate mother-pup reunions after separations due to natural foraging or resulting from disturbances.

Pinniped call characteristics are relevant in assessing potential masking effects of man-made sounds and the likely frequency range of best hearing in species whose hearing has not been tested (In fact, the hearing abilities of California sea lions and harbor seals have all been measured directly). While vocalizations of pups and other conspecifics could be masked by broadband launch noise of high amplitude, this would be extremely brief. Brief masking would not interfere with subsequent functions of the calls, even in a startled group of pinnipeds that might be vocalizing at a higher rate or amplitude than normal.

7.3 Behavioral Reactions of Pinnipeds to Missile Launches

Noises with sudden onset or high amplitude relative to the ambient noise level may elicit a behavioral response from pinnipeds resting on shore. Some pinnipeds tolerate high sound levels without reacting strongly, whereas others may react strongly when sound levels are lower. Published papers and available technical reports describing behavioral responses of pinnipeds to the types of sound recorded near haul-out sites on SNI indicate that there is much variability in the responses (Table 7-1). Responses can range from momentary startle reactions to animals fleeing into the water or otherwise away from their resting sites in what has been termed a stampede. Studies of pinnipeds during missile launch events have demonstrated that different pinniped species, and even different individuals in the same haul-out group, can exhibit a range of responses from alert to stampede. It is this variation that makes setting reaction criteria difficult. An acoustic stimulus with sudden onset (such as a sonic boom) may be analogous to a looming visual stimulus (Hayes and Saif 1967), which can be especially effective in eliciting flight or other responses (Berrens et al. 1988). Missile launches are unlike many other forms of disturbance because of their sudden sound onsets, high peak levels in some cases, and short durations (Cummings 1993).

Previous to the start of the monitoring work at SNI under an IHA issued in 2001, most existing data on reactions of hauled-out pinnipeds to launch noise involved far larger launch missiles or rockets (e.g.,

Titan IV) than the Coyotes and other missiles that will be launched from SNI (Table 7-1). In most cases, where the species of pinnipeds occurring in the PMSR have been exposed to the sounds of large rocket launches (such as the Titan IV and Delta IV from Vandenberg Air Force Base [VAFB]), animals did not flush into the sea unless the sound level to which they were exposed (Table 7-1) was relatively high (Thorson et al. 1999; Thorson et al. 1998). The reactions of harbor seals to even these large rockets launches have been limited to short-term (5–30 min) avoidance of the haul-out sites (68 FR 25347; May 12, 2003). In the context of launches of large missiles and rockets from VAFB, brief alert or startle reactions by pinnipeds on a beach are not considered to constitute disturbance sufficient to require an incidental take authorization (64 FR 9925; April 8, 1999).

Table 7-1. Behavioral responses by California sea lions and Pacific harbor seals hauled out within the PMSR to transient anthropogenic acoustic stimuli of varying source and intensity.

SEL (A-SEL dB re 20 µPa)	*Sound*	*Reproductive Status*		*Notes on Reaction*	*Study Resource*
		Breeding	*Non-breeding*		
California Sea Lion					
No Reaction					
100	Titan IV launch		x	-	(Stewart et al. 1991)
80-100	sonic boom		x	-	(Stewart and Huber 1993)
75-85	sonic boom	x	x	-	(Bowles and Stewart 1980)
Alert/Startle					
100-120	carbide cannon	x		60-90% alert	(Stewart 1982)
110	Titan IV night launch		x		(Stewart and Francine 1992)
Flush/Movement					
110-125	carbide cannon		x	70% fled	(Stewart 1982)
75-100	Titan IV explosion	x		45% fled during 104 s of popping	(Stewart et al. 1993)
Harbor Seal					
No Reaction					
100	Titan IV launch		x	-	(Stewart and Francine 1992)
Alert/Startle					
85	sonic boom		x	-	(Stewart and Huber 1993)
Flush/Movement					
95	Titan IV launch		x	82% fled	(Stewart and Huber 1993)
100	Titan IV launch		x	all fled	(Stewart et al. 1993)
95-100	Titan IV launch		x	-	(Stewart et al. 1991)
75-85	sonic boom	x	x	-	(Bowles and Stewart 1980)
110	Taurus launch at 2.2 km	x		40 s duration 87% fled	(Stewart et al. 1994)
80	Taurus launch at 20.4 km		x	130 s duration 27% fled	(Stewart et al. 1994)
75	Titan IV explosion		x	all fled during 104 s of popping	(Stewart et al. 1993)

