ANNUAL REPORT LETTER OF AUTHORIZATION:

TAKING MARINE MAMMALS INCIDENTAL TO SPACE VEHICLE AND MISSILE LAUNCHES AND AIRCRAFT TEST FLIGHT AND HELICOPTER OPERATIONS AT VANDENBERG AIR FORCE BASE, CALIFORNIA

1 JANUARY TO 31 DECEMBER 2023

Photo: Man Tech SRS, Lom

Submitted to:
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National Marine Fisheries Service
Permits, Conservation and Education Division
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20 March 2024

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Executive Summary

This report is prepared in accordance with a National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS; also called NOAA Fisheries) five-year Letter of Authorization (LOA) to the U.S. Air Force, Vandenberg Air Force Base (VAFB), 30th Space Wing (30 SW) for the incidental harassment of marine mammals related to U.S. Air Force Launches and Operations at Vandenberg Air Force Base (NOAA 2019a). The current LOA was issued on 10 April 2019, after publication of the Federal Register Final Rule on 12 April 2019 (NOAA 2019b).

In May 2021, VAFB was officially designated Vandenberg Space Force Base (VSFB) and the 30th Space Wing was redesignated Space Launch Delta 30 (SLD 30). "Historic" references to VAFB are still found occasionally within this document.

VSFB applied to NMFS for a new LOA on November 2, 2022; a new LOA is expected in early 2024.

This report summarizes results of monthly pinniped surveys in addition to describing pinniped monitoring conducted in association with space vehicle (rocket) and missile launches, together with fixed-wing aircraft, helicopter and unmanned aerial vehicle operations. Species of interest at VSFB included in the LOA are Pacific harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), Northern elephant seals (*Mirounga angustirostris*) and Steller sea lions (*Eumetopias jubatus*). At San Miguel Island (SMI), which is occasionally impacted by sonic booms from rockets, the Northern fur seal (*Callorhinus ursinus*) and Guadalupe fur seal (*Arctocephalus townsendi*) are considered species of interest in addition to the first three species mentioned for VSFB (no known records of Steller sea lions on the Northern Channel Islands or NCI).

During the reporting period (1 January to 31 December 2023), VSFB launched 31 rockets and five missiles or similar vehicles. Space Launch Complex 3 (SLC-3), formerly used for the Atlas V, is being modified to host a new United Launch Alliance (ULA) program, "Vulcan," with the first launch of that program not expected until at least summer 2024. In 2023, it was announced that SLC-6 will be modified to host SpaceX Falcon 9 and Falcon Heavy launch programs. 2023 saw two launches of Firefly Alpha in September and December, after a failed launch attempt in September 2021 (the December launch failed, in that the payload did not reach the correct orbit, however the launch itself was successful). One test launch of a Minuteman III missile also failed.

On-base pinniped monitoring was required for 17 rocket launches, but no missile launches. NCI pinniped monitoring was required for 2 Falcon 9 rocket launches (22 June and 7 July-both launches were monitored on Santa Rosa Island). Seven first stage recoveries ("boost back") of the Falcon 9 required monitoring at VSFB; all other Falcon 9 first stage recoveries landed on an offshore, autonomous barge, west of Baja California, Mexico. When SpaceX recoveries occur offshore, Space Force determined that these recoveries did not result in take to pinnipeds.

During the reporting period, 7,822 operations were conducted from the VSFB airfield. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm., 2023).

LOA monitoring requirements were followed during 2023 and no incidents of injury or mortality of a pinniped caused by VSFB operations were documented.

1.0 Introduction

This report presents information to satisfy the requirements of the LOA (NOAA 2019a) issued to VSFB by NMFS. In accordance with a condition in the 2014 LOA (NOAA 2014, page 1, item #4), instead of notifying NMFS "at least two (2) weeks prior to conducting any launch activities that may result in taking marine mammals by harassment," VSFB has agreed to send quarterly advisories and updates to NOAA. These quarterly advisories were submitted in January, April, July and October 2023 (R. Evans, pers. comm., 2023).

