UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE

PETITION FOR REGULATIONS PURSUANT TO SECTION 101 (a) (5) OF THE MARINE MAMMAL PROTECTION ACT COVERING TAKING OF MARINE MAMMALS INCIDENTAL TO TARGET AND MISSILE LAUNCH ACTIVITIES FOR THE PERIOD 2009-2014 AT SAN NICOLAS ISLAND, CALIFORNIA (50 CFR PART 216, SUBPART I)

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ACRONYMS AND ABBREVIATIONS

3-D	3-dimensional
ABL	Airborne Laser
AGS	Advanced Gun System
~	approximately
ATAR	Autonomous Terrestrial Acoustic Recorder
avg.	average
CFR	Code of Federal Regulations
cm	centimeters
CPA	closest point of approach
dB re 20 µPa	decibels reference 20 micropascals
dBA	decibel, A-weighted, to emphasize mid-frequencies and to de-emphasize low and high frequencies to which human (and pinniped) ears are less sensitive
DR	Ducted Rocket (pertains to GQM-163A “Coyote” SSST)
EIS/OEIS	Environmental Impact Statement/Overseas Environmental Impact Statement
ESA	Endangered Species Act
hr	hours
Hz	hertz
IHA	Incidental Harassment Authorization
JATO	jet-assisted take-off
kg	kilograms
kHz	kilohertz
km	kilometers
LOA	Letter of Authorization
m	meters
min	minute
mm	millimeter
MMPA	Marine Mammal Protection Act
M_{pa}	Frequency weighting appropriate for pinnipeds in air (Southall et al. 2007)
NAWCWD	Naval Air Warfare Center Weapons Division
NMFS	National Marine Fisheries Service
PTS	Permanent Threshold Shift
RAM	Rolling Airframe Missile
s	seconds
SCB	Southern California Bight
SEL	sound exposure level, a measure of the energy content of a transient sound
SEL-A	A-weighted sound exposure level
SEL-f	flat-weighted sound exposure level
SEL-M	M_{pa}-weighted sound exposure level
SNI	San Nicolas Island
SPL	sound pressure level
SPL-A	A-weighted sound pressure level
SPL-f	flat-weighted sound pressure level
SPL-M	M_{pa}-weighted sound pressure level
SSST	Supersonic Sea-Skimming Target
SWFSC	Southwest Fisheries Science Center
TTS	Temporary Threshold Shift
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
VAFB	Vandenberg Air Force Base

Petition for Regulations – Taking of Marine Mammals Incidental to Target and Missile Launch Activities at San Nicolas Island, California

Table of Contents

I. NATURE OF THE REQUEST

The Naval Air Warfare Center Weapons Division (NAWCWD), pursuant to Section 101(a)5 of the Marine Mammal Protection Act (MMPA), 16 United States Code (USC) §1371(a)(5); 50 Code of Federal Regulations (CFR) §216, Subpart I, petitions the National Marine Fisheries Service (NMFS) to implement new regulations for takes of marine mammals incidental to vehicle launches from San Nicolas Island (SNI), California, for the period 2009–2014. The regulations sought would allow the incidental, but not intentional, "taking" of pinnipeds, including harbor seals (*Phoca vitulina*), northern elephant seals (*Mirounga angustirostris*), and California sea lions (*Zalophus californianus*), in the event that such a result occurs in the course of launch operations on SNI.

NAWCWD is the Navy's full-spectrum research, development, test, and evaluation (RDT&E) center of excellence for weapons systems associated with air warfare, aircraft weapons integration, missiles and missile subsystems, and assigned airborne electronic warfare systems. NAWCWD is a multi-site organization that includes the Point Mugu Sea Range and is responsible for environmental compliance for this Range and SNI. Therefore, NAWCWD petitions NMFS to implement the new regulations for incidental takes of marine mammals by harassment during the launch program for missiles and targets from several launch sites on SNI. These activities are considered Military Readiness Activities and are afforded the provisions of Section 318 of the National Defense Authorization Act of 2004.

Based on the results of a standard, ongoing marine mammal monitoring program conducted during vehicle launches during 2001–2007 (e.g., Holst et al. 2005a, b; 2008), the Navy does not anticipate that such launch operations, described in detail in the Point Mugu Sea Range Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) (NAWCWD 2002), will result in the "taking" of significant numbers of marine mammals. Moreover, these takes of marine mammals are not likely to be lethal, and any impact on these species would be negligible. Accordingly, this Petition has been filed for the purpose of ensuring that the activities described herein are conducted in compliance with the MMPA when marine mammals are taken incidentally and unintentionally during the course of launch operations.

II. INFORMATION SUBMITTED IN ACCORDANCE WITH 50 CFR §216.104

NMFS regulations governing the issuance of regulations and Letters of Authorization (LOAs) permitting incidental takes under certain circumstances are codified at 50 CFR Part 216, Subpart I (216.101 – 216.106). Section 216.104 sets out 14 specific items that must be addressed in requests for rulemaking pursuant to Section 101(a) (5) of the MMPA. Each of these items is addressed in detail below.

1. OPERATIONS TO BE CONDUCTED

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 Overview of the Activity

NAWCWD plans to continue a launch program for missiles and targets from several launch sites on SNI, California. The purpose of these launches is to support test and training activities associated with operations on the NAWCWD Point Mugu Sea Range. Figure 1 provides a regional site map of the Range and SNI. A more detailed description of the island and proposed launch activities are provided later in this section, in the Point Mugu Sea Range Final EIS/OEIS (NAWCWD 2002), and in reports on previous vehicle launch monitoring periods (e.g., Holst et al. 2005a, 2008). The Sea Range is used by the U.S. 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. Some of the SNI launches are used for practicing defensive drills against the types of weapons simulated by these vehicles. Some launches may be conducted for the related purpose of testing new types of targets, to verify that they are suitable for use as operational targets.

The vehicles are launched from one of several fixed locations on the western end of SNI and fly generally westward through the Point Mugu Sea Range. Launches are expected to involve supersonic and subsonic vehicles. Some vehicles are launched from the Alpha Launch Complex located 190 meters (m) above sea level on the west-central part of SNI (Figure 2). The Building 807 Launch Complex, used for most launches of smaller vehicles as well as some large ones, is at the western end of SNI at approximately (~) 11 m above sea level.

NAWCWD plans to launch up to 40 vehicles from SNI per year, but this number can vary depending on operational requirements. Launch timing will be determined by operational, meteorological, and logistical factors. Up to 10 launches per year may occur at night. Nighttime launches will only take place when required by the test objectives, e.g., when testing the Airborne Laser system (ABL). For this system, missiles must be launched at night when the laser is visible.

The Navy will continue the existing mitigation and monitoring efforts (described in Sections 11 and 13 of this Petition and in Holst et al. 2005a, 2008) during every launch. These efforts may be scaled back at a future date, at least for launches of the smaller or less noisy launch vehicles, 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. As well, monitoring may be scaled back to only include seasons when pinnipeds are expected to be most susceptible to disturbance (e.g., breeding and pupping periods).

This Petition seeks regulations that would allow NMFS to issue LOAs for the "taking" by Level B harassment of three pinniped species incidental to vehicle launch activities. This Petition also serves as a request for an LOA for the first year of anticipated launch operations under the requested regulations. Annual requests for LOAs will be submitted for future launch operations.

The Navy may launch as many as 200 vehicles from SNI over a 5-year operations program, with up to 40 launches per year. Some launch events involve a single vehicle, while others involve the launch of multiple vehicles either in quick succession or at intervals of a few hours. The number of launches per month varies depending on operational needs. During the second to fifth years, the launch operations would continue in a manner and pattern similar to the first year. Takes of pinnipeds during the 5 years of launch operations are expected to be authorized under successive LOAs issued under the new regulations presently being requested.

The following is a description of the types of vehicles that will be launched. The Coyote Supersonic Sea-Skimming Target (SSST) is anticipated to be the primary launch vehicle. However, it may become necessary to substitute similar vehicles or different equipment in some cases. While other vehicles may be launched in the future, the largest contemplated under this Petition is 23,000 kilograms (kg) (NAWCWD 2002). These larger vehicles could be launched up to three times a year.

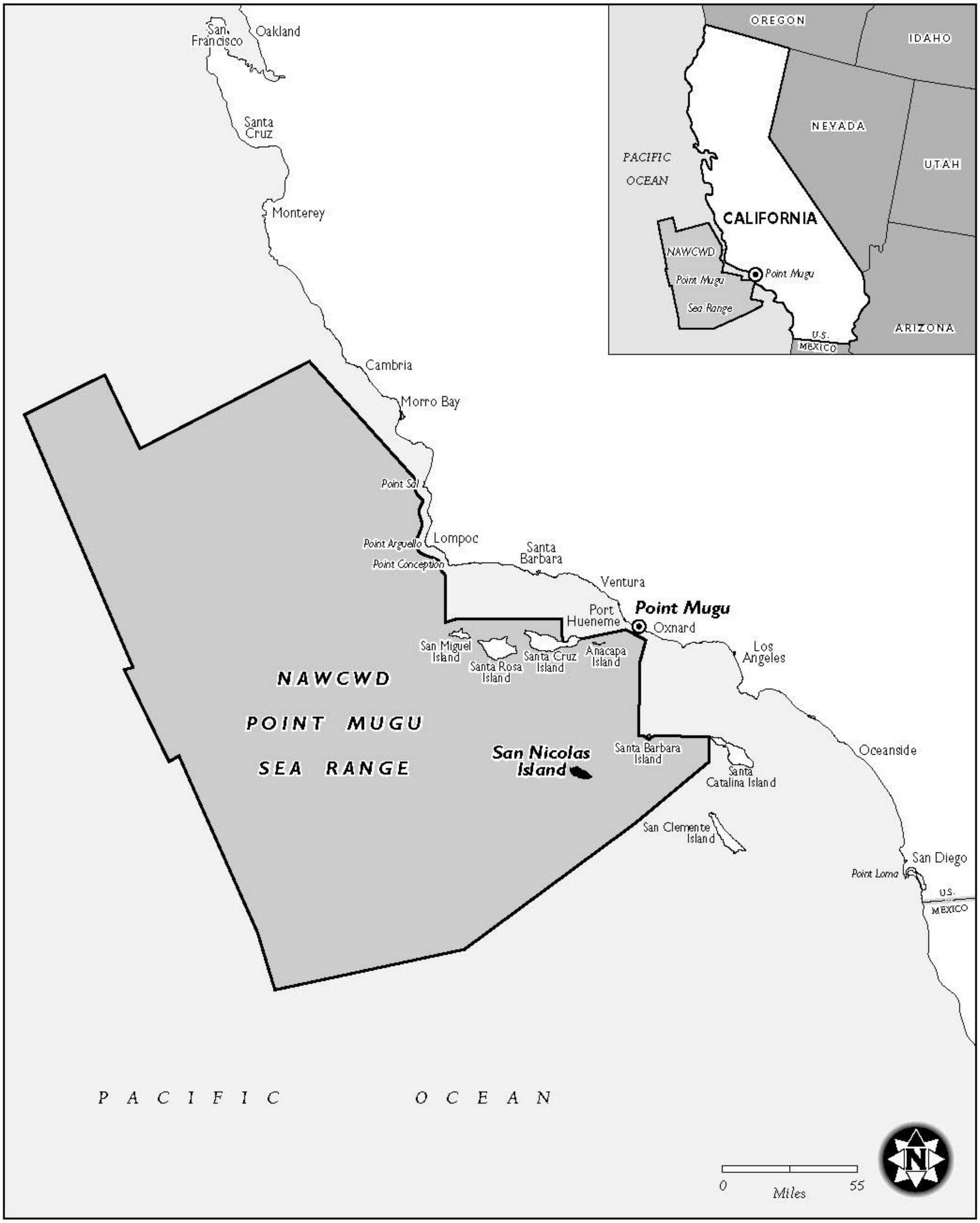

FIGURE 1. Regional Site Map of the Point Mugu Sea Range and SNI.

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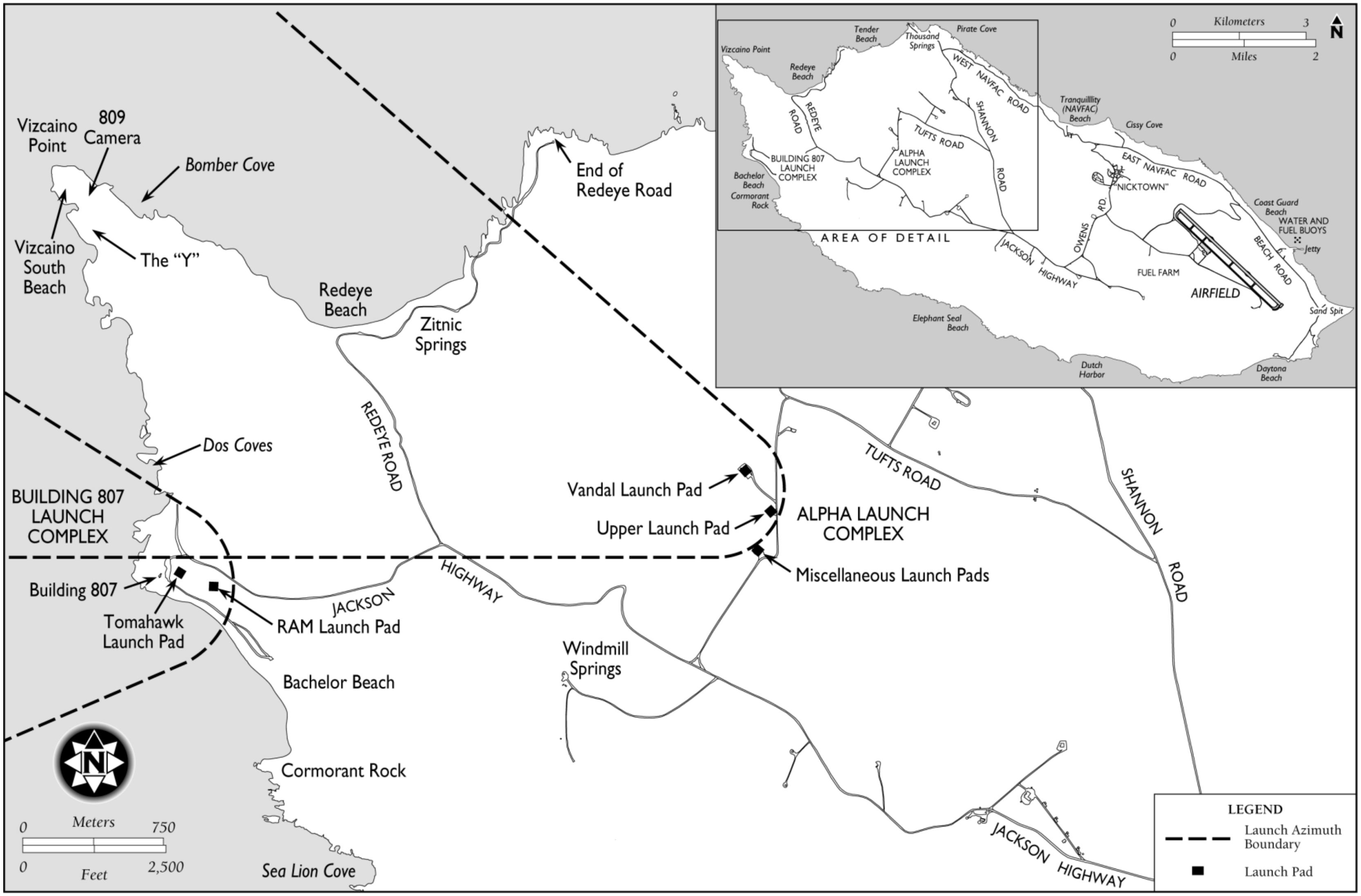


FIGURE 2. Map of SNI showing the Alpha Launch Complex, Building 807 Launch Complex, and the names of adjacent beaches on which pinnipeds are known to haul out. Also shown are the anticipated launch azimuths (dashed lines) for each launch complex. These launch azimuths are typical, although occasionally launch paths could pass outside these boundaries.

1.1.1 Coyote

The Coyote, designated GQM-163A, is an expendable SSST powered by a ducted-rocket ramjet (Figure 3). It has replaced the Vandal, which was used as the primary vehicle during launches from 2001–2005. The Coyote is similar in size and performance to the Vandal.

The Coyote is capable of flying at low altitudes (4 m cruise altitude) and supersonic speeds (Mach 2.5) over a flight range of 83 kilometers (km). This vehicle is designed to provide a ground launched aerial target system to simulate a supersonic, sea-skimming Anti-Ship Cruise Missile threat. The SSST assembly consists of two primary subsystems: MK 70 solid propellant booster and the GQM-163A target vehicle. The solid-rocket booster is ~46 centimeters (cm) in diameter and is of the type used to launch the Navy's "Standard" surface-to-air missile. The GQM-163A target vehicle is 5.5 m long and 36 cm in diameter, exclusive of its air intakes. It consists of a solid-fuel Ducted Rocket (DR) ramjet subsystem, Control and Fairing Subassemblies, and the Front End Subsystem (FES). Included in the FES is an explosive destruct system to terminate flight if required.

The Coyote utilizes the Vandal launcher, currently installed at the Alpha Launch Complex on SNI with a Launcher Interface Kit (Figure 3). A modified AQM-37C Aerial Target Test Set is utilized for target checkout, mission programming, verification of the vehicle's ability to perform the entire mission, and homing updates while the vehicle is in flight.

FIGURE 3. View of the Coyote with booster and launcher at the Alpha Launch Complex on SNI (photograph by U.S. Navy).

During a typical launch, booster separation occurs ~5.5 seconds (s) after launch and ~2.6 km down-range, at which time the vehicle has a speed of ~Mach 2.35 (Orbital Sciences Corp; www.orbital.com). Following booster separation, the GQM-163A's DR ramjet ignites, the vehicle reaches its apogee, and then dives to 5 m altitude while maintaining a speed of Mach 2.5. During launches from SNI, the low-altitude phase occurs over water west of the island. The target performs pre-programmed maneuvers during the cruise and terminal phases, as dictated by the loaded mission profile, associated waypoints, and mission requirements. During the terminal phase, the Coyote settles down to an altitude of 4 m and Mach 2.3 until DR burnout.

During 2003–2007, Coyotes were launched from SNI at azimuths of 270–300º and elevation angles of 14–22º (Holst et al. 2005a, 2008). Coyotes produced flat-weighted sound pressure levels (SPL-f) of 125–134 decibels reference 20 micropascals (dB re 20 µPa) at distances of 0.8–1.7 km from the three-dimensional (3-D) closest point of approach (CPA) of the vehicle, and 82–93 dB at CPAs of 2.4–3.2 km (Holst et al. 2005a, 2008). Flat-weighted sound exposure levels (SEL-f) ranged from 87 to 119 dB re 20 µPa^2·s. SELs M-weighted for pinnipeds in air (M_{pa}) ranged from 60 to 114 dB re 20 µPa^2·s, and peak pressures ranged from 100 to 144 dB re 20 µPa. The reference sound pressure (20 µPa) used here and throughout the document, is standard for airborne sounds.

1.1.2 Advanced Gun System (AGS)

At SNI, a howitzer (Figure 4) has been used to launch test missiles, as the AGS is still being developed. The AGS is a gun designed for a new class of Destroyer; it will be used to launch both small missiles and ballistic shells. It is to be a fully integrated gun weapon system, including a 155-millimeter (mm) gun, integrated control, an automated magazine, and a family of advanced guided and ballistic projectiles, propelling charges, and auxiliary equipment. The operational AGS will have a magazine capacity of 600 to 750 projectiles and associated propelling charges. The regular charge for the gun will replace the booster that is usually associated with a surface-launched missile. The gun gets the missile up to speed, at which point the missile's propulsion takes over. The missile itself is relatively quiet, as it does not have a booster and is fairly small. However, the gun blast is rather strong. Each missile launch is preceded by one (sometimes two) howitzer firings using a slug. The slug is used to verify that the gun barrel is properly seated and aligned.

During 2002–2006, AGS missiles and test slugs were launched from SNI at azimuths of 235–305º and elevation angles of 50–65º (Holst et al. 2005a, 2008). AGS vehicles resulted in SPL-f values of 97–117 dB re 20 µPa, at nearshore sites located 0.75–2 km from the CPA and 125–127 dB at sites located <462 m from the CPA. SEL-f levels ranged from 90 to 113 dB re 20 µPa^2·s, and M_{pa}-weighted SELs ranged from 64 to 103 dB re 20 µPa^2·s. The peak pressure ranged from 107 to 135 dB re 20 µPa. AGS slugs produced SPL-f values of 100–133 dB re 20 µPa nearshore. SEL-f ranged from 88 to 120 dB re 20 µPa^2·s, M_{pa}-weighted SELs ranged from 62 to 103 dB re 20 µPa^2·s, and the peak pressures were 104 to 139 dB re 20 µPa.

1.1.3 Rolling Airframe Missile (RAM)

The Navy/Raytheon RAM is a supersonic, lightweight, quick-reaction missile (Figure 5). This relatively small missile, designated RIM 116, uses the infrared seeker of the Stinger missile and the warhead, rocket motor, and fuse from the Sidewinder missile. It has a high-tech radio-to-infrared frequency guidance system. The RAM is a solid-propellant rocket 12.7 cm in diameter and 2.8 m long. Its launch weight is 73.5 kg, and operational versions have warheads that weigh 11.4 kg.

FIGURE 4. Howitzer used as AGS test launcher at the Alpha Complex (now located at the Building 807 Launch Complex) on SNI (photograph by U.S. Navy).

FIGURE 5. View of the RAM launcher at the Building 807 Launch Complex on SNI (photograph by U.S. Navy).

At SNI, RAMs are launched from the Building 807 Launch Complex. During 2001–2007, RAMs were launched at an azimuth of 240º and elevation angles of 8–10º (Holst et al. 2005a, 2008). The RAMs resulted in SPL-f up to 126 dB near the launcher and 99 dB at a nearshore site located 1.6 km from the CPA (Holst et al. 2005a, 2008). SEL-f ranged from 84 to 97 dB re 20 μPa^2·s, and M_{pa}-weighted SELs were 76 to 96 dB re 20 μPa^2·s. Peak pressure ranged from 104 to 117 dB re 20 μPa.

1.1.4 Arrow Self-Defense Missile

The Arrow (Figure 6) is a theater missile defense weapon or anti-ballistic missile. It was developed in Israel and is designed to intercept tactical ballistic missiles. It is ~6.8 m long and 60 cm in diameter. It travels at hypersonic speed, and it has high and low altitude interception capabilities. The Arrow consists of three main components: a phased array radar (known as Green Pine), a fire control center (called Citron Tree), and a high-altitude interceptor missile that contains a powerful fragmentation warhead. It also has two solid propellant stages, including a booster and sustainer. The array radar is capable of detecting incoming missiles at a distance of 500 km. Once a missile is detected, the fire control center launches the interceptor missile. The interceptor travels at nine times the speed of sound and reaches an altitude of 50 km in less than 3 minutes (min).