* Sound intensity values measured as dBA peak (Stewart et al. 1994)

Although elephant seals are not part of this IHA request, information is provided below for comparison to California sea lions and harbor seals since they were monitored at SNI along with sea lions and harbor seals prior to 2010. The Navy has summarized the systematic monitoring results from missile launches at SNI from mid-2001 through 2017 (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Holst et al. 2005b; LGL Ltd. and Greenridge Sciences Inc. 2002; Ugoretz 2016; Ugoretz and Greene Jr. 2012). Based on SNI launch monitoring results from 2001 to 2017, most pinnipeds – especially California sea lions and northern elephant seals — exhibited no more than short-term alert or startle responses (Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011). Harbor seals when compared to California sea lions or northern elephant seals are more easily disturbed (Holst et al. 2005a; Holst et al. 2008; Stewart 1981a; Stewart et al. 1994). Any localized displacement would be of short duration, although some harbor seals may leave their haul-out site until the following low tide (e.g. low tides provide more accessibility to haul out). Holst and Lawson (2002) noted that numbers occupying haul-out sites on the next day were similar to pre-launch numbers.

Video recordings of pinnipeds around the periphery of western SNI during launches on SNI in 2001–2017 showed that some pinnipeds reacted to a nearby launch by moving into the water or along the shoreline (Burke 2017; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012). California sea lions (especially the younger animals) exhibited more reaction than elephant seals, and harbor seals were the most responsive when comparing the three species. However, video recordings confirmed that the most common type of reaction to missile launch events at SNI were momentary “alert” responses.

Responses of California sea lions to launch events varied by individual and age group (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011). Some sea lions exhibited brief startle responses and increased vigilance for a short period after each launch. Other sea lions, particularly pups that were previously playing in groups along the margin of the haul-out beaches, appeared to react more vigorously. A greater proportion of hauled-out sea lions typically responded and/or entered the water when launch sounds were louder (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012). Adult sea lions already hauled out would mill about on the beach for a short period before settling, whereas those in the shallow water near the beach did not come ashore like the aforementioned pups.

During the majority of launches at SNI, most harbor seals within the audible range of the launch left their haul-out sites on rocky ledges to enter the water and did not return during the duration of the video-recording period (which sometimes extended up to several hours after the launch) (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012). During monitoring the day following a launch, harbor seals were usually hauled out again at these sites (LGL Ltd. and Greenridge Sciences Inc. 2002).

The type of missile being launched is also important in determining the nature and extent of pinniped reactions to launch sounds. Holst et al. (2008) showed that significantly more California sea lions responded during Coyote launches than during other missile launches. The BQM-34 and especially the BQM-74 subsonic drone missiles that may be launched from SNI are smaller and less noisy than Coyotes. Launches of BQM-34 drones from NAS Point Mugu have not normally resulted in harbor seals leaving their haul-out area at the mouth of Mugu Lagoon approximately 3.2 km to the side of the launch track (Lawson et al. 1998).

In addition to noise, night launches will also emit light, a visual cue that could elicit a response. Haul-out beaches near the Building 807 Launch Complex in particular may be affected by light during nighttime launches; however only California sea lions would be expected as most harbor seals would be out foraging during nighttime activities. Additional responses to the light, above and beyond those that are elicited by the launch sounds are not anticipated. The continuation of the launch monitoring program (Chapter 13) will enable further documentation of pinniped responses to various launch missiles with different acoustic characteristics, and to nighttime launches.

7.3.1 Masking

Any man-made noise that is strong enough to be heard has the potential to reduce (mask) the ability of marine mammals to hear natural sounds at similar frequencies, including calls from conspecifics and environmental sounds such as surf noise. However, the infrequent launch events (up to 40 per year, although historical l launch events have totaled fewer than 40 per year), of which some will be small missiles, could cause masking, but it would be expected for no more than a very small fraction of the time during any single day (e.g., usually less than 2 s and rarely more than 5 s during a single launch). Occasional brief episodes of masking at SNI would have no significant effects on the ability of California sea lions or harbor seals to hear one another or to detect natural environmental sounds that may be relevant.