Historically, Pacific harbor seals *(Phoca vitulina*; hereafter harbor seal) have been the most abundant pinnipeds on VSFB, at least during most months. In recent years, northern elephant seals (*Mirounga angustirostris*; hereafter elephant seal) are present in higher numbers than harbor seals in most months and California sea lions (*Zalophus californianus*) are often present in large numbers in the early summer. Steller sea lions (*Eumetopias jubatus*) are also present, albeit rarely; all species except Pacific harbor seals and Steller sea lions increasing in recent years (MSRS 2014, CEMML 2016a, CEMML 2016b). Pacifc harbor seal declines are informally attributed to interspecific competion, specifically the large increase in Northern elephant seal numbers. For about 4 years, between 2016 and 2019, very large numbers of juvenile California sea lions were observed near South Rocky Point (Figure 1) in the early summer months, however this has not re-occurred since 2020. During the latter half of 2016 and throughout 2019, elephant seal numbers had a marked increase and in 2017 established a rookery at Amphitheater Cove. Elephant seal pups were first documented in January 2017, again observed in January-March, all years 2018-2023. The revised 2017 LOA (NOAA 2017), required launch monitoring of the elephant seal rookery beginning 01 January 2018. The small rookery at “Boathouse Beach” on South VSFB was not used as such in 2023 (two pups were born and weaned there each year in 2021 and 2022). More than 40 NES pups were born and weaned at “Amphitheater,” which is located approximately 2 miles northwest.

Potential impacts to pinnipeds on VSFB include harassment from noise, particularly sonic booms, generated from rocket or missile launches, SpaceX Falcon 9 boostback to land (return of the first stage of the rocket for later re-use, which occurred 7 times in 2023), or aircraft noise, which may result in a startle response. In rare cases, sudden disturbances from a variety of causes have resulted in the trampling of pups by adult animals, resulting in injuries or mortalities, though this has not been observed at VSFB. Other potential noise impacts could result in temporary threshold shift (TTS), in which an animal’s hearing is temporarily diminished over part or all of its hearing range. Severe cases can involve permanent threshold shift (PTS), in which the animal’s hearing is permanently diminished over part or all of its hearing range.

During the 2023 reporting period, monitoring on the Northern Channel Islands (NCI) was required for two launches (SpaceX Falcon 9 in June and July). Monitoring on VSFB was required for 17 rockets. This report describes the methods and results of the marine mammal monitoring efforts

and discusses the impacts of Air Force/Space Force operations. A new commercial launch entity, Firefly Space, began operations at Space Launch Complex 2 (SLC-2) in calendar year 2021. Other new entities plan to initiate operations at facilities to include SLC-8, SLC-11 and SLC-5 in 2024.

In 2023, Space Exploration Technologies (SpaceX) continued conducting their "boost-back" action. In 2023, 21 of 28 launches landed on an offshore, autonomous barge; this action results in no noise impacts to the mainland or the Channel Islands (7 landed at Space Landing Complex 4-West, which does result in a boom impacting the mainland). The first stage of the rocket is then refurbished and re-used. In 2023, significant modifications were initiated at SLC-3E for the future Vulcan program; modifications to SLC-6 for the Falcon 9 and Falcon Heavy (SpaceX) are likely to begin in 2024. At least three other existing facilities (TP-01, LF-576E and SLC-8) are also planned for new programs and launch proponents in the next few years, as forecasts for more satellite and micro-satellite "constellations" are now commonplace. The formerly dormant SLC-5 will be reconfigured for a new program in the next 1-3 years, and the construction of two new SLC's, tentatively named SLC-9 and SLC-11 are under consideration.

In July of 2016, VAFB concluded informal Section 7 consultation under the Endangered Species Act with NMFS. NMFS concurred that VAFB rocket launches are "not likely to adversely affect" the Guadalupe fur seal on the NCI.

No research activities related to monitoring the effects of launch noise and sonic booms on marine mammal populations was conducted nor is any anticipated at this time.