The first test of an Arrow in the U.S. took place at SNI on 29 July 2004. At SNI, Arrows have been launched vertically, near the Alpha Launch Complex from the Miscellaneous Launch Pad (Figure 2), at an azimuth of 285°, crossing the beach at an altitude of 2,134 m. During these launches, Arrows produced SPL-f of 84–90 dB re 20 μPa at distances of 1.8–2.7 km from the CPA. SEL-f ranged from 96 to 102 dB re 20 μPa^2·s, and M_{pa}-weighted SELs ranged from 92 to 99 dB re 20 μPa^2·s. Peak pressures ranged from 100 to 107 dB re 20 μPa (Holst et al. 2005a, 2008).

FIGURE 6. View of the Arrow interceptor and launcher at the Alpha Complex on SNI (photograph by U.S. Navy).

1.1.5 Terrier-Black Brant

The Terrier-Black Brant consists of the Terrier Mark 70 booster and the Black Brant rocket (Figure 7). The solid-rocket booster is ~46 cm in diameter, 394 cm long, and weighs 1,038 kg. The Black Brant has a diameter of 44 cm, is 533 cm long, and weighs 1,265 kg. This vehicle reaches an altitude of 203 km and has a range of 264 km. Terrier burnout occurs after 6.2 s at an altitude of 3 km, and Black Brant burnout occurs after 44.5 s at an altitude of 37.7 km. On SNI, this target will typically be launched vertically from the Building 807 Launch Complex. The Terrier-Black Brant will be launched at night to test the ABL and may be used to support other testing after its initial use for ABL.

FIGURE 7. View of the Terrier-Black Brant target.

1.1.6 Terrier-Lynx

The Terrier-Lynx is a two-stage unguided, fin-stabilized rocket (Figure 8). The first stage consists of the Terrier Mark 70 booster (see above), and the second stage is the Lynx rocket motor. The Lynx is 36 cm in diameter and 279 cm long. This vehicle reaches an altitude of 84 km and has a range of 99 km. Terrier burnout occurs after 6.2 s at an altitude of 2.3 km, and Lynx burnout occurs after 58.5 s at 43.5 km. On SNI, this target will typically be launched vertically from the Building 807 Launch Complex using the 50k (50,000 pounds or ~23,000 kg) launcher (Fig. 8). Terrier-Lynx targets will be launched at night to test the ABL. Both the Terrier-Lynx and Terrier-Black Brant will use the same Terrier Mk 70 booster as the Coyote, so launch sound levels should be similar to those from that vehicle.

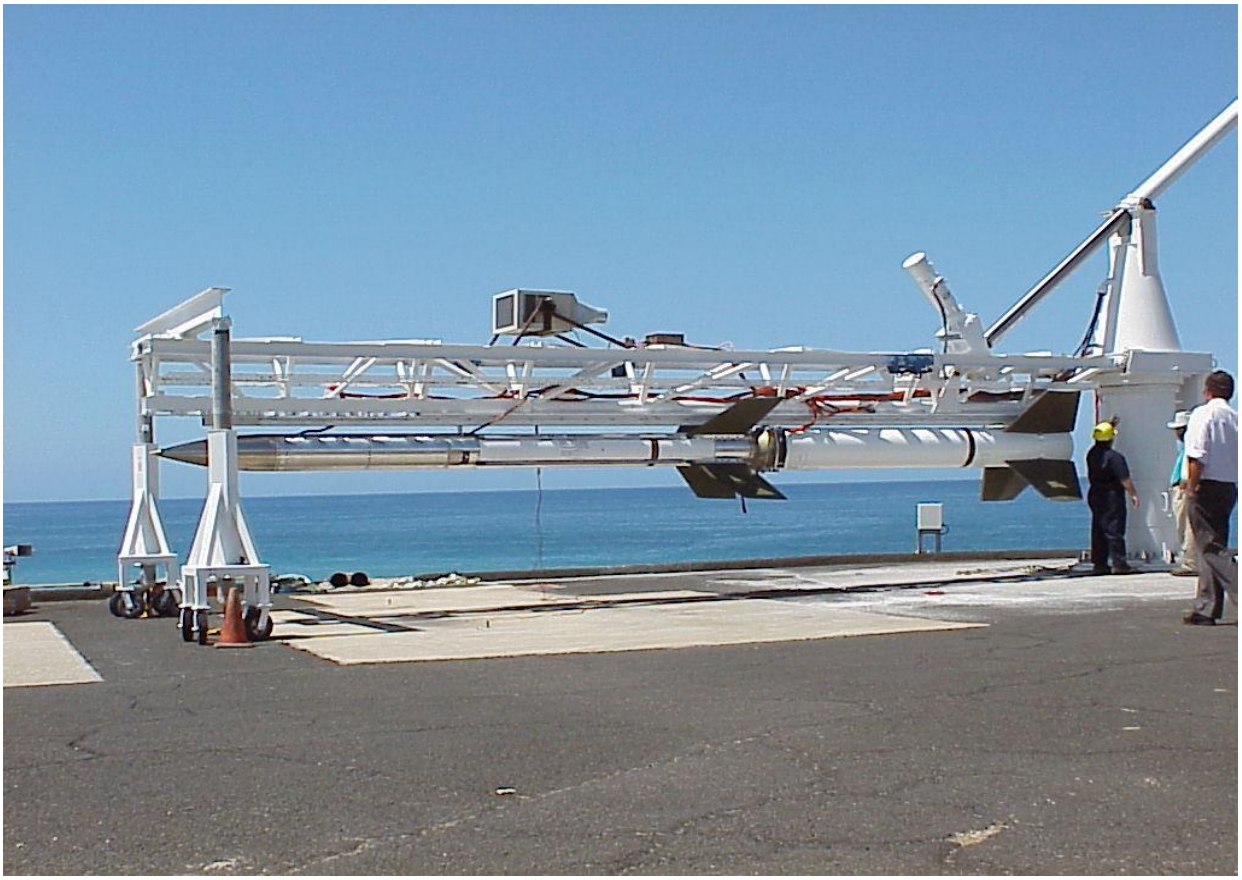


FIGURE 8. View of the Terrier-Lynx target and launcher.

1.1.7 Other Vehicle Launches

The Navy may also launch other vehicles to simulate various types of threat missiles and aircraft, and to test the ABL. For example, on 23 August 2002, a Tactical Tomahawk was launched from Building 807 Launch Complex, and on 20 September 2001, a Terrier-Orion was launched from the Alpha Launch Complex. The Tomahawk produced an SPL-f of 93 dB re 20 µPa, an SEL-f of 107 dB re 20 $\mu Pa^2 \cdot s$, and an M_{pa}-weighted SEL of 105 dB re 20 $\mu Pa^2 \cdot s$ at a distance of 539 m from the CPA; the peak pressure was 111 dB re 20 µPa. The Terrier-Orion resulted in an SPL-f of 91 dB re 20 µPa, an SEL-f of 96 dB re 20 $\mu Pa^2 \cdot s$, and an M_{pa}-weighted SEL of 92 dB re 20 $\mu Pa^2 \cdot s$ at a distance of 2.4 km from the CPA; the peak pressure was 104 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 an M_{pa}-weighted SEL of 82 dB re 20 µPa at a beach located north of the launch azimuth. Near the launcher, the SPL-f was 128 dB re 20 µPa, SEL-f was 126 dB re 20 µPa, and M_{pa}-weighted SEL was 125 dB re 20 µPa.

Vehicles of the BQM-34 or BQM-74 type could also be launched. These are small, unmanned aircraft that are launched using jet-assisted take-off (JATO) rocket bottles; they then continue offshore powered by small turbojet engines. The larger of these, the BQM-34, is 7 m long and has a mass of 1,134 kg plus the JATO bottle. The smaller BQM-74 is up to 420 cm long and has a mass of 250 kg plus the solid propellant JATO bottles. Burgess and Greene (1998) reported that A-weighted SPLs (SPL-A) ranged from 92 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 vehicle 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 2.

1.2 General Launch Operations

Aircraft and helicopter flights between the Point Mugu airfield on the mainland, the airfield on SNI, and the target sites in the Sea Range will be a routine part of a planned launch operation. These flights generally do not pass at low level over the beaches where pinnipeds are expected to be hauled out.

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 vehicles near the island's beaches are also restricted at other times of the year for purposes of environmental protection and preservation of cultural resource sites.

Launch monitoring equipment (e.g., portable video cameras and Autonomous Terrestrial Acoustic Recorders or ATARs) will be deployed and activated prior to the launches (see Section 12).

2. DATES, DURATION, AND REGION OF ACTIVITY

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

The petitioner seeks incidental take authorization for specific launch activities at SNI, with implementation of regulations effective for a period of 5 years commencing in 2009. Launch operations during 2001–2002 and 2002–2003 were conducted under separate Incidental Harassment Authorizations (IHAs). Launch operations from 2003 to the present have been conducted under previously requested and issued LOAs. As part of this request, the petitioner seeks an LOA applicable to the conduct of further such launch operations. An LOA for the first year of launch operations to be conducted under the requested regulations, commencing in 2009, is requested as part of this Petition. Additional LOAs will be requested later for years 2–5 of the period covered by the regulations. The specific location where the "taking" under discussion here may occur is on and around the western portion of SNI (Figure 2).

The timing of these 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. Thus, launches could occur at any time during day or night, and at any time during the 5-year period when the regulations are anticipated to be in place.

Launches of this type have been occurring at SNI for many years and are expected to continue indefinitely into the future. The total number of launches that have occurred since 2001 include 12 launches from August 2001 to July 2002, 19 launches from August 2002 to August 2003, 13 launches from October 2003 to October 2004, 25 launches from January to October 2005, 5 launches from February 2006 to February 2007, and 3 launches from February 2007 to February 2008 (Holst et al. 2005a, 2008). Although no more than 25 launches annually have occurred in the last 5 years, it is anticipated that there could be up to 40 launches of supersonic and/or subsonic vehicles from SNI per year.

This Petition is intended to cover the launches of up to 40 launch vehicles from either the Alpha Launch Complex or the Building 807 Launch Complex. It is assumed in this Petition that launches may occur at any time during the year. On occasion, two or more launches may occur in quick succession on a single day.

Given the launch acceleration and flight speed of the vehicles, 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. 2005a, 2008).

As described in Section 1 above, the launches will occur from the western part of SNI. SNI is one of the Channel Islands in the Southern California Bight (SCB), located ~105 km southwest of Point Mugu (see Figure 1). The vehicles will be launched from one of several locations on the western end of SNI (Figure 2) and will fly generally southwest, west, or northwest through the Point Mugu Sea Range. The Alpha Launch Complex is ~2 km from the nearest beach where pinnipeds are known to haul out. 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 if any pinnipeds are known to haul out on the shoreline immediately adjacent to this launch site.

3. Species and Numbers of Marine Mammals in Area

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

Many of the beaches around the perimeter of SNI are resting, molting, or breeding places for several species of pinnipeds. Three species can be expected to occur on land in the area of proposed activity either regularly or in large numbers during certain times of the year: northern elephant seals, harbor seals, and California sea lions.

Three additional pinniped species that can found on the Point Mugu Sea Range are far less common at SNI and include the northern fur seal (*Callorhinus ursinus*), the Guadalupe fur seal (*Arctocephalus townsendi*), and the Steller sea lion (*Eumetopias jubatus*). The northern fur seal is occasionally sighted on SNI in small numbers (Stewart and Yochem 2000); a single female with a pup was sighted on the island in July of 2007 (G. Smith, NAWCWD, pers. comm.). It is also possible that individual Guadalupe fur seals may be sighted on the beaches. The Guadalupe fur seal is an occasional visitor to the Channel Islands, but breeds mainly on Guadalupe Island, Mexico, which is ~463 km south of the Sea Range. The last sighting was of a lone individual seen ashore in the summer of 2007 (G. Smith, NAWCWD, pers. comm.). The Steller sea lion was once abundant in these waters, but numbers have declined since 1938. No adult Steller sea lions have been sighted on land in the Channel Islands since 1983 (Stewart et al. 1993c *in* NMFS 2008). Thus, it is very unlikely that Steller sea lions will be seen on or near SNI beaches.

Incidental take authorization is only being sought for California sea lions, northern elephant seals, and harbor seals. Due to the rare occurrence of northern fur seals, Guadalupe fur seals, and Steller sea lions in the Sea Range, they are highly unlikely to be affected by launch activities. Thus, incidental take authorization is not being sought for these species. For completeness and to avoid redundancy, the required information about all six pinniped species and (insofar as it is shown) numbers of species near the launch areas, are included in Section 4, below. The Navy is coordinating with the U.S. Fish and Wildlife Service (USFWS) regarding any issues relating to sea otters (*Enhydra lutris*).

4. Status, Distribution and Seasonal Distribution of Affected Species or Stocks of Marine Mammals

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

4.1 Species Likely to be Affected by Launch Activities

The following species are likely to be affected by launch activities on SNI and occur in the area of proposed activity: harbor seals, northern elephant seals, and California sea lions.

4.1.1 Harbor Seal

The harbor seal is not listed under the Endangered Species Act (ESA), and the California stock, which occurs on SNI, is not considered a strategic stock under the MMPA. Harbor seals haul out at various sites around SNI, including the western part of the island. Peak counts on SNI are several hundred seals, representing ~2% of the seals hauling out along all California shorelines. Pupping occurs on the beaches from late February to early April, with nursing of pups extending into May. Harbor seals also haul out during the molting period in late spring, and smaller numbers haul out at other times of the year. The following discussion and figures provide additional details.

Harbor seals are considered abundant throughout most of their range from Baja California to the eastern Aleutian Islands. They are common and widely scattered in coastal waters and along coastlines in California. Approximately 400–600 haul-out sites are distributed along the mainland and offshore islands of California, including sandbars, rocky shores, and beaches (Hanan 1996; Lowry et al. 2005). The SCB is near the southern limit of the range of the harbor seal (Bonnell and Dailey 1993). Harbor seals haul out and breed on all of the southern Channel Islands.

Most information on harbor seals comes from the periods when they are hauled out on land; however, over the period of a year they spend more time in the water than they do on land. Their distribution and movements while at sea are poorly known. The few sightings during aerial and ship-based surveys indicate that harbor seals are primarily found in coastal or nearshore areas. Studies using satellite-linked transmitters (deployed on only a few seals) have confirmed their primarily nearshore distribution and their tendency to remain near their haul-out sites (Stewart and Yochem 1994).

In California, individual harbor seals remain relatively close to their haul-out sites throughout the year. 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). There are seasonal differences in the proportion of time that seals haul out and in the durations of foraging trips. The latter factor probably influences the distance that harbor seals can travel to and from their haul-out sites. 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).

The best estimate of the California stock of harbor seals is 34,233 (Carretta et al. 2007); this estimate was determined by applying Hanan’s (1996) correction factor to the most recent harbor seal counts on shore (26,333 in May–July 2004; Lowry et al. 2005). In 2005, the total count for the Channel Islands was just under 5,000 individuals (Carretta et al. 2007). Koski et al. (1998) provided estimates of 914, 2,860, 927, and 2,065 harbor seals in the Point Mugu Sea Range in winter, spring, summer, and autumn, respectively.

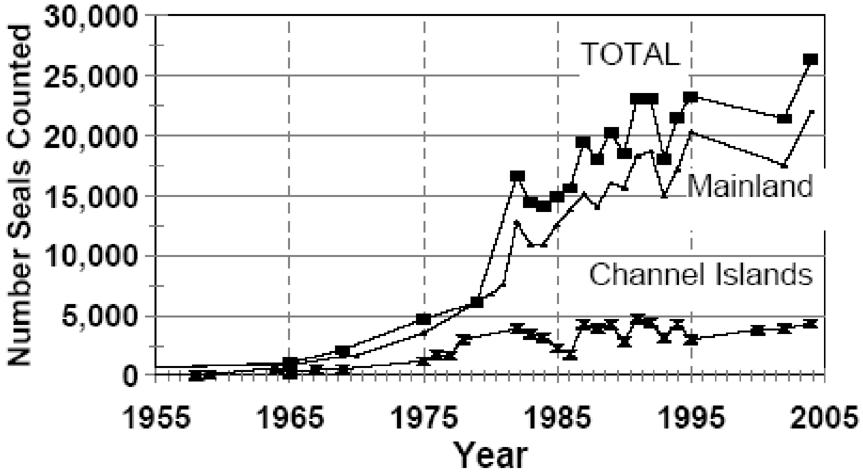


FIGURE 7. Harbor seal haul-out counts in California during May–June (Hanan 1996; R. Read, CDFG unpubl. data; NMFS unpubl. data from 2002 and 2004 surveys). From Carretta et al. (2007).

The California population of harbor seals increased rapidly from 1972 to 1990, but this increase has slowed since (Figure 7; Carretta et al. 2007). The net productivity rate may be decreasing; from 1983–1994, the rate averaged 9.2% (Carretta et al. 2007). Hanan (1996) noted that southern California has the lowest mean annual population growth rate of the three regions (i.e., southern, central, and northern) within California; for California, the realized rate of increase from 1982–1995 was 3.5% (not taking into account fisheries mortality), and for southern California, it was 1.9%. Hanan (1996) reported that the overall population within the Point Mugu Sea Range is relatively stable. This indicates that either harbor seal populations may be approaching the carrying capacity of the environment (Hanan 1996; Carretta et al. 2007), or harbor seals are being displaced by northern elephant seals (Mortenson and Follis 1997). Populations of the latter species 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% per year at San Miguel Island, 0.02% at SNI, and -1.0% 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% per year at Santa Catalina Island and +5.7% at Santa Cruz Island

At SNI, harbor seal abundance increased from the 1960s until 1981, but since then, the average counts have not changed significantly. The mean annual increase from 1982–1995 was 0.02% (±0.036 SE; Hanan 1996). Counts from 1982 to 1994 fluctuated between ~465 and 700 harbor seals based on peak ground counts (Stewart and Yochem 1994) and between 139 and 694 seals based on single counts during annual aerial photographic surveys (Beeson and Hanan 1994; Figure 8). During May–July 2002, 584 harbor seals were hauled out (Lowry and Carretta 2002), representing ~12% of the harbor seals in the Channel Islands. The SNI harbor seal population may be approaching carrying capacity. Alternatively, Stewart and Yochem (1994) hypothesized that counts may not always reflect the true population; seals may be spending more time at sea feeding and/or part of the population may have changed its haul-out behavior and may be hauling out at night.

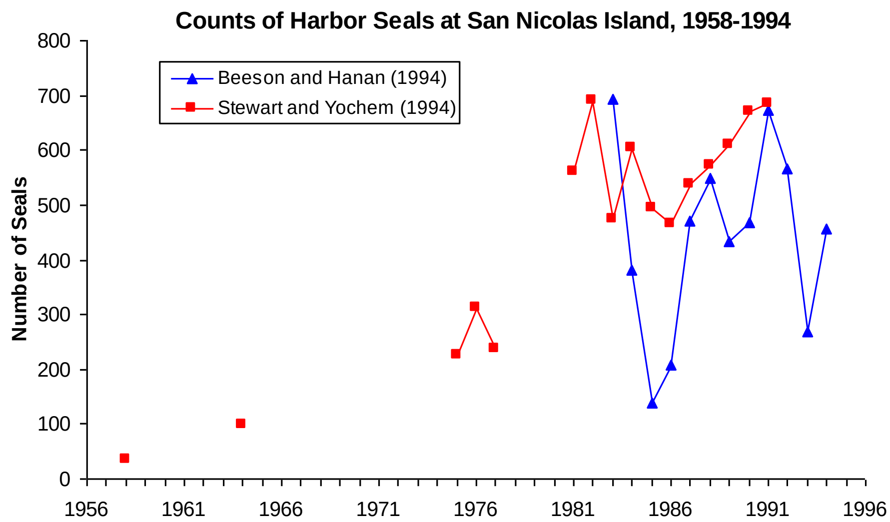


FIGURE 8. Counts of harbor seals at SNI, 1958–94. Aerial count data are from Beeson and Hanan (1994); ground count data are from Stewart and Yochem (1994).

On SNI, most harbor seals haul out at several specific traditionally used sandy, cobble, and gravel beaches (Figure 9). A few seals haul out at onshore and offshore ledges and reefs, mostly during the pupping and molting seasons (Stewart and Yochem 1994). Lowry and Carretta (2002) noted 17 different haul-out sites at SNI in 2002, with a mean of 34.3 seals per haul-out site. The greatest number of seals (154) was hauled out at Pirate's Cove (Figure 9; Lowry and Carretta 2002). Stewart and Yochem (1984) reported that harbor seals hauled out and gave birth at seven sites and used 13 others sporadically. Sites 231 (Sea Lion Cove) and 266 (Dutch Harbor) were the most consistently used haul-out sites throughout the year, and site 270 (Pirate's Cove) had significant numbers of seals during the pupping and molting periods (Figures 9 and 10). Two of these sites (231 and 270) were also the most heavily used sites during the 1975–78 surveys of Bonnell et al. (1981). The latter site is still used heavily (e.g., NAWCWD 1996; Holst et al. 2008; Lowry and Carretta 2002). During 2001–2006, Holst et al. (2008) monitored 11 haul-out sites on western SNI during missile launches; the greatest number of animals seen at any one site exceeded 80 individuals at Phoca Reef (just east of site 270) on 29 July 2004.

Harbor seals remain near their terrestrial haul-out sites and frequently haul out on land throughout the year, at least for brief periods (Figure 11). However, at most haul-out sites, large numbers of seals are seen on land only during the pupping, nursing, and molting periods. In southern California, the harbor seal pupping period extends from late February to early April, with a peak in pupping in late March. The nursing period extends from late February to early May; females and pups haul out for long periods at this time (Figure 12). The molting period is in late May to June, and all ages and sexes of harbor seals haul out at this time. Further details of the general biology of harbor seals are described in Section 3.7.2.3 of the *Marine Mammal Technical Report* (Koski et al. 1998) accompanying the Point Mugu Sea Range Final EIS/OEIS (NAWCWD 2002).

During August to February, smaller numbers of seals are seen hauled out at any given time. 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% of the individual seals that use a haul-out site (Huber 1995; Hanan 1996). During winter, when seals spend most of their time feeding at sea, the number of seals hauled out at most sites is ~15% of the maximum count during the peak of haul out (i.e., 10–12% of those using the site). The typical seasonal pattern is reflected in harbor seal counts on SNI (Figure 13).