7.3.2 Stampede-Related Injury or Mortality

It is possible that launch-induced stampedes could have adverse impacts on individual pinnipeds on the west end of SNI. Bowles and Stewart (1980) reported that harbor seals on San Miguel Island reacted to low-altitude jet overflights with alert postures and often with rapid movement across the haul-out sites, especially when aircraft were visible. During missile launches in 2001–2017, there was no evidence of launch-related injuries or deaths (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012). On several occasions, harbor seals and California sea lion adults moved near and sometimes over older pups (i.e., greater than four months old) as the animals moved in response to the launches, but the pups were not injured (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012), nor did the animals exhibit launch-induced stampedes. Harbor seals on San Miguel Island flushed into the water in response to some sonic booms and to a few of the overflights by light aircraft, jets above 244 m, and helicopters below 305 m (Bowles and Stewart 1980). Sometimes the harbor seals did not return to haul out until the next day, although they more commonly returned the same day. Bowles and Stewart (1980) suggested that such disturbance-induced stampedes or mother-pup separations could be a source of the increased mortality observed. However, observations during actual sonic booms (Table 7-1) and tests with a carbide cannon simulating sonic booms at San Miguel and SNI provided no evidence of such pinniped injury or mortality (Stewart 1982; Thorson et al. 1999), and no mortality has been observed during missile launches at SNI (Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz and Greene Jr. 2012).

Natural mortality and injury is expected at SNI, given the large numbers of pinnipeds that haul out there and give birth on the island. For example, during the 1997–98 El Niño event pup mortality on rookeries increased during this period, particularly for California sea lions. As in previous years, the Navy would continue to document and report any injuries or mortality that could be related to launch events.

7.4 Hearing Impairment

As noted earlier, very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity. Received sound levels must far exceed the animal's hearing threshold for there to be any TTS. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the transient. Received levels must be even higher for there to be risk of permanent hearing impairment. Although it is possible that some pinnipeds may incur TTS during launches from SNI, hearing impairment has not been measured for pinniped species exposed to launch sounds. Auditory brainstem response (i.e., hearing assessment using measurements of brainwaves) was used to demonstrate that harbor seals did not exhibit loss in hearing sensitivity following launches of large rockets at VAFB (Thorson et al. 1999; Thorson et al. 1998). However, the hearing tests did not begin until at least 45 minutes after the launch; therefore, harbor seals may have incurred TTS which was undetectable by the time testing was begun. There was no sign of PTS in any of the harbor seals tested (Thorson et al. 1999; Thorson et al. 1998). Since 2001 no launch events at SNI have exposed pinnipeds to noise levels at or exceeding those where PTS could be incurred.

Available evidence from launch monitoring at SNI in 2001–2017 suggests that only a small number (if any) of the pinnipeds at SNI are exposed to levels of launch sound levels that could elicit TTS (Burke 2017; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012). The assumed TTS threshold for the species with the most sensitive hearing (harbor seal) is 134 dB re 20 $\mu Pa^2 \cdot s$ (Mpa-weighted), with higher values applying to other species (Table 6-1). The measured SEL values near pinniped beaches during missile launches at SNI during 2001–2007 were below 129 dB re 20 $\mu Pa^2 \cdot s$ (A- or Mpa-weighted). In fact, few if any pinnipeds were exposed to SELs above 122 dB re 20 $\mu Pa^2 \cdot s$ on an Mpa-weighted basis and above 118 dBA, even on beaches near Building 807 Launch Complex (Holst et al. 2008). Sounds at these levels are not expected to cause TTS or PTS.

7.5 Non-auditory Physiological Responses

Wolski (1999) examined the physiological responses of pinnipeds to simulated sonic booms. He noted that harbor seals responded with bradycardia, reduced movement, and brief apneas (indicative of an orienting response); and the response of California sea lions was variable. Perry et al. (2002) examined the effects of sonic booms from Concorde aircraft on harbor seals and gray seals (*Halichoerus grypus*). They noted that observed effects on heart rate were generally minor and not statistically significant; gray seal heart rates showed no change in response to booms, whereas harbor seals showed slightly elevated heart rates.