2.0 Operations

Operations that occur on VSFB covered by the LOA include rocket and missile launches as well as fixed-wing aircraft and occasional helicopter activities. Operations activities which occurred in 2021 are detailed below. The locations of launch sites in relation to pinniped haul-out areas on VSFB are shown in Figures 1 and 2.

2.1 Rocket Launches

Thirty rocket launches occurred during the reporting period (Table 1).

Table 1. Rocket Launches in 2023

Vehicle Type	Facility	Launch Date	Launch Time
Falcon 9[1]	SLC-4E	19 January	0743
Falcon 9[1]	SLC-4E	31 January	1117
Falcon 9[1]	SLC-4E	17 February	1416
Falcon 9[1]	SLC-4E	3 March	1038
Falcon 9[1]	SLC-4	17 March	1129
Falcon 9[2]	SLC-4E/W	2 April	0729
Falcon 9[2]	SLC-4E/W	14 April	2348
Falcon 9[1]	SLC-4	27 April	0641
Falcon 9[1]	SLC-4E	10 May	1309
Falcon 9[1]	SLC-4E	20 May	0617
Falcon 9[1]	SLC-4E	30 May	2302
Falcon 9[2]	SLC-4E/W	12 June	1435
Falcon 9[2]	SLC-4E/W	22 June	0019
Falcon 9[1]	SLC-4E	7 July	1229
Falcon 9[1]	SLC-4E	19 July	2109
Falcon 9[1]	SLC-4E	7 August	2057
Falcon 9[1]	SLC-4E	22 August	2254
Falcon 9[2]	SLC-4E/W	2 September	0725
Falcon 9[1]	SLC-4E	12 September	2347
Firefly	SLC-2W	15 September	0227
Falcon 9[1]	SLC-4E	25 September	0011
Falcon 9[1]	SLC-4E	8 October	0047
Falcon 9[1]	SLC-4E	21 October	0123
Falcon 9[1]	SLC-4E	29 October	0200
Falcon 9[2]	SLC-4E/W	11 November	1049
Falcon 9[1]	SLC-4E	20 November	0330
Falcon 9[2]	SLC-4E/W	1 December	1020
Falcon 9[1]	SLC-4E	8 December	0003
Firefly[3]	SLC-2W	22 December	1032
Falcon 9[2]	SLC-4E/W	24 December	0511

[1] Included "boost back" and landing to an off-shore autonomous barge

[2] These launches included "boostback" of the first stage to LZ-4 (or SLC-4W), located about 200 yards west of launch pad SLC-4E

3 Launch failure. Although the launch was successful, the payload did not reach planned orbit

2.2 Missile Launches

Five missile launches occurred during the reporting period from Launch Facilities LF-09, 10 and 24 (Table 2); all of these facilities are on north VSFB. The locations of these sites in relation to pinniped haul-out areas on VSFB are shown in Figure 2. Two launches were unarmed Minuteman III (MM-III) Intercontinental Ballistic Missile (ICBM) test launches, one was a test launch of a Minotaur II, in preparation for additional testing in support of an incoming program, the Ground Based Strategic Defense System (which will replace the MM-III as early as 2025. However, this

launch attempt resulted in a catastrophic failure; the rocket exploded less than 20 seconds after lift-off and crashed back onto land adjacent to the launch pad. A 110-acre fire resulted. The Minotaur II is considered a small rocket in some configurations, however for this report it is considered a missile.

Table 2. Missile Launches in 2023

Missile Type	Facility	Launch Date	Launch Time
Minuteman III	LF-10	10 February	2301
Minuteman III	LF-09	19 April	0411
Minuteman III	LF-10	6 September	0001
Minuteman III	LF-09	1 November	0001
MDA-FTG/OBV	LF-24	11 December	0748

2.3 Fixed-wing Aircraft and Helicopter Operations

Various types of fixed-wing aircraft fly from VSFB. In accordance with the LOA, all aircraft and helicopter flight paths maintain a minimum distance of 1,000 feet from recognized pinniped haul outs and rookeries, except during emergencies or security incidents. Class 0-2 unmanned aerial systems may be flown within 300 feet of recognized pinniped haul outs and rookeries.