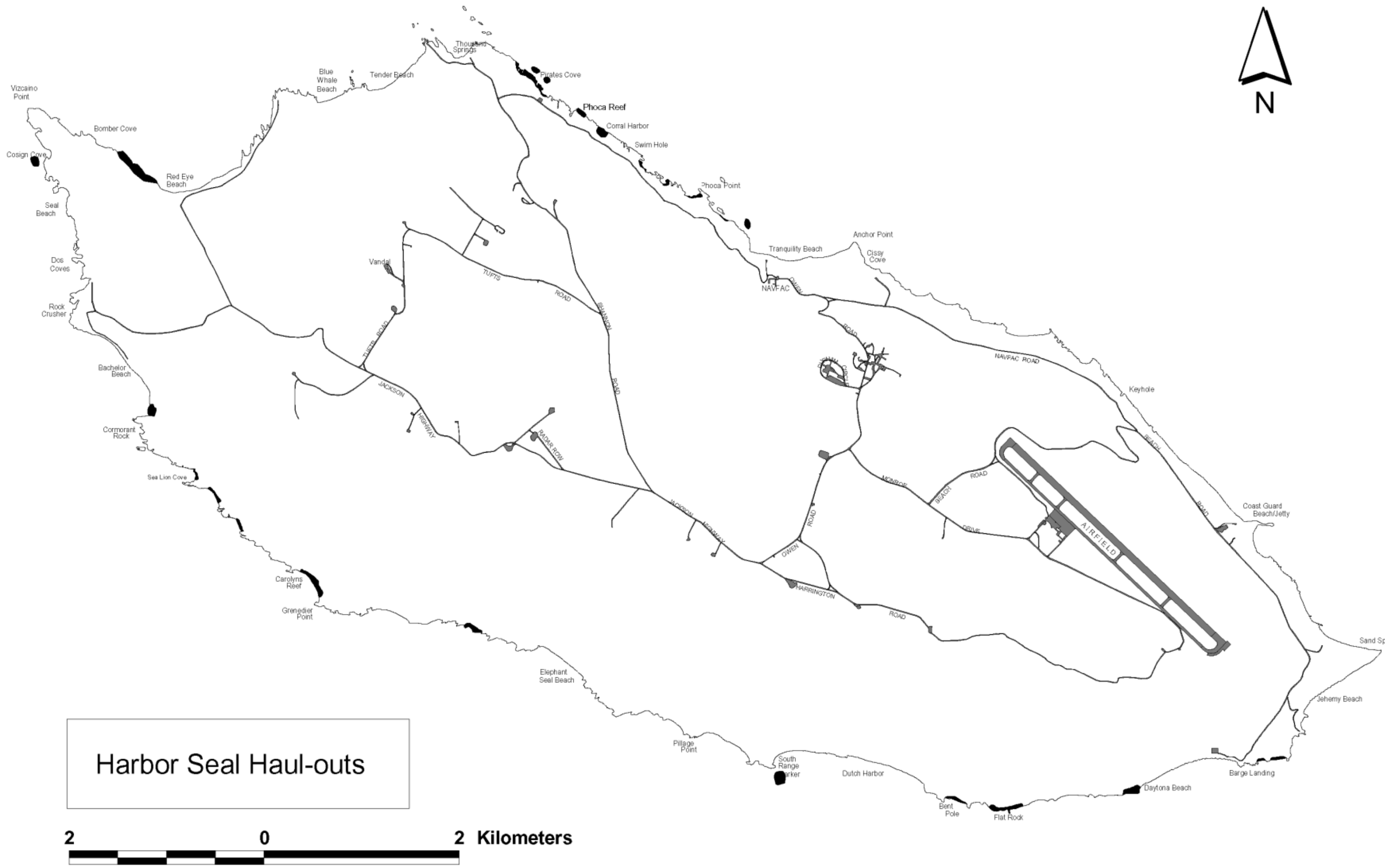


FIGURE 9. Map of SNI showing beaches on which harbor seals are known to haul out. From Koski et al. (1998), and updated in 2000 by G. Smith (NAWCWD, Point Mugu, California, pers. comm.).

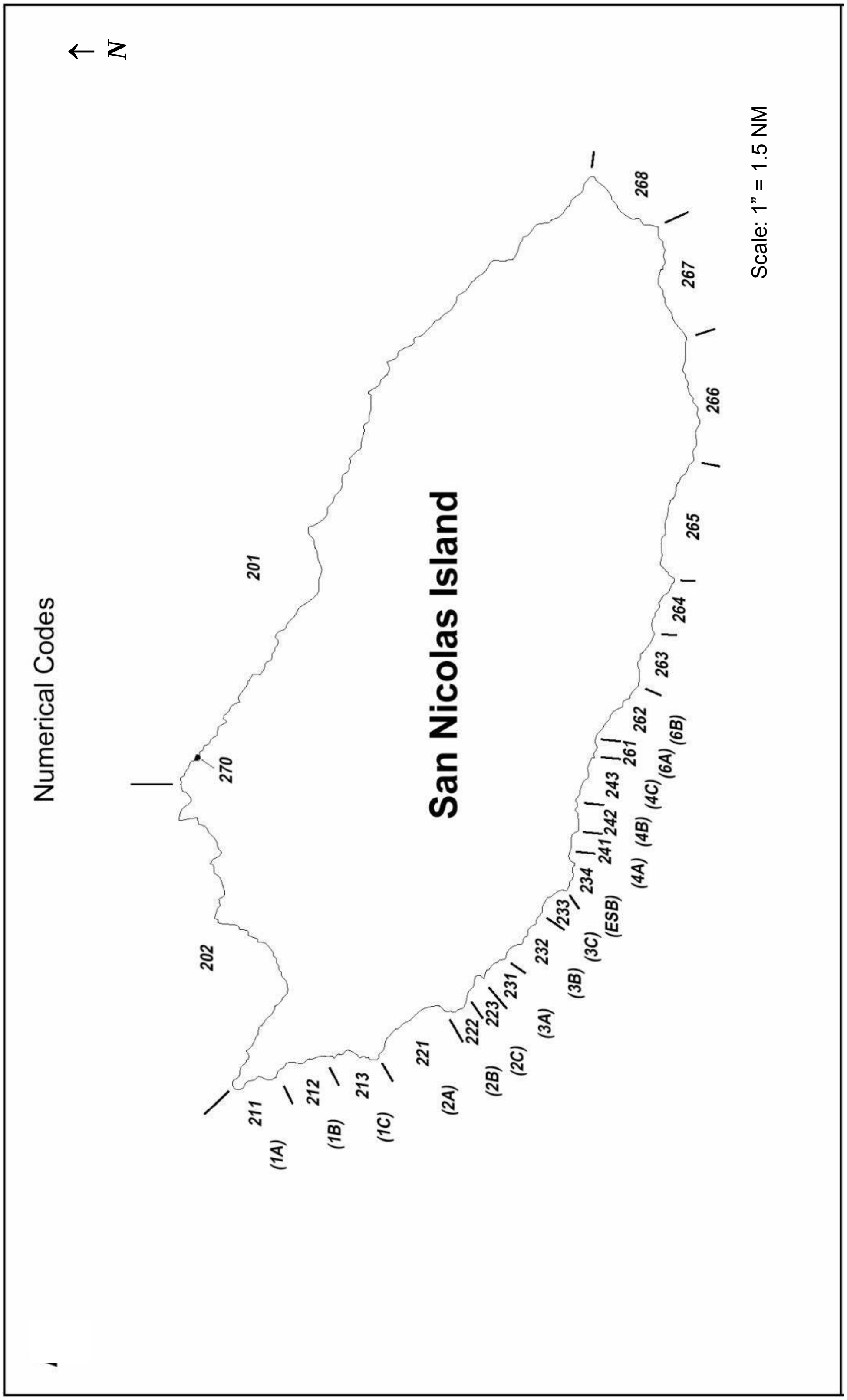


FIGURE 10. SNI census areas and associated numerical codes used by Stewart and Yochem (1984) to identify census areas.

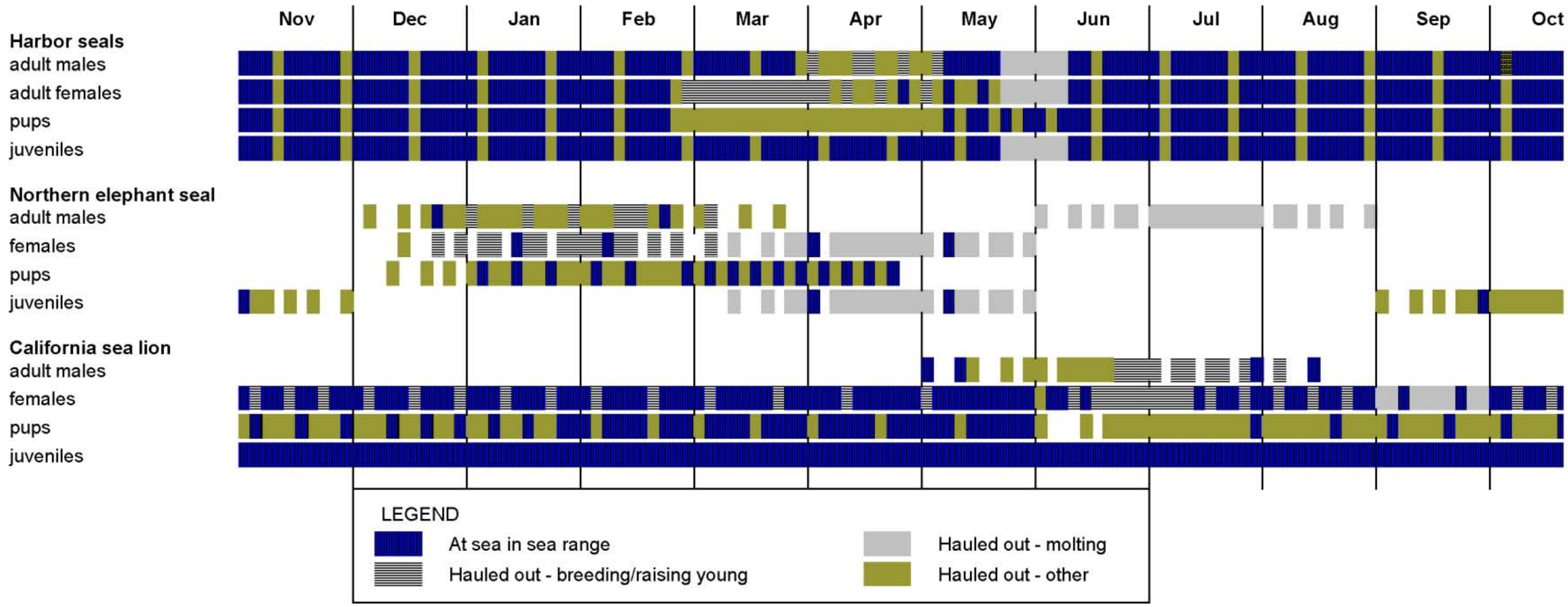


FIGURE 11. Annual activities of three pinniped species common to SNI. Activities include hauling out on land for breeding, pupping, or molting, and feeding at sea. Gaps in the bars indicate that not all animals are engaged in that activity. The size of the gap indicates approximate proportions of animals or time not engaged in that activity.

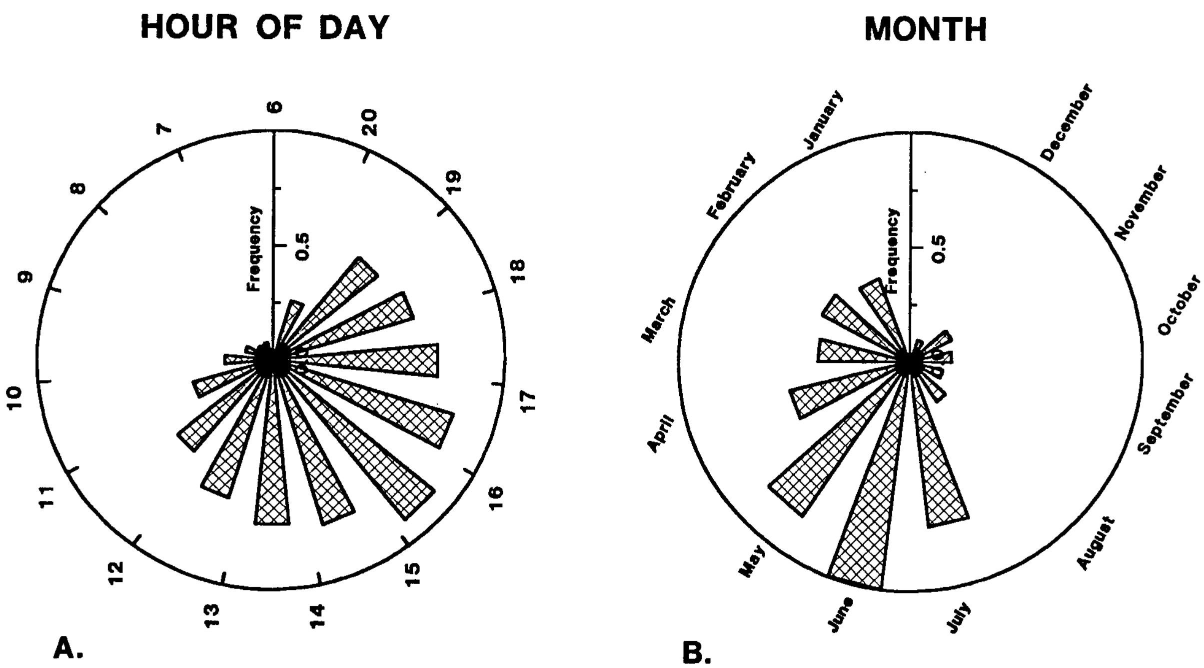


FIGURE 12. Abundance of harbor seals at terrestrial haul-out sites on the Channel Islands on *(A)* an hourly basis during the day and *(B)* a monthly basis during the year. From Stewart and Yochem (1994).

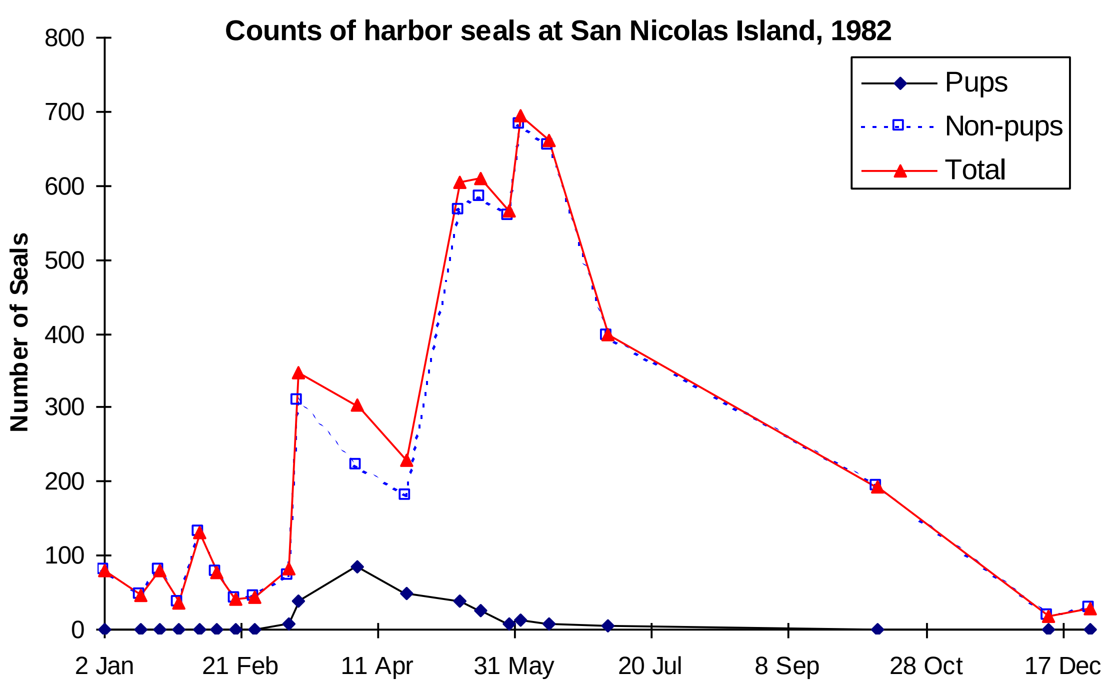


FIGURE 13. Counts of harbor seals throughout the year on SNI, 1982. From Stewart and Yochem (1984).

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 subadult 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), with other environmental factors apparently causing little variation in haul-out behavior (Stewart and Yochem 1994).

4.1.2 Northern Elephant Seal

The northern elephant seal is not listed under the ESA, and the California stock, which occurs on SNI, is not considered a strategic stock under the MMPA. Large and increasing numbers of elephant seals haul out at various sites around SNI, including some on the western part of the island. Over the course of the year, ~32,186 elephant seals may use SNI (see Lowry 2002; Barlow et al. 1993), representing ~32% of the elephant seals hauling out along all California shorelines. Pupping occurs on the beaches from January to early February, with nursing of pups extending into March. 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 following discussion and figures provide additional details.

Historically, northern elephant seals are believed to have hauled out by the thousands along the coast of California and Baja California (Scammon 1874 *in* Bonnell and Dailey 1993), but there is little or no documentation of their actual distribution and breeding range before exploitation (Stewart et al. 1993c). They were heavily hunted during the 19th century and were subsequently reduced to a single breeding colony numbering perhaps as few as a hundred animals on Isla de Guadalupe, Mexico (Barlow et al. 1993). Now, northern elephant seals molt, breed, and give birth primarily on offshore islands in Baja California and California. Rookeries are found as far north as South Farallon Islands and Point Reyes (Barlow et al. 1993). The California population is demographically isolated from the Baja California population and is considered to be a separate stock (Carretta et al. 2007).

The California population has recovered from near extinction in the early 1900s and has continued to grow through 2005 (Figures 14 and 15). The population is currently estimated at 124,000 individuals, based on a pup count of 35,549 in 2005 and a 3.5 multiplier (Carretta et al. 2007). In the Channel Islands, including SNI, northern elephant seal abundance has also increased since the mid-1960s (Figure 15; Barlow et al. 1993). Most pups in California are born on the Channel Islands. In 2005, ~28,000 pups were born or ~79% of the total number (35,549) of pups in California (Figure 14; see Carretta et al. 2007). Applying the multiplier of 3.5 times to this pup count (see Barlow et al. 1993; Carretta et al. 2007), the northern elephant seal population in the Sea Range was ~98,000 individuals in 2005. Koski et al. (1998) estimated that ~26,623, 6,495, 7,409, and 11,356 northern elephant seals are present in coastal and off-shore waters of the Sea Range during winter, spring, summer, and autumn, respectively. These estimates exclude the seals that are on land within the Sea Range and those that have migrated outside the Sea Range. These estimates are quite imprecise given the limitations of aerial and ship surveys in detecting elephant seals at sea—elephant seals are below the surface ~90% of the time (Le Boeuf et al. 1988, 1996; Stewart and DeLong 1993, 1995).

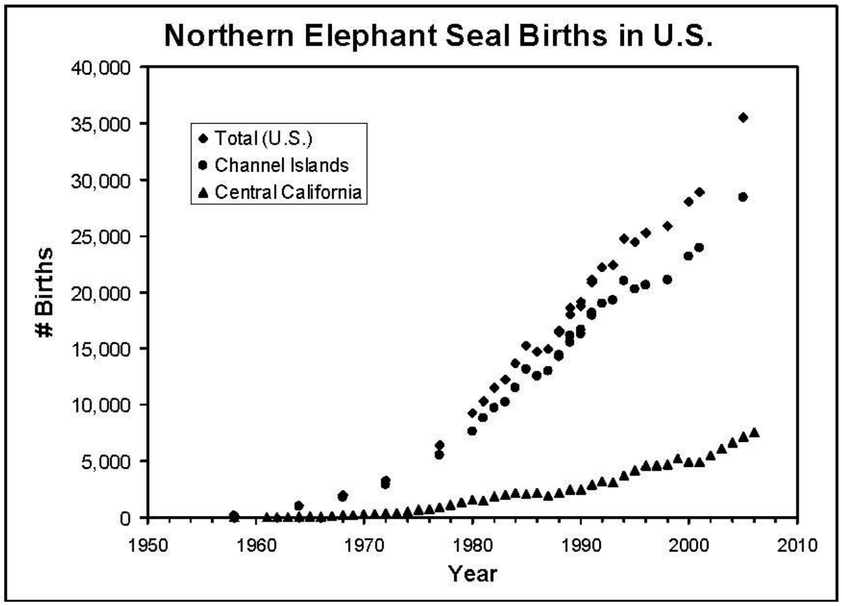


FIGURE 14. Estimated number of northern elephant seal births in California 1958–2005. Multiple independent estimates are presented for the Channel Islands 1988–1991. Estimates are from Stewart et al. (1994a), Lowry et al. (1996), Lowry (2002) and unpublished data from S. Allen, D. Crocker, B. Hatfield, R. Jameson, B. Le Boeuf, M. Lowry, P. Morris, G. Oliver, D. Lee and W. Sydeman. From Carretta et al. (2007).

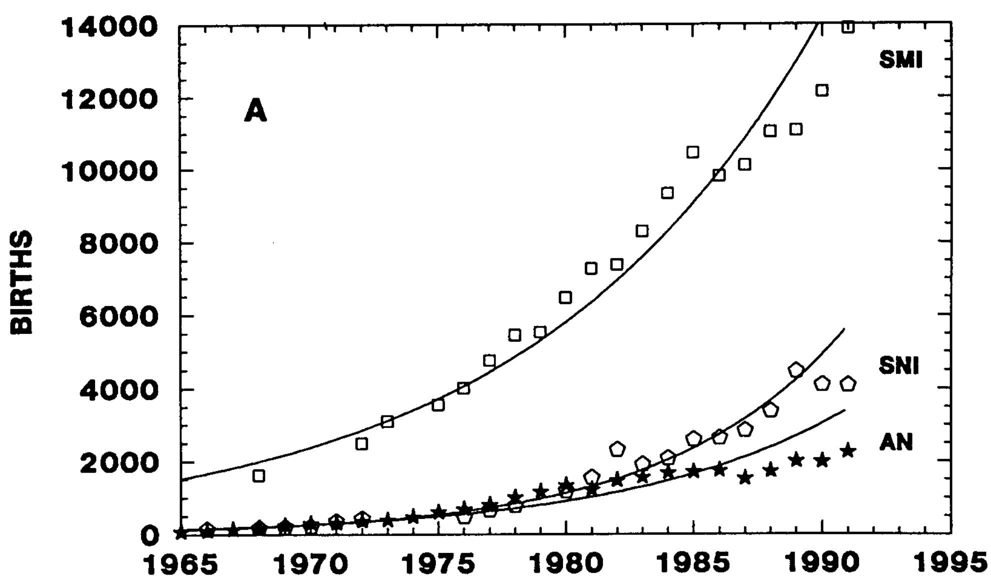


FIGURE 15. Growth of the northern elephant seal population as indicated by births at San Miguel Island (SMI), SNI, and Año Nuevo Island (AN). From Stewart et al. (1994a).