Humans and terrestrial mammals subjected to prolonged exposure to noise can sometimes show physiological stress. However, even in well-studied human and terrestrial mammal populations, noise-induced stress is not easily demonstrated. If noise-induced stress does occur in marine mammals, it is expected to occur primarily in those exposed to chronic or frequent noise. It is very unlikely that it would occur in animals, specifically California sea lions and Pacific harbor seals, exposed to only a few very brief launch events over the course of a year.

7.6 Summary

Missile launches are characterized by sudden onset of sound, moderate to high peak sound levels (depending on the type of missile and distance), and short sound duration. Effects of missile launches on

some pinnipeds in the Channel Islands have been studied. In most cases, where pinnipeds have been exposed to the sounds of large missile and rocket launches (e.g., Titan IV and Delta IV from VAFB), animals did not flush into the sea unless the sound level to which they were exposed was relatively high, or of an unusual duration. Similarly, at SNI, the proportion of responding California sea lions to missile launches are higher with increasing SELs; harbor seal reactions to launch sounds are more variable.

Thus, responses of pinnipeds on beaches exposed to acoustic disturbance arising from launches are highly variable. In addition, some species, such as harbor seals, are more reactive when hauled out compared to other species, such as northern elephant seals. Responsiveness also varies with time of year and age class, with juvenile pinnipeds being more likely to react by leaving the haul-out site. Given this variability in response, the Navy assumes that disturbance will sometimes occur upon exposure to launch sounds with SELs of 100 dB re 20 $\mu Pa^2 \cdot s$ or higher; but for harbor seals, this level may be lower. While the reactions are variable, and can involve abrupt movements by some individuals, biological impacts of these responses appear to be limited. The responses are not expected to result in significant injury or mortality, or long-term negative consequences to individuals or pinniped populations on SNI.

Based on measurements of received sound levels during previous launches at SNI (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012), the Navy expects that there is a very limited potential of effects on hearing sensitivity (TTS) for a few of the pinnipeds present, but if these effects were to occur they are expected to be mild and reversible. Although it is possible that some launch sounds as measured close to the launchers may exceed the PTS criteria, it is not expected that any pinnipeds would be close enough to the launchers to be exposed to sounds strong enough to cause PTS.

Given that the observations of pinnipeds during missile launches at SNI have not shown injury, mortality or extended disturbance, and that their populations and/or distributions on the island are stable or expanding, the effects of missile launches are expected to be limited to short-term and localized behavioral changes.

Chapter 8 Anticipated Impacts on Subsistence Uses

The anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence uses.

No subsistence uses for these pinniped species occur on or near SNI. No impacts are expected to the availability of the species stock as a result of the Proposed Action.

Chapter 9 Anticipated Impacts on Habitat

The anticipated impact of the activity upon the habitat of the marine mammal populations and the likelihood of restoration of the affected habitat.

No impacts to habitat are proposed for or would occur as a result of this Proposed Action. No new structures would be installed that would result in the loss of additional habitat. Therefore, no restoration of the habitat would be necessary.

Various beaches around SNI are used by pinnipeds as places to rest, molt, and breed. These beaches consist of sand (e.g., Red Eye Beach), rock ledges (e.g., Phoca Reef), and rocky cobble (e.g., Bachelor Beach). Pinnipeds continue to use beaches around the western end of SNI, and indeed are expanding their use of some beaches despite ongoing launch activities for many years. Similarly, it appears that sounds from prior launches have not affected pinniped use of coastal areas at VAFB (National Marine Fisheries Service 2003). Thus, periodic launches do not prevent pinnipeds from using beaches.

Pinnipeds forage in the open ocean and in the waters near SNI; however, the airborne launch sounds would not persist in the water near SNI. Therefore, it is not expected that the launch activities would impact prey resources, Essential Fish Habitat (EFH), or feeding success of California sea lions or Pacific harbor seals. Three types of EFH are present in the activity area: groundfish, coastal pelagic species, and highly migratory species, as well as canopy kelp Habitat Areas of Particular Concern (HAPC). However, none of these types of EFH or HAPC will be impacted by the Proposed Action. Therefore, there would be no significant impacts to groundfish, coastal migratory pelagic, or highly migratory species EFH, or canopy kelp HAPC as a result of the Proposed Action.