SNI is currently the second largest elephant seal rookery and haulout in Southern California. Within the Point Mugu Sea Range, ~67% of elephant seals haul out on San Miguel Island, ~32% on SNI, and small numbers on Santa Rosa (1%), Santa Cruz, Anacapa, and Santa Barbara islands. Surveys for northern elephant seals at SNI have been conducted by NMFS' Southwest Fisheries Science Center (SWFSC) since 1988. Surveys take place during the peak of the breeding season (when numbers ashore are greatest) in late January to early February, and late in the breeding season in mid-to-late February. Total counts on the island for the years 1988–2001 and counts by haul-out area for the years 1998–2001 are given in Tables 1 and 2, respectively. The numbers in these tables only provide an estimate of the total number of seals using each haul-out site because:

- only part of the breeding population is present at the rookeries even during the peak of the breeding season (some early-arriving adult females have already departed), and
- there is different timing of occupation of the haul-out sites by different age and sex cohorts during different haul-out phases (see Figure 9).

TABLE 1. Counts of northern elephant seals at SNI obtained from aerial color photographs (augmented with visual counts from sites that were not photographed during the survey). From Lowry et al. (1996) and Lowry (2002).

	Pups			Subadults and Adults		
Survey Date	**Alive and Unk.**	**Decomposed Carcasses**	**Juveniles**	**Adult Female[2]**	**Subadult & Adult Male**	**Unk. Sex**
Peak breeding season						
28 Jan 1989	4,124	50	16	4,313	549	3
3 Feb 1990	4,092	55	5	3,439	475	3
2 Feb 1991	4,053	67	2	4,019	502	0
3 Feb 1992	5,482	78	5	4,745	634	1
29 Jan 1993	4,940	63	23	4,878	554	0
28 Jan 1995	5,218	62	27	6,232	724	0
29 Jan 1996	5,306	49	15	5,853	638	0
Late breeding season						
15 Feb 1988	3,120	34	0	1,732	430	0
16 Feb 1989	4,688	63	0	1,649	537	0
19 Feb 1990	4,079	52	2	976	425	2
18 Feb 1991	4,547	51	3	1,316	469	0
17 Feb 1992[1]	5,387	63				
15 Feb 1993	5,171	37	8	1,973	602	0
13 Feb 1994	5,727	63	7	2,998	648	3
15 Feb 1995	6,486	89	2	3,590	673	0
23 Feb 1996	6,188	44	0	1,237	569	0
13 Feb 1998	6,200	167	8	3,856	595	0
11 Feb 2000	9,713	81	2	7,560	667	0
16 Feb 2001	9,121	75	2	4,111	647	0

[1] Total = all sites were photographed or inspected visually; Incomplete = incomplete count (animals missed due to incomplete photographic coverage).

[2] The count of adult females may contain an extremely small percentage (estimated to be ≤1%) of males that are of similar size as adult females.

TABLE 2. Counts of northern elephant seals at SNI during the breeding season, 1998–2001. Figure 16 shows the locations of areas A to Q. All seals were counted from aerial photographs. From Lowry (2002).

	13 February 1998					11 February 2000					16 February 2001				
	Pups					Pups					Pups				
Area	Alive & unknown	Decom. carcasses	Juveniles	Adult Females	Subadult and adult males	Alive & unknown	Decom. carcasses	Juveniles	Adult Females	Subadult and adult males	Alive & unknown	Decom. carcasses	Juveniles	Adult Females	Subadult and adult males
A	325	5	3	236	26	820	7	0	727	48	889	13	0	391	62
B	77	1	0	29	8	349	1	1	196	14	126	1	0	50	10
C	1002	38	1	651	85	1591	23	0	1264	59	1617	20	0	735	52
D	970	19	0	570	105	1423	22	1	1092	115	1411	10	0	640	119
E	670	20	0	509	34	970	2	0	796	57	863	6	0	389	45
F	637	12	0	339	63	804	3	0	605	63	735	4	0	333	63
G	646	24	0	422	48	438	1	0	365	34	552	6	0	263	38
H	294	4	1	139	39	539	3	0	389	41	427	3	1	160	31
I	524	18	0	350	29	619	6	0	501	38	666	6	0	328	32
J	195	7	3	61	8	577	5	0	383	20	326	1	0	153	20
K	826	18	0	521	106	1029	4	0	744	91	1112	4	0	457	89
L	0	0	0	0	18	22	0	0	15	10	6	0	0	0	29
M	25	1	0	24	15	305	4	0	255	30	227	0	0	122	27
N	0	0	0	0	0	52	0	0	47	8	37	0	0	25	11
O	0	0	0	1	2	2	0	0	2	7	5	0	0	1	1
P	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Q	9	0	0	4	8	173	0	0	179	32	122	1	1	64	18
Total	6200	167	8	3856	595	9713	81	2	7560	667	9121	75	2	4111	647

The total count of elephant seals at SNI for 2001 was 13,956; the total pup count was 9,196 (Lowry 2002). The southern coast has the greatest numbers of elephant seals, with areas C, D, and K being the most populated areas on the island (see Figure 16). A multiplication factor of 3.5 times the annual pup production can be used to estimate the size of growing elephant seal populations (Barlow et al. 1993). Based on this, ~32,186 seals of all ages and both sexes used SNI over the course of the year in 2001. This represents ~32% of the California stock.

From 1988 to 1995, the pup counts on SNI increased at an average rate of 15.4% per year (see Figure 14). From 1988 to 2001, the number of births increased at an average annual rate of 7.3% (Lowry 2002). However, the growth rate of the California population as a whole appears to have slowed in recent years. For all of California, the rate of growth was 14.9% for 1964 to 1979, 10.2% for 1980 to 1985, and 8.41% for 1987 to 1991; slopes for these periods are significantly different (Barlow et al. 1993). It is possible that the elephant seal population is approaching the carrying capacity of its environment. If so, the continued high rate of increase on SNI, while other populations are growing more slowly or stabilizing, suggests that suitable haul-out habitat, rather than abundance of food, is limiting population growth elsewhere, because animals from the different haul-out sites all feed in the same general area. This theory is also supported by the observed expansion of rookery sites and occupation of formerly unused sites on SNI (Lowry 2002; G. Smith, NAWCWD, pers. comm.). Elephant seals began using Daytona Beach (area C) as a pupping area in 1988 when 144 elephant seal pups were born there (Lowry 1995 *in* NAWCWD 1996); in 2001, ~1,617 pups were born there (Lowry 2002). During 2001–2007, Holst et al. (2008) monitored elephant seals during missile launches at 11 locations on SNI, including areas J, K, L, M, and O; the greatest number of seals observed exceeded 1,000 at Bachelor Beach in area K during the molt (5 May 2004) and during the breeding/pupping season (27 January 2005).

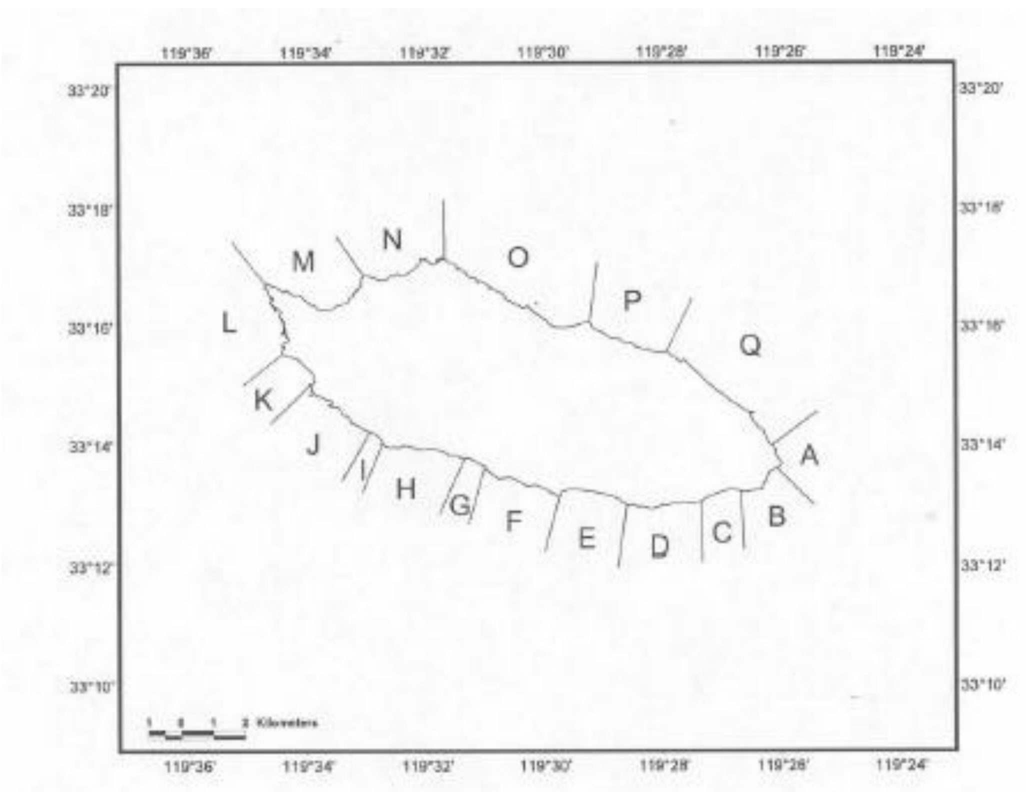


FIGURE 16. Census areas on SNI and associated alphabetic codes used by Lowry (2002) to identify census areas. The alphabetic codes have changed since the previous Petition was submitted in 2002.

Northern elephant seals haul out at beaches twice annually along almost the entire shoreline of SNI, except the north side (Figure 17): once to breed and give birth, and a second time to molt (Figure 11). They prefer gradually sloping, sandy beaches, or sand spits. If sandy beaches are not available, they will haul out on pebbles, or as a last resort, on boulders and rocky shores.

Adult northern elephant seals spend from 8 to 10 months at sea and undertake two annual migrations between haul-out and feeding areas (Stewart and DeLong 1995). Their movements between these areas are rapid. They spend little time in coastal or nearshore waters, as evidenced by the relatively few sightings during marine mammal surveys of these areas. They haul out on land to give birth and breed and after spending time at sea to feed (postbreeding migration), they generally return to the same areas to molt (Odell 1974; Stewart and Yochem 1984; Stewart 1989; Stewart and DeLong 1995). However, they do not necessarily return to the same beach. In the South Farallon Islands, female northern elephant seals often molt on one island and breed on another (Huber et al. 1991). After molting, they undertake a second prolonged foraging migration. Elephant seal activities while hauled out are described in greater detail in Section 3.7.4.3 of the *Marine Mammal Technical Report* (Koski et al. 1998) accompanying the Point Mugu Sea Range Final EIS/OEIS (NAWCWD 2002). Their brief periods of movement through the seas near SNI occur during the times of year with vertical interruptions in the bar graphs shown in Figure 11.

While at sea, elephant seals are usually found well offshore and north of SNI. Females feed between 40º and 45º north latitude, and males range as far north as the Gulf of Alaska (Stewart and DeLong 1995). Pups are weaned and abandoned on the beaches when they are about 1 month old (Odell 1974; Le Boeuf and Laws 1994); they go to sea at 1 to 3 months old.

The timing of haul out by various age and sex categories of seals is shown in Figure 11 and is reflected in the bi-modal peak pattern in the counts of hauled-out elephant seals on the island (Figure 18). Haul out for 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. Elephant seals are highly polygynous. Males establish a dominance hierarchy and defend harems on the beach during the mating season. Vocal activity is important in maintaining social structure and appears to be greatest following sunset (Shipley and Strecker 1986).

Pregnant females begin to arrive in mid-December and peak numbers are present at the end of January and in early February. Numbers of females then begin to decline until the first week in March when they have left the rookery. Younger adult males begin to leave the rookery in late February, but some of the older males remain there until late March (Clinton 1994).

Females have their pups shortly after arriving at the rookery. Pupping occurs from the third week in December until the end of the first week in February. Pups are weaned at 24–28 days old, and they are abandoned on the rookery where they remain for 2–2.5 months. During this period, they undergo their first molt (Le Boeuf and Laws 1994). Breeding occurs from the first week in January through the first week in March and peaks in mid-February. Females return to sea to feed once they have bred and their pups have been weaned.

The female and juvenile molt period starts in mid-March and extends through May (Figure 11). Most females that weaned their pups 6–8 weeks earlier return from northern feeding areas to molt. However, some females and juveniles from the Sea Range rookeries apparently molt farther north (i.e., at Año Nuevo) rather than return to their natal rookeries (Le Boeuf and Laws 1994). The molt takes ~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. By the end of April, 80% of pups have left the rookery, and the remainder leave in May.

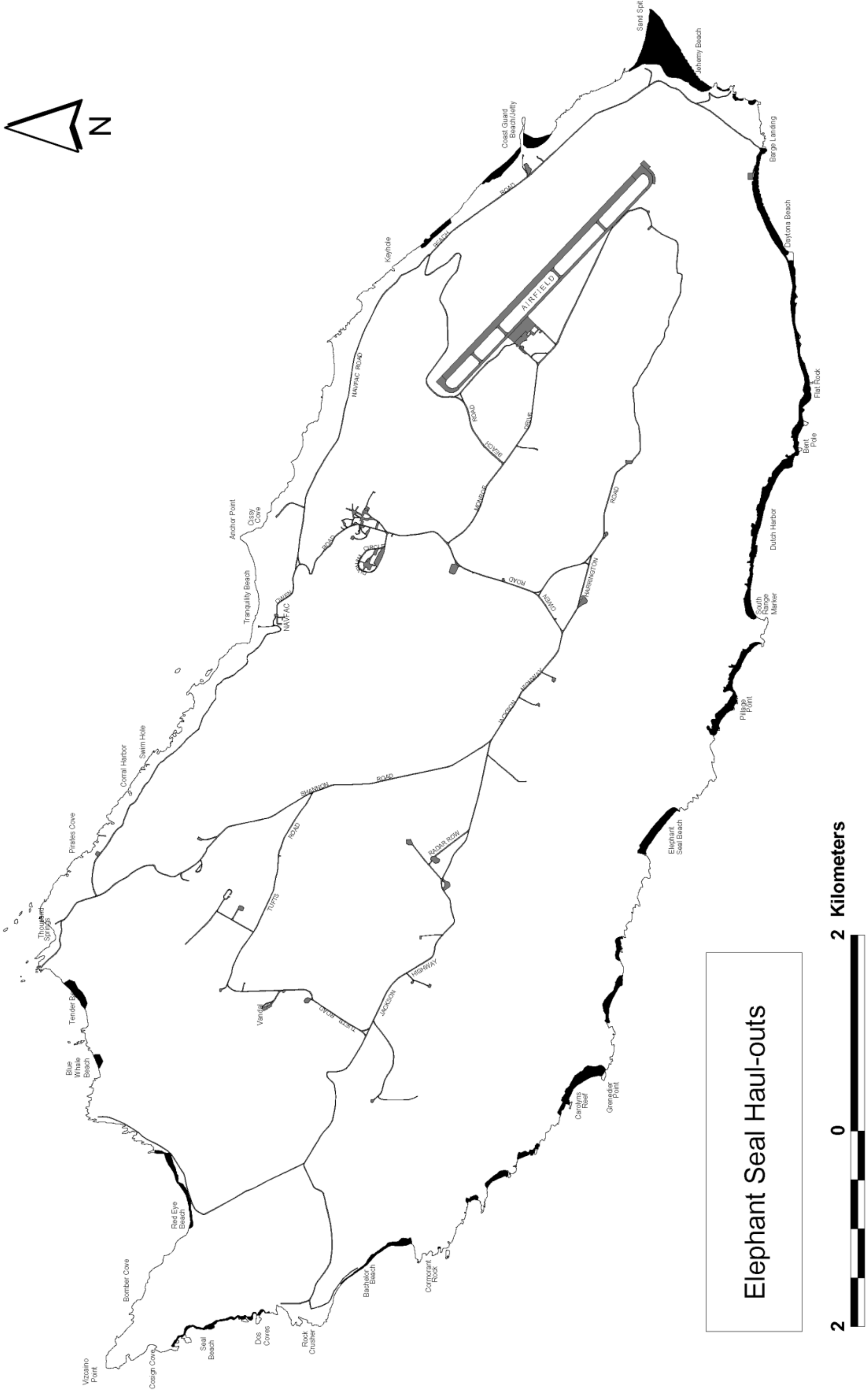


FIGURE 17. Map of SNI showing beaches on which northern elephant seals are known to haul out. From Lowry et al. (1992), and updated in 2000 by G. Smith (NAWCWD, pers. comm.).

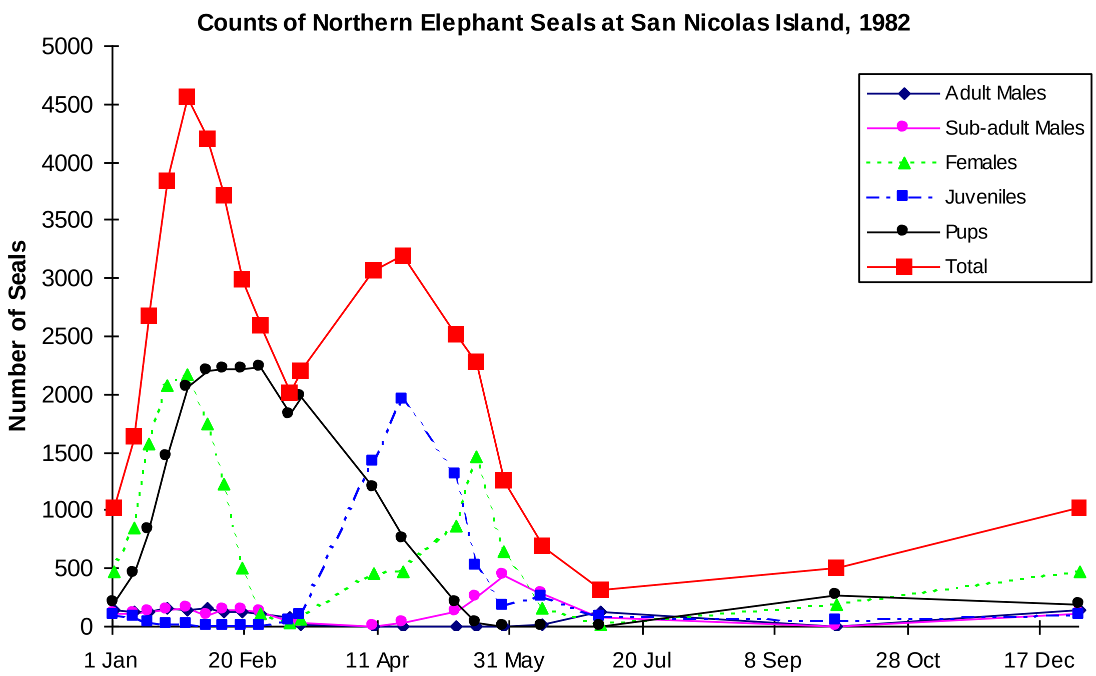


FIGURE 18. Counts of northern elephant seals throughout the year at SNI, 1982. Plotted from Table 1 in Stewart and Yochem (1984).

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 haul-out phase extends from September through November with pubertal subadult males[1] arriving in November and remaining until December. The peak of juvenile haul-out is in October and most (except for pubertal subadult males) have left by the time that adult males arrive in early December (Le Boeuf and Laws 1994).

4.1.3 California Sea Lion

The California sea lion is not listed under the ESA, and the U.S. stock, which occurs on SNI, is not considered a strategic stock under the MMPA. 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-June to mid-July. Females nurse their pups for about 8 days before beginning an alternating pattern of foraging at sea vs. attending and nursing the pup on land; this pattern may last for eight months (with some pups nursing up to one year after birth). California sea lions also haul out during the molting period in September, and smaller numbers of females and young animals haul out during most of the year (Figure 11). The following discussion and figures provide additional details.

The California sea lion includes three subspecies:

- *Zalophus californianus wollebaeki* (in the Galapagos Islands),

- *Z. c. japonicus* (formerly in Japan, thought to be extinct), and
- *Z. c. californianus* (from southern Mexico to southwestern Canada)

Z. c. californianus 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%) breeds and gives birth to pups on San Miguel, San Nicolas, and Santa Barbara islands. Smaller numbers of pups are born on San Clemente Island (southeast of SNI) and the Farallon Islands and Año Nuevo Island, north of SNI (Carretta et al. 2007).

The California sea lion is the most commonly sighted pinniped species at sea near SNI. Sea lions made up 84% (2,137 of 2,538) of identified pinniped sightings at sea during previous studies (see Koski et al. 1998). They have been sighted during all seasons and in all areas with survey coverage from nearshore to offshore areas.

Bonnell and Ford (1987) analyzed survey data from 1975–1978 to describe the seasonal shifts in the offshore distribution of California sea lions. They attributed these seasonal changes in the center of distribution to changes in the distribution of the prey species. If California sea lion distribution is determined primarily by prey abundance, these same areas might not be the center of sea lion distribution every year.

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.

During August and September, after the mating season, the adult males migrate northward to feeding areas as far away as Washington (Puget Sound) and British Columbia (Lowry et al. 1992). They remain there until spring (March to May), when they migrate back to the breeding colonies. Thus, adult males are present in areas offshore of SNI only briefly as they move to and from rookeries.

The distribution of immature California sea lions is poorly known but some make northward migrations that are shorter in length than the migrations of adult males (Huber 1991). However, most immature animals are presumed to remain near the rookeries, and thus remain in or near the Channel Islands (Lowry et al. 1992).

Adult females remain near the rookeries throughout the year. They return to the rookery to give birth to their pups and breed. Most births occur from mid-June to mid-July (peak in late June). Females nurse their pups for about 8 days before going to sea to feed for 2 days. Subsequent feeding trips range from 1.7–3.9 days in duration, and subsequent nursing periods are 1.7–1.9 days long. Females mate two to four weeks postpartum, usually in the water or at the water's edge. Weaning has been reported to occur at 4–8 months (Lowry et al. 1992) and 10–12 months (Ono 1991), but there have been records of females nursing yearling pups. Pups begin to forage on their own when about 7 months old to supplement their mother's milk.

The entire population cannot be counted directly, because different age and sex classes do not come ashore at the same time or places. The size of the sea lion population is estimated by:

[1] Pubertal subadult males: capable of copulating, but not old enough to hold a breeding territory.

- counting pups late in the breeding season,
- multiplying pup counts by 1.15 to account for pup mortality between birth and the counting period, and
- multiplying the number of pups by 4.28 to account for other age and sex components of the population (see Carretta et al. 2007).

In 2005, 48,277 pups were counted in California; this number was adjusted for a 15% mortality rate and the percentage of pups in the population (23.3%; Boveng 1988; Lowry et al. 1992) to come up with an estimate of 238,000 (Carretta et al. 2007). California sea lion populations have increased steadily since 1950 (see Carretta et al. 2007). For the U.S. stock of California sea lions, the number of pups showed an annual increase of 5.6% between 1975 and 2005 (Figure 19; Carretta et al. 2007). In contrast, up until 1994, the population on SNI increased at 21.4% per year.

Barlow et al. (1997) reported that 47% of the U.S. stock or 49% of the Point Mugu Sea Range population used the shoreline of SNI to breed, pup, or haul out in 1994. Based on extrapolations from a total count of 26,154 pups at SNI for 2006 (see Table 3) and assuming that about half of the U.S. stock hauls out at SNI, over 100,000 sea lions of all ages and sexes might be associated with the haul-out sites and rookeries on SNI over the course of the year. At the peak of the breeding season, about half of these animals may be hauled out on land at one time (see below).

The population of California sea lions at SNI grew from 1970–1994 (see Figure 20) and appears to still be growing (see Table 3). Sea lions have occupied new areas on SNI over the last several years. During the 1980s, California sea lions were rarely found east of Elephant Seal Beach, but now, they are found on many beaches along the entire southern shore (Figure 21). Sea lions have been counted in every survey area from 2001–2006 (Table 3). At least for the last 16 years, maximum counts were typically found along the south coast in area H (see Figure 16). El Niño events caused substantial reductions in numbers of pups produced and in counts of non-pups at the rookeries in 1983, 1992-1993, 1998, and 2003 (see Carretta et al. 2007). To date, there is no indication that California sea lions on SNI have reached the carrying capacity of the surrounding habitat, except during these El Niño years when sea lions may have to spend more time feeding and may have to forage farther from rookeries. During 2001–2007 launch monitoring at SNI (Holst et al. 2005a, 2008), 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 area L.

4.2 Other Pinniped Species that May Occur in the Area

4.2.1 Northern fur seal

There are two stocks of northern fur seals recognized in the U.S.: the San Miguel Island stock and the Eastern Pacific stock, which primarily breeds on the Pribilof Islands in the Bering Sea. The San Miguel Island stock is not listed as threatened or endangered under the ESA, and it is not considered depleted under the MMPA. 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 (Angliss and Outlaw 2008). Adult females and pups migrate from the Bering Sea to California (e.g., Ream et al. 2005). Thus, both stocks occur in the Sea Range during autumn and winter, but only the San Miguel 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 Point Mugu Sea Range, with most seen in offshore locations (Koski et al. 1998). 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.).

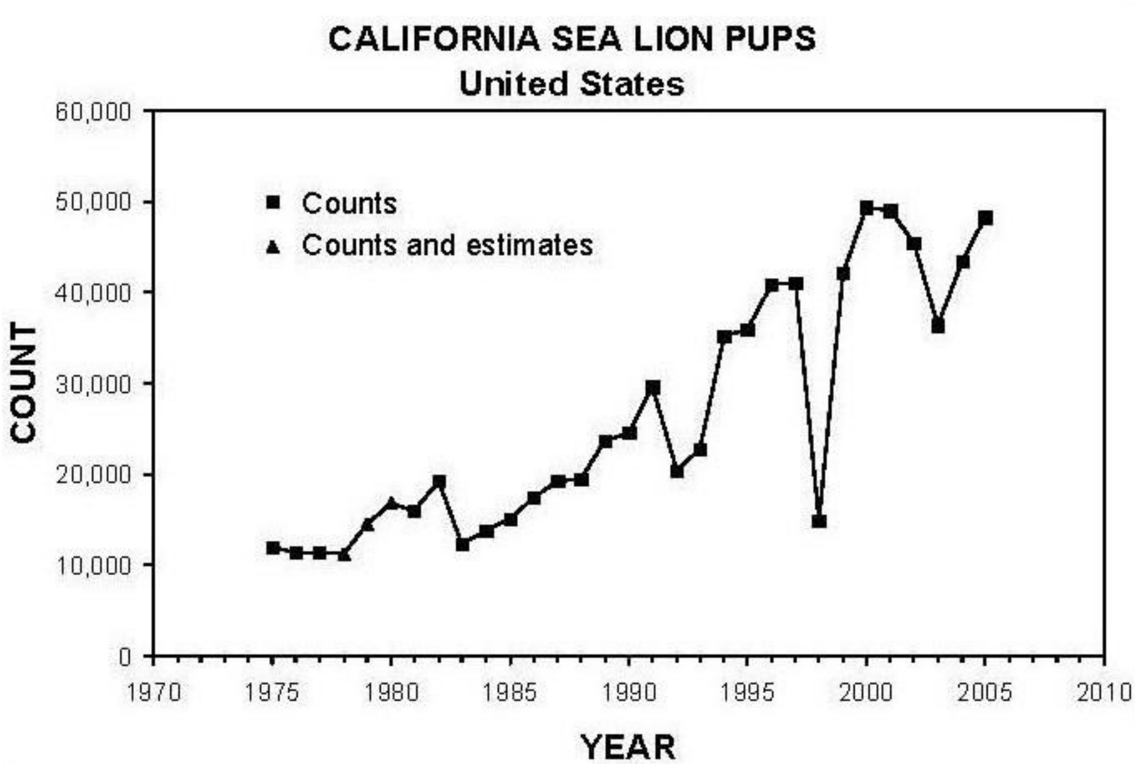


FIGURE 19. U.S. pup count index for California sea lions (1975–2005). From Carretta et al. (2007).

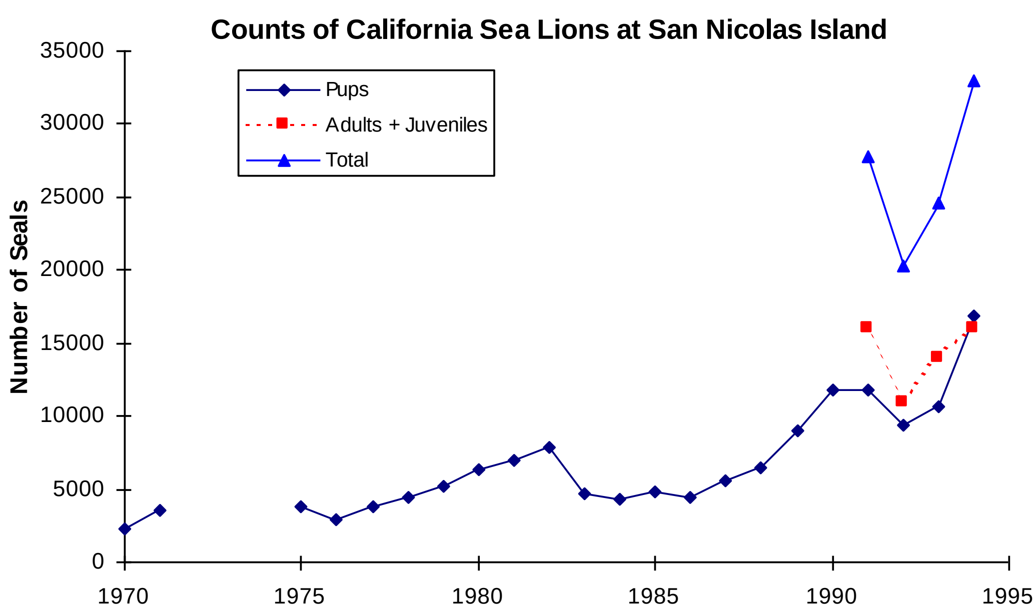


FIGURE 20. Counts of California sea lions at SNI, 1970–1994. Plotted from Table 1 in Lowry et al. (1992) and Table 3 in Lowry (n.d.).

TABLE 3. Counts of California sea lions at SNI in July (during late breeding season), 2001-2006. Figure 15 shows the locations of areas A to Q. Data are from Lowry (unpublished data).

	2001			2002			2003			2004			2005			2006		
Area	Pups	Non-pups	Total	Pups	Non-pups	Total	Pups	Non-pups	Total	Pups	Non-pups	Total	Pups	Non-pups	Total	Pups	Non-pups	Total
A	0	926	926	0	412	412	4	1117	1121	0	1342	1342	0	829	829	1	755	756
B	1	550	551	6	488	494	20	618	638	11	507	518	15	584	599	122	720	842
C	228	1319	1547	312	809	1121	356	1257	1613	335	1208	1543	244	659	903	467	837	1304
D	3056	2473	5529	2787	1915	4702	2564	2544	5108	3943	3137	7080	4097	3272	7369	4964	3085	8049
E	1030	1135	2165	644	765	1409	519	1172	1691	743	1292	2035	509	1225	1734	782	1361	2143
F	3721	2179	5900	2904	1628	4532	2256	2305	4561	2768	2265	5033	2667	1863	4530	3016	2556	5572
G	317	557	874	254	437	691	172	802	974	281	859	1140	269	563	832	240	942	1182
H	5937	3944	9881	4593	2613	7206	3464	3862	7326	4352	4054	8406	4368	3525	7893	5089	4193	9282
I	2218	1611	3829	1808	1056	2864	1369	1762	3131	1674	1741	3415	1523	1327	2850	1667	1569	3236
J	3628	3399	7027	2907	2169	5076	2283	3606	5889	2658	3606	6264	2859	3264	6123	3397	3657	7054
K	0	683	683	0	376	376		625	625	0	518	518	0	255	255	0	480	480
L	4113	3494	7607	3116	2425	5541	2313	3446	5759	3530	4125	7655	4424	4175	8599	5237	4224	9461
M	492	2368	2860	388	1192	1580	382	2032	2414	571	2400	2971	822	2208	3030	1172	2527	3699
Q	0	2584	2584	0	1315	1315		2320	2320	0	1603	1603	2	952	954	0	895	895
Total	**24,741**	**27,222**	**51,963**	**19,719**	**17,600**	**37,319**	**15,702**	**27,468**	**43,170**	**20,866**	**28,657**	**49,523**	**21,799**	**24,701**	**46,500**	**26,154**	**27,801**	**53,955**

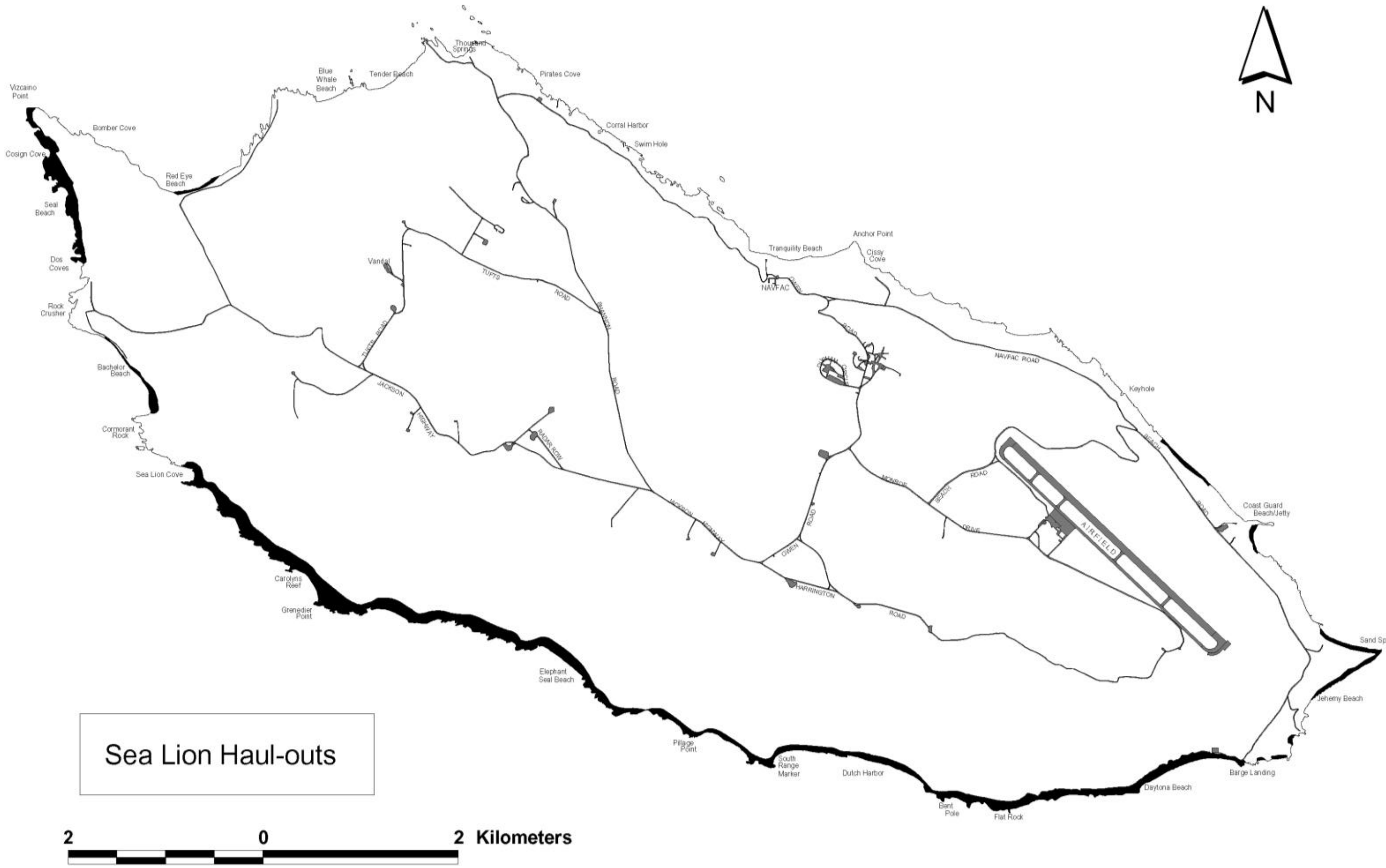


FIGURE 21. Map of SNI showing beaches on which California sea lions are known to haul out. From Lowry et al. (1992), and updated in 2000 by G. Smith (NAWCWD, pers. comm.)

San Miguel Island and the adjacent Castle Rock have the only rookery 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 (R. DeLong, pers. comm. *in* Carretta et al. 2007). Although the number of pups decreased by 80% from 1997 to 1998 (Melin et al. 2005), the population began to recover in 1999. Based on 2005 counts, the current population estimate for San Miguel Island is 9,424 (Carretta et al. 2007).

The 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 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). Adult males leave the haul-out sites in early August and go to sea to feed until the following May (Carretta et al. 2007). Juveniles and other non-breeding animals haul out from mid-August to early October to molt.

4.2.2 Guadalupe fur seal

The Guadalupe fur seal is listed as threatened under the ESA. It is considered depleted and designated as a strategic stock under the MMPA. Sealing during the 19th century nearly reduced the once abundant Guadalupe fur seal to extinction (Townsend 1931). However, from 1954 to 1993, the Guadalupe fur seal population increased at an average annual rate of 13.7%, and it may be expanding its range (Le Boeuf and Bonnell 1980; Gallo-Reynoso 1994; Carretta et al. 2007). The best available population estimate is 7,408 for 1993 (Gallo-Reynoso 1994; Carretta et al. 2007). However, very few of these animals are expected to occur within the Sea Range.

Guadalupe fur seals mainly breed and pup on Isla de Guadalupe in Mexico (Le Boeuf and Bonnell 1980). In 1997, a second rookery was discovered at Isla Benito del Este, Baja California (Maravilla-Chavez and Lowry 1999), and a pup was born and reared successfully to weaning at San Miguel Island (Melin and DeLong 1999).

Archaeological evidence suggests that the Guadalupe fur seal was typically found in the Channel Islands before commercial exploitation (Walker and Craig 1979). Since the drastic decline, only occasional sightings have been made in offshore waters of the Channel Islands, including in or near the Sea Range. From 1969 to 1986, 43 sightings of Guadalupe fur seals were made at San Miguel and San Nicolas islands. Two sightings have also been recorded at Santa Barbara Island, and one sighting was made at San Clemente Island (Stewart et al. 1987). Prior to 1985, there were only two sightings of Guadalupe fur seals from central and northern California, in Monterey Bay in 1977 and Princeton Harbor in 1984 (Webber and Roletto 1987). However, nine strandings and five sightings were reported along the central and northern coast of California from 1988 to 1995, suggesting that the Guadalupe fur seal may be expanding its range (Hanni et al. 1997).

Twenty-one sightings of Guadalupe fur seals were made on SNI from 1949 to 1986 (Bartholomew 1950; Stewart 1981a; 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 ~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.). 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 no individuals of this species have been seen on SNI since 1997, it is unlikely any would occur ashore during the proposed activities during the period of the regulations.

4.2.3 Steller sea lion

The Eastern stock of Steller sea lions, which occur farther north in California, is listed as threatened under the ESA as a result of steep declines in southwest Alaska from 1956–1960 to 1985 (Merrick et al. 1987). This stock is a strategic stock under the MMPA and is considered depleted. Although the size of the Eastern stock has been increasing over the several years and is currently estimated at 48,519–54,989 (Angliss and Outlaw 2008), the numbers in California declined from 6,000–7,000 in the late 1960s to ~2,000 in 1989 (Loughlin et al. 1992). The population size in northern and central California appears to be stable at 1,500–2,000 non-pup individuals (NMFS 2008; Angliss and Outlaw 2008). The size of the colony closest to SNI, on Año Nuevo Island, has been declining since 1970, resulting in an 85% reduction in the breeding population by 1987 (Le Boeuf et al. 1991). From 1990 to 1993, the number of pups declined by 9.9%, and non-pups declined by 31.5% (Westlake et al. 1997). More recently, non-pup counts appear to have stabilized at Año Nuevo and Farallon Islands (Hastings and Sydeman 2002); pup counts at Año Nuevo have also stabilized (NMFS 2008). Pup counts at Año Nuevo Island and the Farallon Islands in 2000 and 2002 were 349 and 380, respectively (Angliss and Outlaw 2008). In 2004, the pup count for Año Nuevo was 221 individuals (NMFS 2008), but only 22 pups were counted on the Farallons (see Hastings and Sydeman 2002; NMFS 2008). 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). However, because no adults have been sighted on any of the Channel Islands since 1983, it is unlikely any would be ashore on SNI during the period of the regulations, and it is not discussed further in this Petition.

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.

NAWCWD requests issuance of regulations and associated LOAs to authorize non-lethal incidental take by harassment (Level B) during planned vehicle launch operations at SNI, California. Injury or mortality is unlikely during routine launch activities.

Some of the operational activities outlined in Sections 1 and 2 for the SNI launch program have the potential to disturb or displace pinnipeds. These activities may result in "Level B" harassment as defined in the 1994 amendments to the MMPA. No take by serious injury or death is likely, given the nature of the planned activities, the standard, ongoing monitoring and mitigation measures, and the previous monitoring results (Sections 11 and 13). NAWCWD will adopt mitigation measures to reduce disturbance to marine mammals that might occur on the western end of the island. These measures will also be designed to minimize the possibility of injury, e.g., to pups (see Section 11).

6. NUMBERS OF MARINE MAMMALS THAT MAY BE TAKEN

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 [Section 5], and the number of times such takings by each type of taking are likely to occur.

The material for Sections 6 and 7 has been combined and presented in reverse order to minimize duplication between sections.

7. ANTICIPATED IMPACT ON SPECIES OR STOCKS

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

First we summarize the potential impacts on marine mammals of launch operations, as called for in Section 7. Then, we estimate the numbers of marine mammals that could be affected by the proposed launch activities on SNI. This section includes a description of the rationale for the estimates of the potential numbers of harassment takes during the planned operations, as called for in Section 7

The likely or possible impacts of the planned vehicle launch operations at SNI on marine mammals involve both acoustic and non-acoustic effects. Acoustic effects relate to sound produced by the engines of all launch vehicles and, in some cases, their booster rockets. The acoustic sense of marine mammals probably constitutes their most important distance receptor system, and launch sounds could (at least in theory) have several types of effects on marine mammals.

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 not expected to result in any disturbance to pinnipeds hauled out nearby. Any visual disturbance caused by passage of a vehicle overhead is likely to be minor and brief as the launch vehicles are relatively small and move at great speed. There is a small chance that a pup might be injured or killed during a stampede of pinnipeds on the shore during a vehicle launch, but this has not been documented in videotaped records of pinniped groups during launches at SNI in 2001–2007 (Holst et al. 2005a, b; 2008).

7.1 Noise Characteristics and Effects

The effects of noise on marine mammals are highly variable, and can be categorized as follows (based on Richardson et al. 1995). 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 vehicle 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.

(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 vehicle 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 (see Section 7.5, below). 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 temporary threshold shift (TTS). Received levels must be even higher for there to be risk of permanent threshold shift (PTS).

7.1.1 Launch Sound

The extremely rapid departure of the vehicles means that the pinnipeds would be exposed to increased sound levels for only very short time intervals (up to 5 s). Nonetheless, most launches would be considered to produce prolonged rather than impulsive sounds (unless they produce a sonic boom), as measured durations are typically several seconds long. However, durations can be as long as 16 s or shorter than 1 s. The sonic booms from some supersonic vehicle flights are very short, on the order of 0.05 s. However, the definition of duration as the time interval associated with receipt of 90% of the cumulative energy (interval between receipt of 5% and 95%) effectively extends the duration because the propulsion noise following the sonic boom includes a substantial portion of the total energy. Consideration of these longer times results in lower SPLs, because the SPL is an average over the defined duration, including the portion with comparatively low-level sounds. Another measure of each launch sound (SEL) represents the total received energy, and that measure is little-affected by the measurement duration.

During the 2001–2007 period, the strongest sounds originating from a vehicle in flight over the beaches at SNI were produced by Vandal and Coyote launches (see Table 4; Figures 22 and 23; Holst et al. 2008). Coyotes were launched from SNI during 2003–2007 and are expected to be the primary large vehicle to be launched from SNI during the period of applicability of the regulations now sought. SELs during Coyote launches ranged from 115 dBA re 20 µ$Pa^2 \cdot s$ (123 dB M_{pa}-weighted) near the launcher, to 96–107 dBA (105–114 dB M_{pa}-weighted) at beaches 0.8–1.7 km from the CPA, and 46–87 dBA (60–91 dB M_{pa}-weighted) at CPAs of 2.4–3.2 km (Figure 22; Holst et al. 2008). (All dBA values are referenced to 20 µPa.) Coyotes are launched from an inland location, so no pinnipeds occur near the launcher. The closest pinnipeds to the Coyotes are pinnipeds on 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 vehicles (Figures 22 and 23). Stronger sounds were also recorded at the launcher when small or large vehicles were launched. Although launches of smaller vehicles, such as AGS missiles and slugs, occur from Building 807 Complex near the beach, the closest pinniped haul-outs (elephant seals and 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 of vehicles launched from Building 807 Complex.