Boosters from missiles (e.g., jet-assisted take off rocket bottles for BQM drone missiles) may be jettisoned shortly after launch and fall on the island and would be collected, but are not expected to impact beaches. Fuel contained in these boosters is consumed rapidly and completely, so there would be no risk of contamination even in the very unlikely event that a booster did land on a beach or nearshore waters. Overall, the proposed missile launch activity is not expected to cause significant impacts or have permanent, adverse effects on pinniped habitats or on their foraging habitats and prey.

Chapter 10 Anticipated Effects of Habitat Impacts on Marine Mammals

The anticipated impact of the loss or modification of the habitat on the marine mammal populations involved.

The Proposed Action's activities are not expected to result in any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or populations. As described in Chapter 9, the Proposed Action is expected to have no impact on the ability of marine mammals to disperse in their foraging areas or impact their foraging areas. There would be no increase in permanent habitat loss as a result of the project.

Chapter 11 Mitigation Measures

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Chapter 6 describes the maximum potential number of marine mammals—by species—that may be exposed to acoustic sources that would be considered Level B harassment by NMFS. Marine mammals will be protected from Level A harassment as no individual animal is expected to be exposed to airborne noise that reaches the level of injury or mortality and marine mammal monitoring; this chapter describes the methods. The number of individual animals expected to be disturbed during the proposed activity will be small in relative to their population and stock abundance estimates. With the standard, ongoing monitoring and mitigation provisions described below, effects on those individuals are expected to be well documented, and limited to Level B harassment. This is expected to have negligible impacts on the species and stocks. The mitigation measures provided are proposed by the NAWCWD in order to minimize the number of marine mammals potentially affected by launch activities.

In addition, to minimize the likelihood that impacts will occur to the species and stocks of marine mammals, all operational activities will be conducted in accordance with all Federal, state, and local regulations. NAWCWD will coordinate all activities with the relevant Federal and state agencies. These will include NMFS, the U.S. Fish and Wildlife Service, and the California Coastal Commission.

The Navy will continue the existing mitigation and monitoring efforts (described here in Chapter 11 and in Chapter 13 of this Application) during every launch when pinnipeds are present on beaches in the zone of influence or area of potential take[6].

Consistent with the Navy's previous Letter of Authorization and associated Regulations (National Marine Fisheries Service 2014), where practicable, the Navy will adopt the following mitigation measures, provided that doing so will not compromise operational safety, human safety, national security or other requirements or mission goals:

(1) Personnel cannot enter pinniped haul-outs below the predicted missile path for two hours prior to a launch.
(2) Launches are to be avoided during harbor seal pupping season (February through April) unless constrained by mission objectives or certain other factors,
(3) Launches are to be limited during Elephant Seal (January through February) and California sea lion (June through July) pupping seasons unless constrained by mission objectives or certain other factors.

[6] These efforts may be scaled back at a future date, at least for launches of the smaller or less noisy launch missiles when NMFS and the Navy concur that previous monitoring results are sufficient to show that the effects of these launches on marine mammals at SNI are minimal or to only include seasons when pinnipeds are expected to be most susceptible to disturbance (e.g., breeding and pupping periods).

(4) Missiles may not cross over pinniped haul-outs at elevations less than 1,000ft.
(5) Launches of multiple missiles in quick succession should be avoided.
(6) Launches at night should be limited.
(7) Other aircraft cannot fly at altitudes less than 1,000ft over pinniped haul-outs and rookeries.

Chapter 12 Mitigation Measures to Protect Subsistence Uses

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, you must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses.

Not applicable. The proposed activity would take place on or near San Nicolas Island, California, in the PMSR and no activities would occur in or near a traditional Arctic subsistence hunting area.

Chapter 13 Monitoring and Reporting

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking or impacts on populations of marine mammals that are expected to be present while conducting activities and suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that would be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

The Navy will monitor the haul-out areas before, during, and after launch operations to document and characterize any observed responses, and (to the extent feasible) to detect any instances of pinniped injuries or deaths should they occur. The monitoring will be designed to determine how common the disturbance reactions are, the area over which they occur, and their relationship to launch sounds. Any changes to the monitoring plan would be proposed separately and subject to NMFS approval.