TABLE 4. The range of sound levels (maximum in bold) recorded near the launcher and at nearshore locations for all vehicle types launched at SNI from 2001 through 2008. Units for Peak and SPL are in dB re 20 µPa; SEL is shown in dB re (20 µPa)^2·s.

	CPA (m)	Peak	SPL-f	SPL-A	SPL-M	SEL-f	SEL-A	SEL-M
Launcher[1]								
AGS Slug	12	**166**	**154**	**143**	**149**	**142**	**130**	**136**
AGS Missile	12-22	157-**165**	148-**156**	133-**143**	139-**150**	136-**143**	122-**131**	127-**137**
RAM	2-4	146-**147**	124-**126**	122-**125**	124-**125**	129-**131**	128-**130**	129-**130**
Vandal	27	**156**	**137**	**119**	**129**	**136**	**118**	**128**
Coyote	72	**142**	**126**	**113**	**122**	**128**	**115**	**123**
Nearshore[2]								
AGS Slug								
Min	1578	104	100	53	75	88	43	62
Max	461-1268	**139**	**133**	**107**	**117**	**120**	**92**	**103**
AGS Missile								
Min	1492-2115	107	97	53	71	90	48	64
Max	265-462	**135**	**126**	**104**	**114**	**113**	**92**	**103**
RAM								
Min	581-2013	104	86	72	83	84	64	76
Max	580-1555	**117**	**99**	**87**	**93**	**97**	**92**	**96**
Vandal								
Min	2139-2909	104	85	51	65	92	48	64
Max	399-421	**150**	**142**	**131**	**135**	**129**	**118**	**122**
Coyote								
Min	2413-3236	100	82	54	60	87	46	60
Max	883-1311	**144**	**134**	**119**	**126**	**119**	**107**	**114**
Arrow								
Min	2262-2656	100	84	72	81	96	82	92
Max	1821	**107**	**90**	**83**	**90**	**102**	**92**	**99**
Terrier-Orion	2433	**104**	**91**	**78**	**87**	**96**	**83**	**92**
Tomahawk	529	**111**	**93**	**92**	**92**	**107**	**102**	**105**

Note: - means no launch sounds were recorded near the launcher.
[1] No acoustic data were recorded near the launcher during Arrow, Terrier-Orion, or Tomahawk launches. RAMs and, as of July 2004, AGS vehicles, are launched from Building 807 Complex near the beach.
[2] Acoustic data were only recorded at a single nearshore site during Terrier-Orion and Tomahawk launches.

7.1.2 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 must be 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.

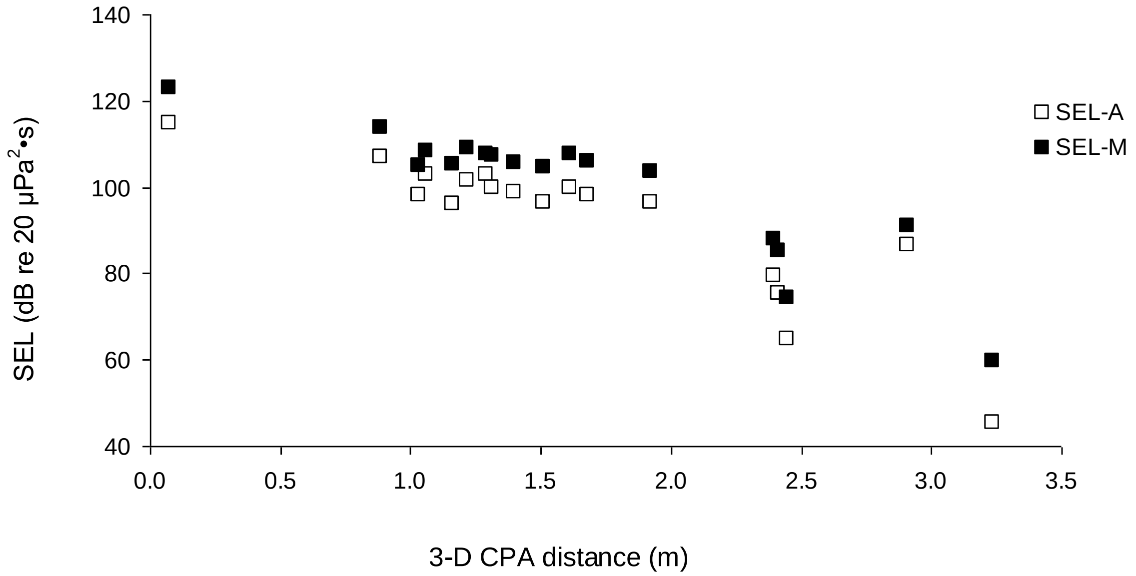


Figure 22. SELs (A- and M_{pa}-weighted) for Coyote launches at SNI relative to the 3-D CPA distance, 2003–2007.

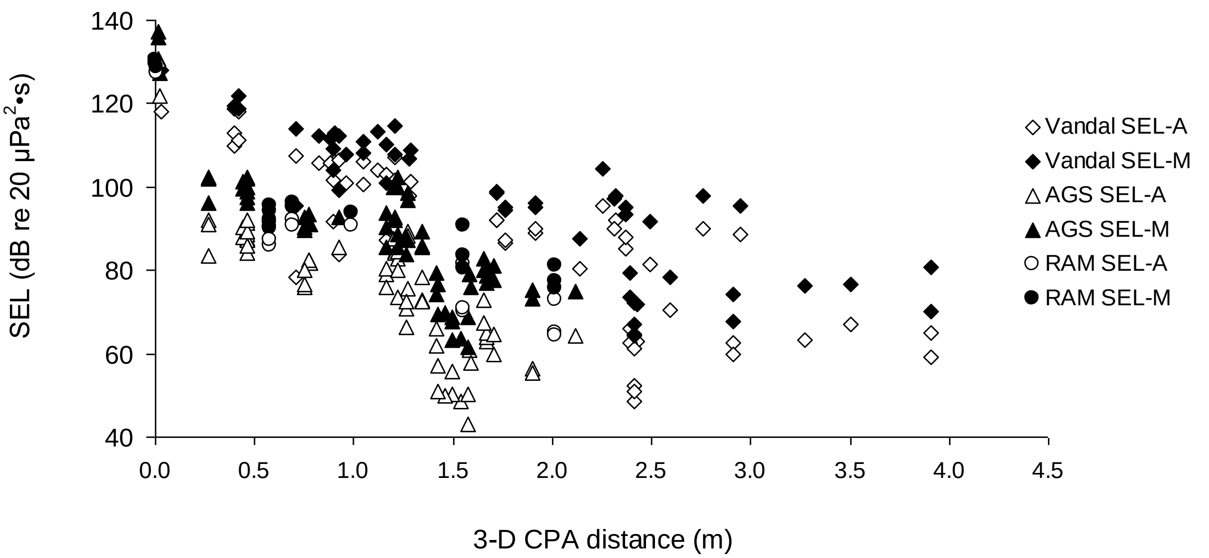


Figure 23. SELs (A- and M_{pa}-weighted) for Vandal, AGS, and RAM launches relative to the 3-D CPA distance, 2003–2007.

Ambient noise levels in air at SNI are expected to be dominated by breaking waves at the shoreline and the strong winds that are common on the west end of SNI, both of which will be further elevated during storms. Ambient noise measurements are an important component of acoustic monitoring of vehicle launches on SNI.

Background sounds have been (and will be) recorded on a second audio channel of the ATAR (see Section 13) using a higher sensitivity microphone and higher gain setting. This channel will overload during the brief periods when it receives the vehicle flight 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 2001–2007 were generally relatively quiet[2], ranging from 22 to 72 dBA re 20 μPa or 23 to 91 dB re 20 μPa flat-weighted (Holst et al. 2005a, b; 2008). These sounds are comparable to sound levels expected in residential areas. Further sound measurements during launches will be used to better characterize the range of ambient noise levels on the western end of SNI.

7.1.3 Sound Propagation

In-air sound propagation from vehicle launch sources at SNI had not been well studied prior to the monitoring work during 2001–2007. Measured sound levels of several vehicle types as related to CPA distance are shown in Figures 22 and 23. Additional data are needed for a full characterization of the sounds produced by the launches; the monitoring program described in Section 13 will provide additional information. However, some relevant general principles can be described (see 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.

7.2 Pinniped Sound Production

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 the three species of concern here have all been measured directly.) Except for harbor seals, the species of pinnipeds present in the study area are very vocal during their mating seasons. In each species, the calls are at frequencies from several hundred to several thousand hertz—above the frequency range of the dominant noise components from most of the proposed launch activities.

In air, harbor seals are not as vocal as California sea lions or northern elephant seals, 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 and northern elephant seals make extensive use of in-air vocalizations to maintain mother-pup bonds and facilitate interactions between adult pinnipeds (e.g., Peterson and Bartholomew 1967; Petrinovich 1974; Shipley et al. 1981, 1986; Riedman 1990; Gisiner and Schusterman 1991). 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.

While vocalizations of pups and other conspecifics could be masked by broadband launch noise of high amplitude, this would be 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 Pinniped Hearing Abilities

In-air audiograms have been obtained using behavioral methods for the three common species of pinnipeds on SNI. 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. California sea lions are similar to phocid seals with regard to underwater hearing sensitivity at moderate frequencies (Kastak and Schusterman 1998, 1999). In air, however, otariids apparently have slightly greater sensitivity and a higher high-frequency cutoff than do phocids—especially northern elephant seals. Northern elephant seals have lower aerial hearing sensitivity than harbor seals or California sea lions, but better underwater sensitivity than the other species, at least at low frequencies (Figure 24; Kastak and Schusterman 1998, 1999). These hearing sensitivity data, coupled with outer and middle ear adaptations not found in other phocids (Kastak and Schusterman 1999), suggest that the northern elephant seal is adapted for underwater rather than aerial hearing. These differences in in-air hearing sensitivity may at least in part explain why northern elephant seals are less reactive to strong sounds from vehicle launches (see below).

7.4 Behavioral Reactions of Pinnipeds to Vehicle 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 (see Figure 25). 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 vehicle launch events have demonstrated that different pinniped species, and even different individuals in the same haul-out group, can exhibit a range of response 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). Vehicle 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).

[2] These average ambient sounds are comparable to sound levels expected in quiet residential areas.

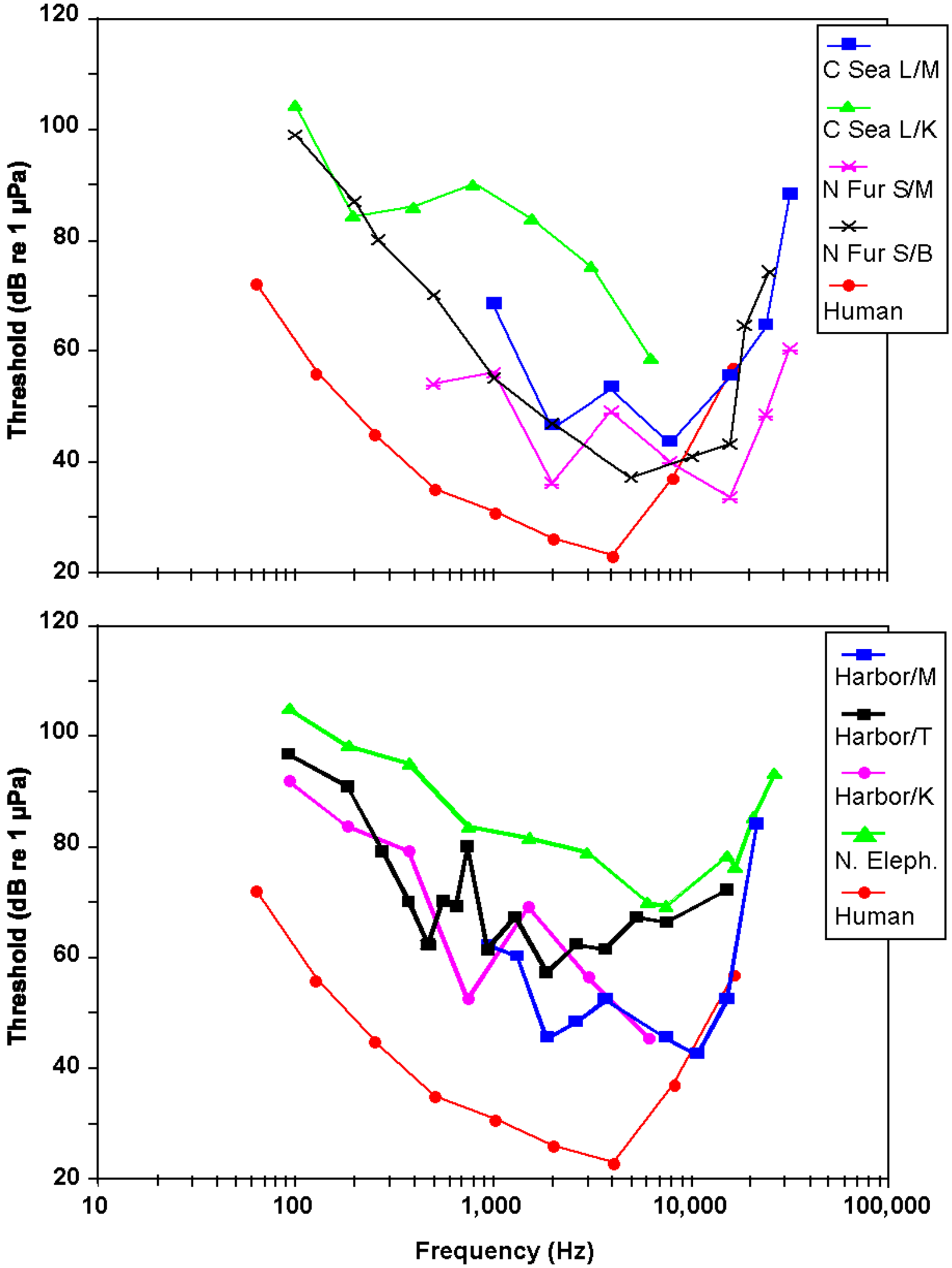
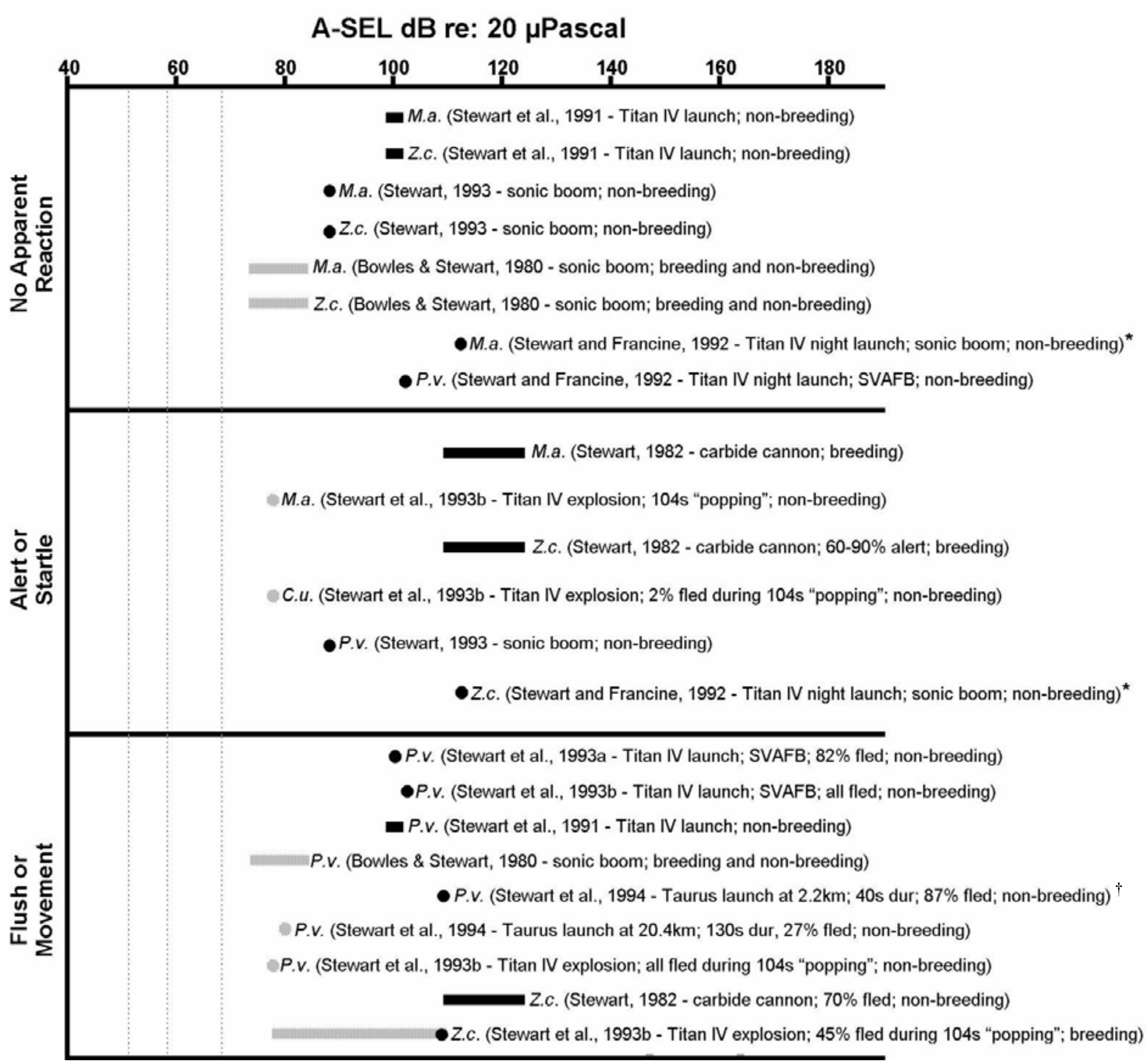


FIGURE 24. In-air hearing thresholds for selected otariid and phocid pinnipeds, and the sensitivity thresholds for humans for comparison. (Subtract 26 dB from these values to obtain the equivalent levels in dB re 20 µPa, the usual units for in-air hearing thresholds.) Adapted from Richardson et al. (1995) with the addition of data from Kastak and Schusterman (1998, 1999).

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 sonic booms or launch noise involved far larger launch vehicles (e.g., Titan IV) than the Coyotes and other vehicles that will be launched from SNI (see Figure 25). In most cases, where the species of pinnipeds occurring in the Sea Range have been exposed to the sounds of large vehicle launches (such as the Titan IV from Vandenberg Air Force Base [VAFB]), animals did not flush into the sea unless the sound level to which they were exposed was relatively high (see Figure 25). The reactions of harbor seals to even these large vehicle launches have been limited to short-term (5–30 min) abandonment of haul-out sites (NMFS 2003). NMFS (1999) has stated, in the context of launches of large vehicles from VAFB, that brief alert or startle reactions by pinnipeds on a beach are not considered to constitute disturbance sufficient to require an incidental take authorization.



*** Sound intensity values measured as dBA peak. † Stewart et al. 1994b.**

FIGURE 25. Behavioral responses by pinnipeds hauled out within the Point Mugu Sea Range to transient anthropogenic acoustic stimuli of varying source and intensity. *C.u.* = *Callorhinus ursinus, M.a.* = *Mirounga angustirostris, P.v.* = *Phoca vitualina, Z.c.* = *Zalophus californianus.*

Holst et al. (2005a, 2008) summarize the systematic monitoring results from SNI from mid-2001 through 2007. In particular, northern elephant seals seem very tolerant of acoustic disturbances (Stewart 1981b; Holst et al. 2008). In contrast, harbor seals are more easily disturbed. Based on SNI launch monitoring results from 2001 to 2007, most pinnipeds — especially northern elephant seals — would be expected to exhibit no more than short-term alert or startle responses (Holst et al. 2005a, 2008). Any localized displacement would be of short duration, although some harbor seals may leave their haul-out site until the following low tide. However, Holst and Lawson (2002) noted that numbers occupying haul-out sites on the next day were similar to pre-launch numbers.

The most common type of reaction to vehicle launches at SNI is expected to be a momentary "alert" response. When the animals hear or otherwise detect the launch, they are likely to become alert, and (at least momentarily) to interrupt prior activities in order to pay attention to the launch. Animals that are well to the side of the launch trajectory will likely not show any additional reaction. Animals that are closer to the trajectory may show a momentary alert response, or they may react more strongly. Previous observations indicate that elephant seals, in particular, will rarely if ever show more than a momentary alert reaction (Stewart 1981b; Stewart et al. 1994b; Holst et al. 2005a, b; 2008)—even when exposed to noise levels or types that caused nearby harbor seals and California sea lions to flee.

Video recordings of pinnipeds around the periphery of western SNI during launches on SNI in 2001–2007 have shown that some pinnipeds react to a nearby launch by moving into the water or along the shoreline (Holst et al. 2005a, b; 2008). Pinniped behavioral responses to launch sounds were usually brief and of low magnitude, especially for northern elephant seals. California sea lions (especially the young animals) exhibited more reaction than elephant seals, and harbor seals were the most responsive of the three species.

Northern elephant seals exhibited little reaction to launch sounds (Holst et al. 2005a,b; 2008). Most individuals merely raised their heads briefly upon hearing the launch sounds and then quickly returned to their previous activity pattern (usually sleeping). During some launches, a small proportion of northern elephant seals moved a short distance on the beach, away from their resting site, but settled within minutes.

As expected, responses of California sea lions to the launches varied by individual and age group (Holst et al. 2005a, b; 2008). 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. 2005a, b; 2008). 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 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. 2005a,b; 2008). During monitoring the day following a launch, harbor seals were usually hauled out again at these sites (Holst and Lawson 2002).

The type of vehicle 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 vehicle launches; AGS launches caused the fewest reactions. Elephant seals showed significantly less reaction during launches involving vehicles other than Vandals (Holst et al. 2008).

The BQM-34 and especially the BQM-74 subsonic drone vehicles 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 ~3.2 km to the side of the launch track (Lawson et al. 1998).

In addition to noise, the night launches will also emit light. Haul-out beaches near Building 807 Launch Complex in particular may be affected by light during ABL launches. We are unaware of behavioral reactions of pinnipeds to nighttime launches or other bright lights at night. However, we anticipate that there will not be any additional responses to the light, above and beyond those that are elicited by the launch sounds.

The proposed continuation of the launch monitoring program will enable further documentation of pinniped responses to various launch vehicles with different acoustic characteristics, and to nighttime launches.

7.4.1 Habituation

Since the launches are relatively infrequent, and of such brief duration, it is unlikely that the pinnipeds near the launch sites will become habituated to these sounds. Pinnipeds that haul out on the island for extended periods, or that return to haul-out sites regularly over the course of the year, may be exposed to sounds of more than one launch, and may be "taken" by harassment more than once each year. However, given the infrequency and brevity of these events, it is questionable whether much (if any) habituation has occurred.

7.4.2 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 launches (up to 40 per year, of which some will be of small vehicles) will cause masking 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). It can be assumed that these occasional brief episodes of masking will have no significant effects on the abilities of pinnipeds to hear one another or to detect natural environmental sounds that may be relevant to the animals.

7.4.3 Stampede-Related Injury or Mortality

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. These harbor seals 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. Sometimes the harbor seals did not return to land until the next day, although they more commonly returned the same day. These authors postulated that such disturbance-induced stampedes or mother-pup separations could be a source of increased mortality. However, observations during actual sonic booms (see Figure 22) 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).

It is possible, although unlikely, that launch-induced stampedes could have adverse impacts on individual pinnipeds on the west end of SNI. However, during vehicle launches in 2001–2007, there was no evidence of launch-related injuries or deaths (Holst et al. 2005a, b; 2008). On several occasions, harbor seals and California sea lion adults moved over pups as the animals moved in response to the launches, but the pups did not appear to be injured (Holst et al. 2005a, 2008). Given the large numbers of pinnipeds giving birth on SNI, it is expected that injuries and deaths will occur as a result of natural causes. For example, during the 1997-98 El Niño event, pup mortality reached almost 90% for northern fur seals at nearby San Miguel Island, and some adults may have died as well (Melin et al. 2005). Pup mortality also increased during this period for California sea lions.

Indirect evidence that launches have not caused significant, if any, mortality comes from the fact that populations of northern elephant seals and especially California sea lions on SNI are growing rapidly despite similar launches for many years. Harbor seal numbers have remained stable, but new harbor seal haul-out sites have been established at locations directly under and near the launch tracks of vehicles (Figure 9).

7.4.4 Behavioral "Take" 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, at SNI, harbor seals appear to be more responsive during the pupping/breeding season, whereas California sea lions seem to be less responsive during the pupping season (Holst et al. 2005a, 2008).

It is difficult to derive unequivocal criteria to identify situations in which launch sounds are expected to cause biologically significant disturbance responses to pinnipeds hauled out on SNI. Consistent with NMFS (2002), 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.

Before the start of the monitoring work at SNI in 2001, the available data were quite limited in detail and highly variable (e.g., Figure 25). Even with the monitoring results from 2001–2007, the available data are insufficient to establish the relationships between sound levels and the responses of each pinniped species. However, Holst et al. (2005a, 2008) did find that a greater proportion of California sea lions and elephant seals responded with increasing SELs; the relationship between harbor seal responses and SELs was less clear. Even though pinnipeds are disturbed at SNI during launches, no deaths due to stampeding have been witnessed at SNI during the 2001–2007 monitoring period (Holst et al. 2005a, b; 2008).

Table 5 shows the received levels of transient and prolonged sounds at which "taking" may begin to occur for pinnipeds. Lawson et al. (1998) noted disturbance criteria for prolonged sounds of 100 dBA re 20 $\mu Pa^2 \cdot s$ SEL for all pinnipeds. Based on the results of launch monitoring at SNI that showed that harbor seals responded to launches with SELs <100 dBA, Holst et al. (2005a) suggested a disturbance criterion of 90 dBA SEL for harbor seals. Southall et al. (2007), based on the same data but with different frequency-weighting, noted that M_{pa}-weighted SELs of 100 dB re 20 $\mu Pa^2 \cdot s$ could result in significant behavioral changes by pinnipeds (M_{pa}-weighted values are greater than A-weighted SELs for launch sounds [see Figures 22 and 23]).

TABLE 5. Assumed in-air sound pressure criteria for significant disturbance and forTTS and PTS in pinnipeds

	Criterion Level		
Criterion Type	**A-weighted (re 20 µPa²·s SEL)**	**M_{pa}-weighted (re 20 µPa²·s SEL)**	**Peak pressure (flat) [f] (re 20 µPa)**
Disturbance by prolonged sound	Harbor seals: 90 dB [a] Sea lions & elephant seals: 100 dB [b]	Pinnipeds in air: 100 dB [f]	Pinnipeds in air: 109 dB
TTS for transient sound	California sea lions: 135 dB [c]	-	-
TTS for pulses	-	Pinnipeds in air: 129 dB [d, f, g]	Pinnipeds in air: 143 dB [g]
TTS for non-pulse sound	-	Harbor seals: 131 dB [e, f] California sea lion: 154 dB [e] Elephant seal: 163 dB [e]	Pinnipeds in air: 143 dB [g]
PTS for pulses [f]	-	Pinnipeds in air: 144 dB [g]	Pinnipeds in air: 149 dB [g]
PTS for non-pulse sound [f]	-	Pinnipeds in air: 144.5 dB [g]	Pinnipeds in air: 149 dB [g]

[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 Sea Range (Lawson et al. 1998), with relevant sections included in Section 8 of this Petition. Monitoring work at SNI has found that typically only a small fraction (approx. 10%) of elephant seals respond to these levels.
[c] For transient sounds based on J. Francine, quoted in NMFS (2001:41837).
[d] For simulated sonic booms (Bowles et al. pers. comm.).
[e] For non-pulse noise (Kastak et al. 2004).
[f] Southall et al. (2007).
[g] Applies specifically to harbor seal; values for California sea lion and northern elephant seal probably are higher (Southall et al. 2007:444-445).

Previous monitoring at SNI has shown that sea lions and harbor seals move along the beach and/or enter the water at M_{pa}-weighted SELs >100 dB re 20 µPa²·s. In fact, sea lions and harbor seals can be disturbed at lower levels. Some harbor seals have been shown to leave the haul out site and/or enter the water at M_{pa}-weighted SELs as low as 60 dB re 20 µPa²·s, although the proportion of animals reacting is smaller when levels are lower (e.g., Holst et al. 2005a, b; 2008). Stampedes of California sea lions into the water occur infrequently during launches at SNI, especially when received sound levels are <100 dB re 20 µPa²·s (e.g., Holst et al. 2005a, b; 2008). Northern elephant seals tolerate much higher sound levels without reacting strongly. In general, there is much variability, with some pinnipeds tolerating high levels of sound and others reacting to lower levels (e.g., Figure 25).

Continued testing and improvement of the provisional disturbance criteria will occur, using additional quantitative field observations coupled with accurate sound measurements. This is desirable in order to establish more firmly the relationship between behavioral responses and the acoustic stimuli that elicit them. The previous launch monitoring program has shown that the proportions of responding California sea lions and northern elephant seals were significantly greater with increasing SEL values (Holst et al. 2005a, 2008). The monitoring work described in Section 13 of this Petition will seek to verify or refine the provisional disturbance criterion used here as it applies to exposure of the three most common species of pinnipeds on SNI to launches of supersonic and subsonic vehicles.

7.5 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 (particularly harbor seals) may incur TTS (and possibly, although unlikely, even slight PTS) during launches from SNI, hearing impairment has not been shown for pinniped species exposed to launch sounds. Thorson et al. (1998, 1999) used measurements of auditory brainstem response to demonstrate that harbor seals did not exhibit loss in hearing sensitivity following launches of large vehicles at VAFB.

7.5.1 Auditory "Take" Criteria

There are few published data on TTS thresholds for pinnipeds in air exposed to impulsive or brief non-impulsive sounds. J. Francine, quoted in NMFS (2001:41837), has mentioned evidence of mild TTS in captive California sea lions exposed to a 0.3-s transient sound with an SEL of 135 dBA re 20 $\mu Pa^2 \cdot s$ (see also Bowles et al. 1999). However, mild TTS may occur in harbor seals exposed to SELs lower than 135 dB SEL (A. Bowles, pers. comm., 2003). Unpublished data indicate that the TTS threshold on an SEL basis 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; Southall et al. 2007). The same research teams have found that the TTS thresholds of California sea lions and elephant seals exposed to strong sounds are higher as compared to the harbor seal (Kastak et al. 2005; see Table 5). 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 ~143 dB re 20 µPa (peak) or if received M_{pa}-weighted SEL is ~129 dB re 20 $\mu Pa^2 \cdot s$. Those levels apply specifically to harbor seals; those levels are not expected to elicit TTS in elephant seals or California sea lions (Southall et al. 2007). Less is known about levels that may cause PTS, but in order to elicit PTS, a single sound pulse would probably need to exceed the TTS threshold by at least 15 dB stronger, on an SEL basis (Southall et al. 2007; Table 5).

7.5.2 Possibility of Hearing Impairment during Launches at SNI

Available evidence from launch monitoring at SNI in 2001–2007 suggests that only a small minority (if any) of the pinnipeds at SNI are exposed to levels of launch sound levels that could elicit TTS or especially PTS (see Holst et al. 2008). The assumed TTS threshold for the species with the most sensitive hearing (harbor seal) is 129–131 dB re 20 $\mu Pa^2 \cdot s$ (M_{pa}-weighted), with higher values applying to other species (Table 5). The measured SEL values near pinniped beaches during vehicle launches at SNI during 2001–2007 were <129 dB re 20 $\mu Pa^2 \cdot s$ (A- or M_{pa}-weighted). In fact, few if any pinnipeds were exposed to SELs >122 dB re 20 $\mu Pa^2 \cdot s$ on an M_{pa}-weighted basis and >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. However, small numbers of northern elephant seals and California sea lions may have been exposed to peak pressures as high as 150 dB re 20 µPa when Vandals flying over the beach created a sonic boom. That peak-pressure level would not be expected to elicit PTS in elephant seals or California sea lions, but might be near the minimum level that could elicit PTS in harbor seals if any harbor seals at SNI had been exposed to such high levels (which apparently did not occur; see Holst et al. 2008). Harbor seals were not hauled out on beaches were such high sound levels were measured, and they do not haul out near the Building 807 Launch Complex. However, it is possible that some harbor seals, and perhaps elephant seals and California sea lions, did incur TTS during launches at SNI, as peak-pressure levels at haul-out sites sometimes reached ≥143 dB re 20 μPa when a sonic boom occurred. In the event that TTS did occur, it would typically be mild and reversible.

7.6 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), northern elephant seals responded similarly, 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. There have been no studies to determine whether noise-induced stress occurs in pinnipeds. 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 exposed to only a few very brief noise events over the course of a year.

7.7 Estimating "Takes" by Harassment

The petitioner seeks authorization to "take" marine mammals under the jurisdiction of NMFS in the proposed area of activity. Species for which authorization is sought are California sea lions, harbor seals, and northern elephant seals. No takes are expected for Guadalupe fur seals, northern fur seals, or Steller sea lions as these species occur only rarely on SNI at present. For purposes of this Petition, pinnipeds are assumed to be "taken by harassment" if, as a result of a launch, TTS occurs, or biologically significant behavioral patterns of pinnipeds are significantly altered. Any takes are most likely to result from operational noise as launch vehicles pass near haul-out sights, and/or associated visual cues. This section estimates maximum potential take and the likely take, per year, during the planned vehicle launch program at SNI, and describes the rationale for these take estimates.

The launch sounds could be received for several seconds and, to be conservative, are considered to be prolonged rather than transient 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 $\mu Pa^2 \cdot s$ (M_{pa}-weighted) is considered appropriate as a disturbance criterion for pinnipeds hauled out at the west end of SNI, particularly for California sea lions and northern elephant seals. Some pinnipeds that haul-out on the western end of SNI are expected to be within the area where M_{pa}-weighted SELs from launches reach >100 dB re 20 $\mu Pa^2 \cdot s$. It is likely that far fewer pinnipeds occur within the area where sounds from smaller launch vehicles, such as the BQMs or AGS missiles and slugs, reach >100 dB re 20 $\mu Pa^2 \cdot s$. However, none of the recorded SELs appear to be sufficiently strong to induce TTS. This assumes that an M_{pa}-weighted SEL of 129 dB re 20 $\mu Pa^2 \cdot s$ from a single launch might cause TTS, at least in harbor seals, and that no pinnipeds (especially harbor seals) will occur close to the launchers at the Building 807 Launch Complex.

Based on the reaction criterion, the distance to which it is assumed to extend, and the estimated numbers of pinnipeds exposed to M_{pa}-weighted SELs ≥100 dB re 20 $\mu Pa^2 \cdot s$, estimates of the numbers of pinnipeds on the west end of SNI that might react strongly to the launch sounds are shown below. Based on data collected during 2001–2007, an additional adjustment was made for harbor seals, as they are known to react strongly at times to M_{pa}-weighted SELs <100 dB re 20 $\mu Pa^2 \cdot s$.

To estimate the number of hauled-out pinnipeds within the area where sound levels are expected to be >100 dB re 20 µPa^2·s M_{pa}-weighted, we first determined where M_{pa}-weighted SELs >100 dB have been recorded during past launches and then calculated the total number of pinnipeds of each species expected to occur within that area for the first year (2009) under the sought regulations (see details below). We used census data obtained during aerial and ground-based surveys of SNI by staff of SWFSC. These data are contained in Lowry (n.d. [approx. 1995], 2002, unpubl. data) and Lowry and Carretta (2002), and provide the most recent counts available of northern elephant seals, harbor seals, and California sea lions at SNI. For each species, censuses were typically done at a time of year when maximum numbers are known to occur on land. All three species are seasonal breeders: elephant seals are most abundant on land during their winter breeding period; harbor seals and California sea lions are most abundant on land during their spring and summer breeding periods, respectively. In addition, other life history traits such as feeding patterns 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.

During any monitoring year from 2001 to 2007, a maximum of 1,990 California sea lions, 395 harbor seals, and 130 northern elephant seals were estimated to have been potentially affected by vehicle sounds during the launch program at SNI (Holst et al. 2005a, 2008). These numbers may represent multiple exposures of single 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, left the water at a vigorous pace, or exhibited prolonged movement or behavioral changes relative to their behavior immediately prior to the launch. Of the California sea lions, many were young animals such as pups or juveniles. It seems unlikely that any of the pinnipeds on SNI were adversely impacted by such behavioral reactions (Holst et al. 2005a, 2008).

Although the effects of sounds from vehicles proposed for launching from SNI on in-air hearing sensitivity of pinnipeds have not been measured, there is a possibility that some launch sounds (particularly those associated with sonic booms) as received on beaches where pinnipeds haul out on SNI may cause TTS. However, any cases of TTS are expected to be mild and reversible, and would not constitute injury (Southall et al. 2007).

7.7.1 Northern Elephant Seal

All sex and age of northern elephant seals classes could be found on the beaches at certain times of year. However, adult northern elephant seals are at sea for 8 to 10 months per year, and juveniles are offshore for an even greater proportion of the time. Based on what is known about the proportion of the year that various age and sex classes spend ashore, it is likely that elephant seals might be ashore only 17 to 34% of the year. Northern elephant seals are most abundant on land during their winter breeding period (late January to early February).

To estimate the potential numbers of northern elephant seals that might be exposed to sound levels ≥100 dB re 20 µPa^2·s M_{pa}-weighted, we used the pup count within map areas K, L, and M for 2001, and assumed a continuing growth rate of 7.3% since 2001. Based on data collected from 1988 to 2001, we approximated the total count of all age classes expected to be hauled out in 2009 by multiplying the pup count by 2 (the 3.5x factor mentioned earlier would overestimate the number of animals potentially hauled out). Thus, the expected number of elephant seals that may be exposed to sound levels ≥100 dB M_{pa}-weighted during 2009 is estimated to be 4,741. In 2000 and 2001, shore counts during the breeding season (Table 2) found that 2501 and 2069 northern elephant seals, respectively, were found within the K to M areas.

In the absence of any contrary data, we assume that elephant seals exhibit high site fidelity when they do return to shore, and that the 4,741 seals mentioned above represent the total number that might be exposed to "strong" (≥100 dB re 20 $\mu Pa^2 \cdot s$ M_{pa}-weighted) sounds during the year. If some seals haul out on different beaches at various times during the year, sometimes within and sometimes outside the area exposed to levels ≥100 dB, then the number of times an individual elephant seal might be exposed to strong launch sounds would be reduced. However, the total number of individuals that would be exposed at least once over the course of the year would probably be increased. Movements from one beach to another may be more likely for juveniles than for older seals, given that this has been observed in other pinniped species (such as for harbor seal pups; Thompson et al. 1994).

Published studies and results from the 2001–2007 monitoring at SNI indicate that elephant seals are more tolerant of transient noise and other forms of disturbance than are California sea lions or harbor seals. Hence, the 100 dB re 20 $\mu Pa^2 \cdot s$ M_{pa}-weighted SEL criterion for disturbance, as used here, is probably too low (conservative) for this species. If so, the actual impact zone is smaller than assumed here, and the number of elephant seals that might be "taken by harassment" will be *substantially* lower than the number of seals present within the area where sound levels are ≥100 dB. For example, during the 2001–2007 launch program, the majority of northern elephant seals did not exhibit more than brief startle reactions in response to launches (Holst et al. 2005a, b; 2008). Most individuals merely raised their heads briefly upon hearing the launch sounds and then quickly returned to their previous activity pattern (usually sleeping). During some launches, a small proportion (typically much less than 10%) of northern elephant seals moved a short distance (<10 m) away from their resting site, but settled within minutes.

In summary, the Navy estimates that up to 10% of 4,741 elephant seals (or 474 seals) might be "taken by harassment" during each year of planned launch operations. The effects of this harassment on individuals and the population are expected to be negligible. The Navy's standard, ongoing monitoring activities (Section 13) will further investigate if northern elephant seals react in ways that would be considered harassment under certain launch conditions and (if so) the approximate numbers involved.

7.7.2 Harbor Seal

All sex and age classes of harbor seals (including pregnant females) could be 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.

To determine the potential numbers of harbor seals that might "taken by harassment", we used the most current total harbor seal count for SNI (584 seals in 2002) and assumed that the population has remained relatively stable subsequently. Previous monitoring during 2001–2007 showed that M_{pa}-weighted SELs ≥100 dB re 20 $\mu Pa^2 \cdot s$ were measured in areas K, L, and M; most if not all monitored harbor seals entered the water in response to those launches. However, a small proportion of harbor seals in area O reacted to levels below 100 dB M_{pa}-weighted (as low as 60 dB) by entering the water. It was previously estimated that ~70% of harbor seals that haul out on SNI use the beaches within areas K, L, and M. If harbor seals are expected to respond to launches with lower sound levels, then it can be assumed that a small proportion of animals hauled out in areas I, J, N, and O would also be affected. Therefore, a better approximation of the percentage of harbor seals on SNI that may be impacted is likely around 80%.

The 2002 count of 584 seals may be an underestimate as it is based on a single survey, with no consideration of the natural variability in the number of these seals observed at other haul-out sites.

However, assuming this survey estimate is correct, the number of harbor seals that might be affected within areas I through O is 467.

The proportion of harbor seals hauled out at any given time varies with time of day, date, 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. Thus, the average proportion of harbor seals ashore over the course of a 24-hour (hr) 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% of the maximum numbers ashore during the breeding season. During winter, the proportion hauled out relative to the peak season might be only 15%. 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 ~40 launches per year.

During the majority of launches, 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 2005a, 2008). During follow-up monitoring the next day, harbor seals were usually hauled out again at these sites (Holst and Lawson 2002). There was no evidence of mortality or injury to these seals. Additional monitoring is needed to establish the relationship between received sound levels, distance from the sound source, and the nature and consistency of responses.

The Navy estimates that 467 harbor seals on SNI might be taken by harassment during a 1-year period of launches. The Navy's standard, ongoing monitoring activities will 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.

7.7.3 California Sea Lion

Adult female California sea lions could be found on the beaches throughout the year, although in reduced numbers at certain times due to foraging patterns and adverse weather. Males come ashore only briefly during the spring breeding period.

To estimate the potential numbers of sea lions that might be hauled out within areas exposed to sound levels ≥100 dB re 20 $\mu Pa^2 \cdot s$ M_{pa}-weighted, we estimated the number of sea lions occurring within map areas K to M (Figure 16) at some point during the year (in this case, July). During the 2006 breeding season, Lowry (unpublished data) found 13,640 animals within areas K to M (Table 3). After adjusting for a population growth of 5.6% per year, we estimate that 16,062 sea lions of all ages and sexes might be hauled out within the area exposed to levels ≥100 dB in 2009. 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 near the trackline during launches, only a portion of the seal lions ashore flee into the water; many startle or move only a short distance on the beach (Holst et al. 2005a, b; 2008). An even smaller proportion of sea lions hauled out further away from the trackline or CPA react to the launches (e.g., Holst et al. 2005a, b; 2008).

During 2001–2007, responses of California sea lions to the launches varied by individual and age group. 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. All age classes settled back to pre-launch behavior patterns within minutes of the launch time.

Until the monitoring program further quantifies the reactions of sea lions to vehicle launch sounds, the Navy assumes that perhaps 10% of the California sea lions exposed to launch sounds during each year of launch activity will exhibit disturbance of behavioral patterns. Thus, the Navy estimates that 1,606 California sea lions on SNI might be taken by harassment during a 1-year period. The Navy's standard, on-going monitoring activities will provide information valuable in determining how many California sea lions do react in any significant way to these launches. Any take is expected to be limited to Level B harassment.

7.8 Summary

Vehicle launches are characterized by sudden sound onsets, moderate to high peak sound levels (depending on the type of vehicle and distance), and short sound duration. Effects of vehicle launches on some pinnipeds in the Channel Islands have been studied. In most cases, where pinnipeds have been exposed to the sounds of large vehicle launches (such as the Titan 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 or quality (e.g., the explosion of a Titan IV). Similarly, at SNI, the proportion of responding California sea lions and elephant seals to vehicle launches are significantly higher with increasing SELs; harbor seal reactions to launch sounds are more variable.

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

The numbers of individuals that might stampede or make large-scale movements are difficult to estimate. However, monitoring results to date indicate that the reactions of many pinnipeds (especially elephant seals) are no more than minor. The Navy provisionally estimates that no more than the following numbers of pinnipeds are likely to be "taken" in this manner during all the launches within a one-year period of applicability of the expected regulations: 474 northern elephant seals, 467 harbor seals, and 1,606 California sea lions.