The planned monitoring tasks are described in detail below (Sections 13.1 and 13.2) and are equal to those adopted by NMFS for NAWCWD missile launch activities in 2010 (75 FR 71672; November 24, 2010). In November 2010, the Navy's monitoring plan was revised in two ways: (1) northern elephant seals were removed from the plan for targeted monitoring due to their lack of response to launches, and (2) the use of Forward-Looking Infrared Radiometer (FLIR) thermal imaging cameras for nighttime launches was added (75 FR 71672; November 24, 2010). The proposed monitoring plan is described below. It is very similar to the launch monitoring that has been conducted since 2010. This will assure that the results from the ongoing and previous work are consistent and can be combined for overall analyses.

The monitoring work described here has been planned as a self-contained project independent of any other related monitoring projects that may be occurring in the same region. The Navy is prepared to discuss coordination of its monitoring program with any related work that might be done by other groups insofar as this is practical and desirable (see Chapter 14).

13.1 Visual Monitoring of Pinnipeds during Each Launch

The Navy proposes to conduct marine mammal and acoustic monitoring during launches from SNI, using simultaneous autonomous audio recording of launch sounds and video recording of pinniped behavior. The land-based monitoring will provide data required to characterize the extent and nature of "taking". In particular, it will provide the information needed to document the nature, frequency, occurrence, and duration of any changes in pinniped behavior that might result from the missile launches, including the occurrence of stampedes.

These video and audio records will be used to document pinniped responses to the launches. This will include the following components:

(1) Identify and document any change in behavior or movements that may occur at the time of the launch;

(2) Compare received levels of launch sound with pinniped responses, based on acoustic and behavioral data from up to three monitoring sites at different distances from the launch site and missile path during each launch; from the data accumulated across a series of launches, to attempt to establish the "dose-response" relationship for launch sounds under different launch conditions if possible;

(3) Ascertain periods or launch conditions when pinnipeds are most and least responsive to launch activities, and

(4) Document take by harassment and, although unlikely, any mortality or injury.

13.1.1 Field methods

The launch monitoring program will include remote video recordings before, during, and after launches when pinnipeds are present in the area of potential impact, as well as visual assessment by trained observers before and after the launch. Remote cameras are essential during launches because safety rules prevent personnel from being present in most of the areas of interest. In addition, video techniques will allow simultaneous "observations" at up to three different locations, and will provide a permanent record that can be reviewed in detail. During some launches, use of video methods may allow observations of up to three pinniped species during the same launch, though in general one or two species will be recorded.

The Navy will seek to obtain video and audio records from up to three locations at different distances from the flight path of each missile launched from SNI. It is very likely that paired video and audio data will be obtained from less than three sites during some launches, given the various potential problems with video and acoustic recorders, timing of remote recordings when launches are delayed, absence of pinnipeds from some locations at some times, etc. Corresponding data is available from the previous monitoring periods (2001–2018).

Two different types of cameras will be available for use in obtaining video data simultaneously from three sites:

(1) Small handheld high-definition video cameras on photographic tripods are available to be set up by Navy personnel at various locations on the day of a launch, with the video data being accessible following the launch. Recording duration varies between 300 and 600 minutes following initiation of record mode on these cameras, depending upon battery life, external memory card available and other factors. The digital data is later copied to DVD-ROMs for subsequent viewing and analysis.

(2) Portable FLIR video cameras will be set up by the Navy for nighttime launches. These cameras have a recording duration of approximately 300 minutes from initiation of the record mode. The FLIR video data will be accessible following the launch. The digital data will later be copied to DVD-ROMs for subsequent viewing and analysis.

Before each launch, Navy personnel will set up or activate up to three of the available video cameras such that they overlook chosen haul-out sites. Placement will be such that disturbance to the pinnipeds is minimized, and each camera will be set to record a focal subgroup of sea lions or harbor seals within

the haul-out aggregation for the maximum recording time permitted by the videotape capacity. The entire haul-out aggregation on a given beach will not be recorded during some launches, as the wide-angle view necessary to encompass an entire beach would not allow detailed behavioral analyses (Holst et al. 2005a; Holst et al. 2008). It will be more effective to obtain a higher-magnification view of a sample of the animals on the beach. Prior to selecting a focal animal group, a pan of the entire haul out beach and surrounding area will be made in order to document the total number of animals in the area. Trained staff will make observations of the haul-out and note them on field data sheets prior to and after the launch.