If the regulations and associated LOAs are issued by NMFS for the planned five-year period of launch operations, the Navy provisionally estimates that no more than 2,210 northern elephant seals, 2,335 harbor seals, and 7,605 California sea lions might be "taken" in this manner in 2009–2014. These values are five times the annual estimates listed above, and include repeated counts of the same individuals in as many as 5 successive years. However, based on the results of the marine mammal monitoring conducted by the Navy during the 2001–2007 launch program, all of these estimates (annual and 5-year) are likely substantial overestimates of the actual numbers of pinnipeds that will show strong reactions. This is particularly the case for northern elephant seals and for California sea lions. Also, with this procedure, many of the same animals would be counted during more than one of the five years; the total numbers reacting over the 5-year period would be lower than the 5-year values quoted above. The monitoring program described in Section 13 will provide data on the actual numbers of "takes", on the specific nature of the "taking", and on the relationship between sound exposure and the nature and frequency of responses.

Based on measurements of received sound levels during previous launches at SNI (e.g., Holst et al. 2005a,b; 2008), the Navy expects that there may be some effects on hearing sensitivity (TTS) for a few of the pinnipeds present, but these effects 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 unlikely 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 vehicle launches at SNI have not shown injury, mortality or extended disturbance, and that their populations and/or distributions on the island are expanding, the effects of vehicle launches are expected to be limited to short-term and localized behavioral changes falling within the MMPA definition of Level B harassment.

8. ANTICIPATED IMPACT ON SUBSISTENCE

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

There are no subsistence uses for these pinniped species in California waters, and thus no anticipated impacts on subsistence.

9. ANTICIPATED IMPACT 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.

During the period of the proposed activity, three species of pinnipeds will use various beaches around SNI 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., Vizcaino 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 (NMFS 2003). Thus, periodic launches do not prevent pinnipeds from using beaches.

The pinnipeds do not feed when hauled out on these beaches, and the airborne launch sounds will not persist in the water near the island for more than a few seconds. Therefore, it is not expected that the launch activities will have any impact on the food or feeding success of these pinnipeds.

Boosters from vehicles (e.g., JATO bottles for BQM drone vehicles) may be jettisoned shortly after launch and fall on the island, but not on the 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.

Overall, the proposed vehicle launch activity is not expected to cause significant impacts on habitats used by pinnipeds on SNI, or on the food sources that these pinnipeds utilize.

10. ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF HABITAT

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

As described in Section 9, "ANTICIPATED IMPACT ON HABITAT", the effects of the planned launch activities on pinniped habitats and food resources at SNI are expected to be negligible. Thus, "loss or modification of habitat" will not have any impacts on the pinnipeds of SNI.

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 on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

To minimize the likelihood that impacts will occur to the species and stocks, launch operations will be conducted in accordance with all federal regulations.

This activity will happen infrequently, with a variety of launch azimuths, and will produce only brief but rapid-onset sounds. Any given animal is expected to haul out during only a small number of the launches and will be close to the launch azimuth for only a few launches. Thus, it is unlikely that pinnipeds hauled out on beaches at the western end of SNI will exhibit much, if any, habituation to vehicle launch activities.

The number of individual animals expected to be disturbed during the proposed activity will be small in relation to regional population sizes. With the standard, ongoing monitoring and mitigation provisions (see below), effects on those individuals are expected to be well documented, and limited to harassment. This is expected to have negligible impacts on the species and stocks.

As during launches conducted under the previous Regulations, where practicable, the Navy will adopt the following mitigation measures, provided that doing so will not compromise operational safety requirements or mission goals:

(1) The Navy will attempt to limit launch activities during the harbor seal pupping season,
(2) The Navy will attempt not to launch vehicles from the Alpha Complex at low elevation (less than 1,000 feet) on launch azimuths that pass close to pinniped haul-out site(s) when occupied,
(3) The Navy will attempt to avoid multiple vehicle launches in quick succession over haul-out sites when occupied, especially when young pups are present, and
(4) The Navy will attempt to limit launch activities during nighttime hours, except when operationally required (e.g., up to 10 nighttime launches for ABL testing are planned per year).

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, USFWS, and the California Coastal Commission.

To avoid additional harassment to the pinnipeds on beach haul-out sites, and to avoid any possible sensitizing and/or predisposing pinnipeds to greater responsiveness to the sights and sounds of a launch, the Navy will limit activities near the beaches in advance of launches. Existing safety rules for vehicle launches provide a built-in mitigation measure of this type: personnel are not normally allowed near any of the pinniped haul-out beaches that are located close to the flight track on the western end of SNI within several hours prior to launch. Also, because of the presence of colonies of sensitive seabirds (as well as pinniped haul-out sites) on western SNI, there are already special restrictions on personnel movements near beaches on which pinnipeds haul out. Furthermore, most of these beaches are closed to personnel year-round.

During and for some time following each launch, personnel are also not allowed near any of the pinniped haul-out beaches that are close to the flight track on the western end of SNI.

Prior to and after launch operations, associated fixed-wing and rotary aircraft will maintain an altitude of at least 305 m when traveling near beaches on which pinnipeds are hauled out.

12. PLAN OF COOPERATION

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, the applicant must submit …

As the proposed activity will take place in California, Section 12 does not apply to this Petition.

13. MONITORING AND REPORTING PLAN

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 expects that the planned launches will cause disturbance reactions by some of the pinnipeds on the beaches, but no pinniped mortality or serious injuries, and no significant long-term effect on the stocks of pinnipeds hauled out on SNI. During the first year of operations under the requested regulations and associated LOA, 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. Monitoring plans for subsequent years would be proposed in the applications for subsequent LOAs, and subject to further discussion with NMFS. The Navy anticipates that, if monitoring of certain types of launches shows that they cause no or minimal disturbance to pinnipeds, monitoring during subsequent launches of those types would either be terminated or scaled back.

The planned monitoring tasks for the first year of operations under an LOA are introduced briefly here, and then described in more detail in subsequent subsections:

(1) The Navy will continue a standard, ongoing, land-based monitoring program to assess effects on harbor seals, northern elephant seals, and California sea lions on SNI. This monitoring will occur at three sites at different distances from the launch site before, during, and after each launch. The monitoring will be via autonomous video cameras. Pinniped behavior on the beach will be documented prior to the planned launch operations, during the launch, and following the launch.

(2) New video equipment capable of obtaining video during night launches will be acquired for the ABL program.

(3) During each launch, the Navy will obtain calibrated recordings of the sounds of the launches as received at different distances from the vehicle's flightline. It is anticipated that acoustic data

will be acquired at three locations during each launch, with a variety of different recording sites being used over the course of each year. These recordings will provide for a thorough description of launch sounds as received at different locations on western SNI, and of the factors that affect received sound levels. Insofar as possible, the acoustic data will be obtained at the same sites as the video data on pinniped responses to the launches. By analysis of the paired data on behavioral observations and received sound levels, the Navy will further characterize the relationship between the two. If there is a clear correlation, we will determine the “dose-response” relationship.

(4) Upgrades to the current acoustic recording system will be made in late summer/early fall 2008. Upgrades are intended to improve reliability of the systems and will not compromise the capabilities of the units as used in 2001-2007.

The proposed Monitoring Plan for the initial year of operations under the new regulations is described below. It is very similar to the launch monitoring that has been conducted from 2001 through 2007. This will assure that the results from the ongoing and previous work are consistent and can be combined for overall analyses. The Navy understands that this Monitoring Plan will be subject to further review by NMFS, and that refinements may be required.

The monitoring effort may be scaled back in the future, if and when NMFS and the Navy concur that previous monitoring results are sufficient to show that the effects of some or all types of launches on some or all species of pinnipeds at SNI are minimal. The following paragraphs describe anticipated changes in the monitoring effort over the 5-year period of applicability of the requested regulations:

(1) Monitoring may be reduced during launches of small or less noisy vehicles, depending on results from ongoing and future monitoring efforts. In particular, monitoring effort may be scaled back in the future for northern elephant seals, as this species has shown little reaction to most launches at SNI (see Holst et al. 2005a, b; 2008).

(2) Depending on results from ongoing and future monitoring efforts, monitoring for launches from Building 807 may eventually be terminated when only small and relatively quiet vehicles are launched from that location, during which "takes" are not expected. Monitoring at this location could cease, at least during launches of small vehicles, if ongoing and future monitoring shows no substantial effects on pinnipeds during launches of the small vehicles typically launched from Building 807. In addition, if large vehicles are launched from this location, they are expected to have a smaller area of influence as compared with launches from the Alpha Launch Complex. Monitoring during launches of larger vehicles from Building 807 may also be discontinued at some future date.

(3) Monitoring may be scaled back to include only the launches during sensitive seasons for pinnipeds (e.g., breeding/pupping period for harbor seals), as launches are expected to have the greatest impact on populations during these times.

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 Section 14, COORDINATING RESEARCH).

13.1 Visual Monitoring of Pinnipeds during Each Launch

During the initial year of operations under the provisions of the renewed regulations, the Navy proposes to conduct marine mammal and acoustic monitoring during each launch from SNI, using simultaneous autonomous audio recording of launch sounds and high-resolution video 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 vehicle 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 flightline during each launch; from the data accumulated across a series of launches, establish the "dose-response" relationship[3] for launch sounds under different launch conditions;
(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 both remote video recordings and, when feasible, direct observation of a remote video feed by an observer. Observations will be obtained before, during, and after each launch. Remote cameras are essential because, during launches, safety rules prevent personnel from being present in many 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.

For this first year of monitoring under new regulations, the Navy will seek to obtain video and audio records from three locations at different distances from the flight path of each vehicle launched from SNI. This will be important to ascertain the lateral extent of the disturbance effects and the "dose-response" relationship between sound levels and pinniped behavioral reactions. 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, etc. However, if there are up to 40 launches during the year, about 80 paired video and audio observations may be obtainable. Corresponding data is available from the previous monitoring periods (2001–2007).

Three different types of camera installations will be available for use in obtaining video data simultaneously from three sites:

(1) A permanent camera has been installed at Building 809 overlooking Vizcaino Point (809 Camera). This weatherproof camera is mounted on a pole and has autoexposure and autofocus capabilities (see Holst et al. 2005a; 2008). More importantly, the camera can be tilted, panned, and zoomed from a remote recording location, and the video signal is available for viewing and

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

recording at the remote location in real time. Thus, this camera provides continuous, user-selectable video coverage of any pinniped groups that might be hauled out along this beach. The operator at the remote location can control the camera and view the real-time video feed on a large monitor. The high-resolution video output of this camera is recorded onto digital videotape and later copied to DVD-ROMs for subsequent viewing and analysis.

(2) Small Sony handicam cameras on photographic tripods are available to be set up by Navy personnel at additional locations on the day of a launch, with the video data being accessible following the launch. Recording duration is 120 min following initiation of record mode on these cameras. The digital data is later copied to DVD-ROMs for subsequent viewing and analysis.

(3) Portable video cameras with night-vision capabilities will be set up by the Navy for nighttime launches. The 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 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 within the haul-out aggregation for the maximum four hours permitted by the videotape capacity. The entire haul-out aggregation on a given beach will not be recorded, as the wide-angle view necessary to encompass an entire beach would not allow detailed behavioral analyses (Holst et al. 2005a, 2008). It will be more effective to obtain a higher-magnification view of a sample of the animals on the beach. After setting up the equipment and just prior to the launch, Navy personnel can circulate among the cameras to change videocassettes (if necessary), to adjust the cameras' fields of view as required by changes in the geometry of the pinniped groups, and to record observations of the pinnipeds in a field logbook as possible. This may resume when access to some or all sites is permitted following the launch.

Following a launch, video records will be made for up to one hour. Observers will return to the observing sites as soon as it is safe, to record the numbers and types of pinnipeds that are on the haul-out site(s). 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

Following each launch, video data will be transferred to DVD-ROMs. A biologist will review and code the data from the video data as they are played back to a high-resolution color monitor. Procedures will follow those of Holst et al. (2005a, 2008). A DVD player with high-resolution freeze-frame and jog shuttle will be used to facilitate distance estimation, event timing, and characterization of behavior.

The variables transcribed from the videos, or recorded directly at the beach sites, will include:

(1) composition of the focal subgroup of pinnipeds (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,
(3) movements of pinnipeds, including number and proportion moving, direction and distance moved, pace of movement (slow or vigorous), and
(4) interaction types: agonistic, mother/pup, play, copulatory, etc. sequence types.

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:

(5) study location,
(6) local time,
(7) substratum type (a categorical description of the substratum upon which the focal group of pinnipeds is resting [sand, cobble, rock ledges, or water less than 1 m deep]),
(8) substratum slope (zero to 15 degrees, greater than 15 degrees, or irregular), either measured with a plumb bob and hand-held compass during times when no pinnipeds are hauled out, or estimated from the video records,
(9) weather (including an estimate of wind strength and direction, and presence of precipitation),
(10) horizontal visibility (the average horizontal visibility [in meters] around the focal subgroup of pinnipeds resulting from meteorological conditions and/or physical obstructions; this will be estimated by determining what the furthest visible object is relative to the interacting pinnipeds using known positions of local objects, and accounting for obstructing terrain), and
(11) tide state (the number of hours before or after peak flood tide; exact times for local high tides will be determined by consulting relevant tide tables).

13.2 Acoustical Measurements

Acoustical recordings will be obtained at three locations during each launch in the first year of operations under an LOA. These recordings will be suitable for quantitative analysis, by an acoustical contractor, 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 three autonomous audio recorders to make acoustical measurements (Holst et al. 2005a, 2008). During each launch, these will be located as close as practical to three pinniped haul-out sites at various distances from the launch path. These three sites will typically include (1) one site as close as possible to the vehicle's planned flight path, (2) another site at a location where the received sound levels are estimated to reach an SEL of 100 dB re 20 $\mu Pa^2 \cdot s$ M_{pa}-weighted, and (3) a third site intermediate in distance as compared with the other two sites. 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 or the day following the launch (Holst et al. 2005a, 2008). The ATARs are designed to record continuously for up to 48 hr, and may not be retrieved until the third day following deployment, if the launch is delayed.

During each launch, data on the type and trajectory of the vehicle will be documented. From these records, we will determine the CPA of the vehicle to the microphone, along with its altitude and launch phase (booster or sustainer power) at that time. These data will be important in comparing acoustic data with those from other launches. We will analyze how these and other factors affect the levels and characteristics of the received sound. 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 (e.g., Holst et al. 2005a, 2008), as well as measurements to be obtained during launches under the provisions of the Regulations and LOA.

13.2.1 Analysis Procedures and Terminology

Currently, the ATARs record digital data directly onto a hard drive within the ATAR. The digital data on the hard drives are copied to a recordable CD-ROM after the recording period and returned to the acoustical contractor, Greeneridge Sciences Inc., 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 (rms) SPL, and SEL. SPL and SEL are determined with three alternative frequency weightings: flat-, A-, and M_{pa}-weighted. Frequency-domain results included estimation of SPLs in one-third octave bands for center frequencies from 4 to 16,000 kilohertz (kHz). The following subsections describe how these values are defined and calculated (see also Holst et al. 2008 for additional details).

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:

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

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 f_s 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% and 95% of E.

Duration is defined as the difference between these start and end times.

Sound exposure is defined as 90% of E, representing total sound exposure in units of $Pa^2 \cdot s$. **SEL** is determined from 10·log (sound exposure).

Sound pressure is defined as the square root of the sound exposure divided by the duration. Sound pressure is equivalent to the rms value of the signal, less background noise, over the duration. **SPL** is determined from 20·log (sound pressure).

The **peak instantaneous pressure** is defined as the largest sound pressure magnitude (positive or negative) exhibited by the signal, even if the signal reaches that level only momentarily.

Peak instantaneous pressure level is determined from 20·log (peak instantaneous pressure).

Frequency-Domain Analysis—Frequency weighting is a form of filtering that serves to measure sounds over a broad frequency band with various schemes for de-emphasizing sounds at frequencies not heard well and retaining sounds at frequencies that animals hear well. The concept is that sound at frequencies not heard by animals is less likely to injure or disturb them, and therefore such sounds should not be included in measurements relevant to those animals.

Welch's (1967) Weighted Overlapped Segment Averaging (WOSA) 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 (vehicle 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%. This results in frequency cells spaced by 1.35 hertz (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%. 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 vehicle signal, are segmented into 44,100-sample blocks overlapped by 50% 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 M_{pa}-weightings. ***Flat-weighting*** leaves the signal spectrum unchanged. For instantaneous peak pressure, where the highest instantaneous pressure is of interest, it is not useful to diminish the level with filtering, so only the flat-weighted instantaneous peak pressure is relevant. Also, non-uniform weighting is not useful when reporting results for specific frequencies or narrow frequency bands. Therefore, only flat-weighting is used for frequency-domain analyses.

A-weighting shapes the signal's spectrum based on the standard A-weighting curve (Kinsler et al. 1982:280; Richardson et al. 1995:99). This slightly amplifies signal energy at frequencies between 1 and 5 kHz and attenuates signal energy at frequencies outside this band. This process is designed to mimic the frequency response of the human ear to sounds at moderate levels. It is a standard method of presenting data on airborne sounds. The relative sensitivity of pinnipeds listening in air to different frequencies is more-or-less similar to that of humans (Richardson et al. 1995), so A-weighting may be relevant to pinnipeds.

M_{pa}-weighting is a recent development that arose from an effort to develop science-based guide-lines for regulating sound exposures (see Southall et al. 2007). During this process, separate weighting functions have been developed for five categories of marine mammals, with these functions being approp-riate 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 M_{pw} and M_{pa}, respectively. The five "M-weighting" functions are almost flat between the known or inferred limits of functional hearing for the species in each group, but down-weight ("attenuate") sounds at higher and lower frequencies. As such, they are analogous to the C-weighting function that is often applied in human noise exposure analyses where the concern is about potential effects of high-level sounds. With M_{pa}-weighting, the lower and upper "inflection points" are 75 Hz and

30 kHz.[4] M_{pa}-weighted sound levels are useful for purposes of assessing impacts on pinnipeds of sounds with high-received levels, such as those during some vehicle overflights.

13.3 Reports

An interim technical report will be submitted to NMFS 60 days[5] prior to the expiry of the first LOA issued under the regulations, along with a request for a follow-on LOA. This interim technical report will provide full documentation of methods, results, and interpretation pertaining to all monitoring tasks for launches during the period covered by the first LOA. (However, only preliminary information would be included for any launches during the 60-day period immediately preceding submission of the interim report to NMFS.)

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.

The proposed launch monitoring activities in 2009–2010 will constitute the eighth year of formal, concurrent pinniped and acoustical monitoring during launches from SNI. Following submission in 2010 of the interim report on the first phase of monitoring under an LOA, it would be appropriate for the Navy and NMFS to discuss the scope for any additional launch monitoring work on SNI subsequent to "Year 1" of the regulations. In particular, some biological or acoustic parameters may be documented adequately prior to or during "Year 1" (2009–2010), and it may not be necessary to continue all aspects of the monitoring work after that period.

14. Coordinating Research To Reduce and Evaluate Incidental Take

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 Section 13) with the SNI pinniped census program conducted by Mark Lowry (NMFS). 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.

As noted in Section 13, the Navy will sponsor pinniped and acoustical monitoring methods that will facilitate comparing and combining monitoring data where appropriate with other vehicle launch monitoring programs in California (e.g., U.S. Air Force research on the effects of large booster launches from VAFB; Thorson et al. 1999; Southall et al. 2007:519-20).

III. CONCLUSION

Up to six species of marine mammals under the jurisdiction of NMFS occur on SNI. The California sea lion is abundant within the potentially affected area on western SNI, and northern elephant seals and harbor seals are found in lesser numbers on certain beaches and in nearshore waters. Northern fur seals may also be present in very small numbers on occasion, and there is a slight chance that Guadalupe fur seal(s) might be present. Steller sea lions have been sighted occasionally in the past. Given the sporadic

[4] The data will only be recorded at frequencies up to 20 kHz, so the (probably negligible) energy at 20–30 kHz is not included in calculating the M_{pa} (or other) measures.

[5] Or such other interval as may be negotiated between NMFS and the Navy.

occurrence of these last three species, it is unlikely that any of them would be exposed to the effects of missile launches and take authorization for these species is not being requested.

The Navy is requesting regulations to authorize taking by harassment of pinnipeds incidental to the launch of vehicles from the west end of SNI, California. Because previous monitoring of similar launches has shown that most of the disturbance to nearby pinnipeds (when it occurs) will be transitory and of small amplitude, NAWCWD is requesting authorization for a take of pinnipeds by Level B harassment. NAWCWD has proposed mitigation and monitoring measures to reduce the likelihood and severity of impacts to marine mammals, to characterize the nature of incidental "takes", and to estimate the actual numbers of marine mammals "taken" incidentally during planned launch operations at SNI.

The potential impacts of the planned launch operations at SNI on pinnipeds involve both acoustic and non-acoustic effects. Acoustic effects could result from sounds produced by vehicle launches and overflights. In addition to the launches themselves, the presence of personnel and the placement of monitoring equipment are potential sources of non-acoustic effects. During average ambient conditions, some activities are expected to be audible to marine mammals at distances up to several kilometers. However, the relatively low received sound levels at such long distances are not expected to disturb most seals or sea lions at these maximum distances.

Although sounds from some of the larger vehicle launches may be strong enough to cause TTS in certain individual pinnipeds close to the launch trajectory, any cases of TTS are expected to be mild and reversible. It is also possible that launch sounds might on rare occasions exceed (by a narrow margin) the current best estimate of the PTS-onset criterion, particularly for launches of large vehicles that produce sonic booms. However, sounds exceeding the PTS criteria have only been recorded at pinniped haul-out sites during Vandal launches (see Holst et al. 2008), which have been discontinued at SNI. Thus, it seems unlikely that any pinnipeds would be exposed to launch sounds strong enough to cause PTS during the 2009–2014 monitoring period.

Previous monitoring has shown that pinniped reactions to launches from SNI are highly variable, and could involve occasional stampedes or other abrupt movements by some individuals on the beaches around the western end of the island. These disturbance reactions are not expected to result in long-term negative consequences for the individuals or their populations.

The numbers of individuals that might stampede or otherwise move more than a few feet on the beach are difficult to estimate. The Navy provisionally estimates that no more than 474 northern elephant seals, 467 harbor seals, and 1,606 California sea lions are likely to be "taken" in this manner during all the launches within any one-year period of applicability of the expected regulations. However, these estimates may be substantial overestimates of the actual numbers of pinnipeds that will show strong reactions (especially those for northern elephant seals and California sea lions).

Larger numbers of pinnipeds are expected to show momentary alert or startle reactions that do not involve sudden large-scale movements on the beaches. These momentary reactions would involve blinking of the eyes, lifting or turning the head, or moving a few feet along the beach. Consistent with previous guidance from NMFS, these pinnipeds are not considered to be "taken".

For reasons set forth above, it is expected that the Navy's vehicle launch operations on SNI will have no greater than a Level B harassment impact on California sea lions, harbor seals, and northern elephant seals. NAWCWD requests that NMFS promulgate regulations allowing takes of pinnipeds incidental to vehicle launch operations at SNI, California.

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