Following each launch, video recordings will continue for at least 15 minutes and up to several hours. Personnel will return to the observing sites as soon as it is safe, to record the numbers and types of pinnipeds that remain on the haul-out site(s) and any notable changes. Greater post-launch time intervals are not advisable as storms and other events may alter the composition of pinniped haul-out groups independent of launch events.

13.1.2 Video and Data Analysis

Video data will be transferred to DVD-ROMs. A trained biologist will review and code the data from the video data as they are played back to a monitor (Holst et al. 2005a; Holst et al. 2008). The variables transcribed from the videos, or recorded directly at the beach sites, will include:

(1) Composition of the focal subgroup of pinnipeds (approximate numbers and sexes of each age class),

(2) Description and timing of disruptive event (launch); this will include documenting the occurrence of launch, whether launch noise is evident on audio channel, and duration of audibility, and

(3) Movements of pinnipeds, including number and proportion moving, direction and distance moved, pace of movement (slow or vigorous). In addition, the following variables concerning the circumstances of the observations will also be recorded from the videotape or from direct observations at the site:

    a. Study location,

    b. Local time,

    c. Weather (including an estimate of wind strength and direction, and presence of precipitation), and

    d. Tide state (Exact times for local high and low tides will be determined by consulting relevant tide tables for the day of the launch).

13.2 Acoustical Measurements

Acoustical recordings will be obtained during each monitored launch. These recordings will be suitable for quantitative analysis of the levels and characteristics of the received launch sounds. In addition to providing information on the magnitude, characteristics, and duration of sounds to which pinnipeds are exposed during each launch, these acoustic data will be combined with the pinniped behavioral data to determine if there is a “dose-response” relationship between received sound levels and pinniped behavioral reactions.

The Navy will use up to four autonomous audio recorders to make acoustical measurements. During each launch, these will be located as close as practical to monitored pinniped haul-out sites and near the launch pad itself. The monitored haul-out sites will typically include one site as close as possible to the missile's planned flight path and one or two locations farther from the flight path within the area of potential impact with pinnipeds present. ATARs will be deployed at the recording locations on the launch day well before the launch time, and will be retrieved later the same day.

During each launch, data on the type and trajectory of the missile will be documented. From these records the CPA of the missile to the microphone will be determined, along with its altitude above the shoreline. These data will be important in comparing acoustic data with those from other launches. Other factors to be considered will include wind speed and direction and launch characteristics (e.g., low- vs. high-angle launch). These analyses will include data from previous and ongoing monitoring work (Burke 2017; Holst et al. 2010; Holst et al. 2005a; Holst et al. 2008; Holst et al. 2011; Ugoretz 2016; Ugoretz and Greene Jr. 2012), as well as measurements to be obtained during launches under this IHA.

13.2.1 Analysis Procedures and Terminology

Currently, the ATARs record digital data directly onto a removable memory drive within the ATAR. The digital data on the removable drives are copied to a recordable CD-ROM after the recording period and returned to an acoustical contractor for sound analysis.

Both time-series and frequency-domain analyses are performed on the acoustic data. Time-series results include signal waveform and duration, peak pressure level (peak), root mean square SPL, and SEL. SPL and SEL are determined with three alternative frequency weightings: flat-, A-, and Mpa-weighted. Frequency-domain results included estimation of SPLs in one-third octave bands for center frequencies from 4 to 16 kHz. Holst et al. (Holst et al. 2008) describes how these values are defined and calculated.

Time-Series Analysis—All analyses require identification of a signal's beginning and end. This identification can be complicated by background noise (whether instrumental or ambient), poorly defined signal onsets, and gradually diminishing signal "tails." To obtain a consistent measure of signal duration for each flight, we first defined a "net energy" E. This measure of energy in excess of background is calculated as the cumulative signal energy above mean background energy:

$$E = \frac{1}{fs}\sum_{i=1}^{N}\left(x_i^2 - (n^2)\right) Pa^2 s$$

where x represents all data points in an event file, n represents only background noise data points before the flight sound, N is the total number of samples in the event file, and fs is the sampling rate.

Based on this consistent definition of net energy E, the beginning and end of a flight sound is defined as the times associated with the accumulation of 5 percent and 95 percent of E.

Welch (1967) Weighted Overlapped Segment Averaging method is used to generate representative power spectral densities in each case. Power spectral densities are calculated for the signal and pre-signal background noise on the low-sensitivity channel, and for background noise on the high-sensitivity channel. These spectral density values are then summed into one-third octave bands.

For these analyses, the "signal" consists of the recorded data (missile signal plus background noise). This time series is segmented according to duration (determined from the broad-band time series analysis) as follows:

- for duration >1 s, use 32,768-sample blocks of total length 0.74 s with Blackman-Harris (Harris 1978) minimum three-term window, overlapped by 50 percent. This results in frequency cells spaced by 1.35 Hz and an effective cell width (resolution) of 2.3 Hz.
- for 0.0929 s< duration <1 s, use 4,096-sample blocks of total length 0.0929 s with Blackman-Harris minimum three-term window, overlapped by 50 percent. This results in frequency cells spaced by 10.77 Hz and an effective cell width (resolution) of 18.3 Hz.
- for duration <0.0929 s, use the samples spanning the signal duration and apply a uniform window. This results in cell spacing in hertz given by the reciprocal of the record length in seconds. The cell width (resolution) is the same as the cell spacing.

Background noise data recorded on the high sensitivity channel, consisting of 4 s of data selected from before the missile signal, are segmented into 44,100-sample blocks overlapped by 50 percent and weighted by the Blackman-Harris minimum three-term window. This results in 1-Hz cell spacing and 1.7-Hz cell width, or resolution.

The spectral density values are integrated across standard one-third octave band frequencies to obtain summed SPLs for each band. This analysis is performed for the signal, the noise on the signal channel (low sensitivity channel), and the background noise (high sensitivity channel). Note that when the cell spacing is broad, the lowest frequency one-third octave bands cannot be computed. However, the cases of broad cell spacing correspond to cases of very short duration signals. Low frequencies are not important for short duration sounds.

Time-series results for the full 3 to 20,000 Hz bandwidth are calculated for flat-, A-, and Mpa-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; Richardson et al. 1995). 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.

Mpa-weighting is a recent development that arose from an effort to develop science-based guidelines for regulating sound exposures (Southall et al. 2007). During this process, separate weighting functions have been developed for five categories of marine mammals, with these functions being appropriate in relation to the hearing abilities of those groups of mammals (Southall et al. 2007). Two of these categories are pinnipeds listening in water and in air, for which the weighting functions have been

designated Mpw and Mpa, 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 Mpa-weighting, the lower and upper “inflection points” are 75 Hz and 30 kHz. Four Mpa-weighted sound levels are useful for purposes of assessing impacts on pinnipeds of sounds with high-received levels, such as those during some missile overflights.

13.3 Reports

A technical report will be submitted to the NMFS’ Office of Protected Resources, and the Southwest Regional Office, no later than 90 days from the date the IHA expires. This report will provide full documentation of methods, results, and interpretation pertaining to all monitoring tasks for launches for the duration of the IHA.

In the unanticipated event that any cases of pinniped mortality are judged to result from launch activities at any time during the period covered by the regulations, this will be reported to NMFS immediately.

Chapter 14 Suggested Means of Coordination

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

The Navy plans to discuss and where possible, coordinate its terrestrial pinniped monitoring program (as summarized in Chapter 13) with the SNI pinniped census program conducted by NMFS scientists. In particular, where the Navy's monitoring efforts might contribute to improvements of haul-out correction factors for aerial surveys, the Navy will make such information available to NMFS. The Navy will coordinate with NMFS and facilitate any on-island monitoring of pinnipeds by NMFS scientists.

As noted in Chapter 13, the Navy will sponsor pinniped and acoustical monitoring methods that will facilitate comparing and combining monitoring data where appropriate with other missile launch monitoring programs in California (e.g., U.S. Air Force research on the effects of large booster launches from VAFB) (Southall et al. 2007; Thorson et al. 1999; Thorson et al. 1998).

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