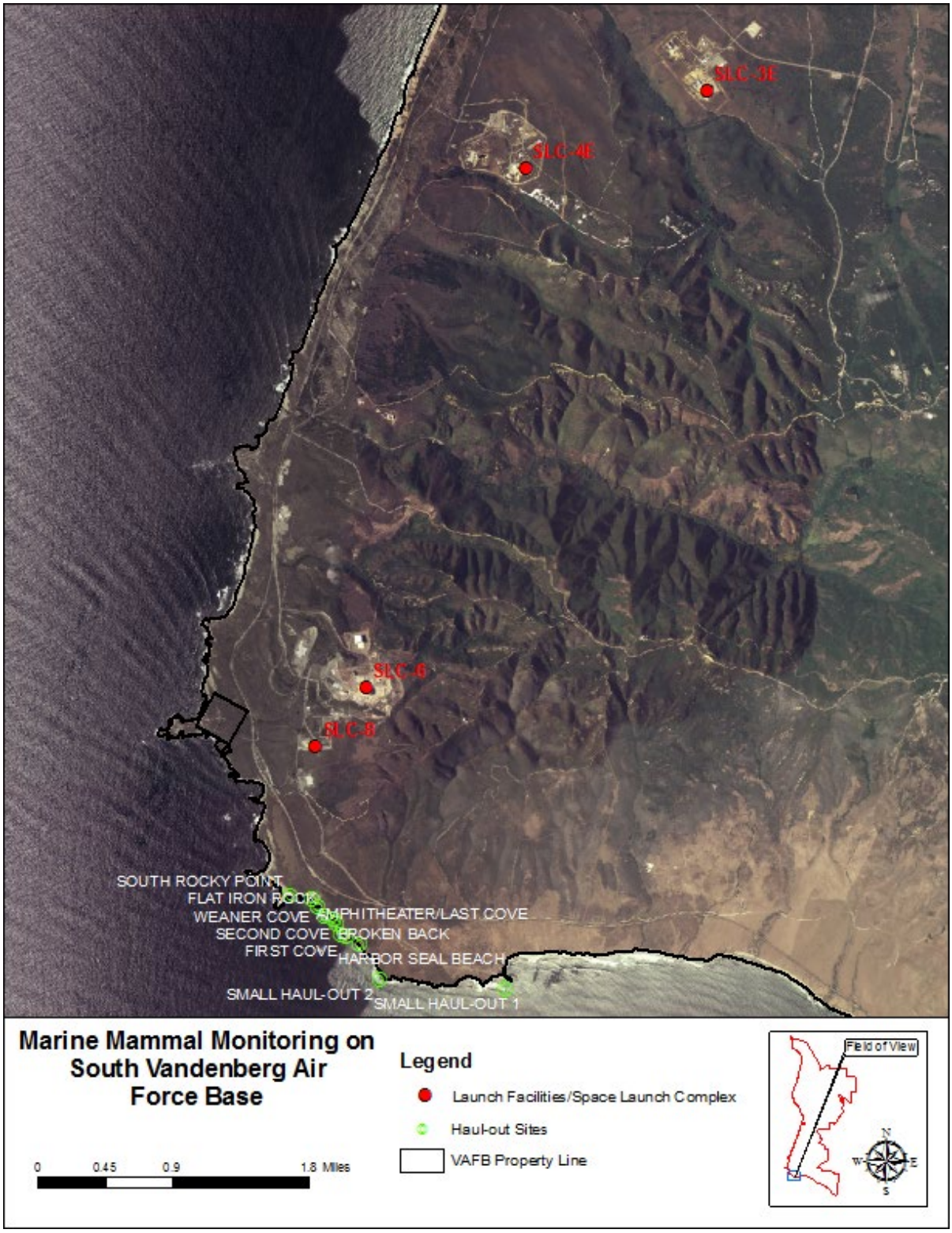

Figure 1. Launch Sites and Pinniped Haul-out Areas on South VSFB.

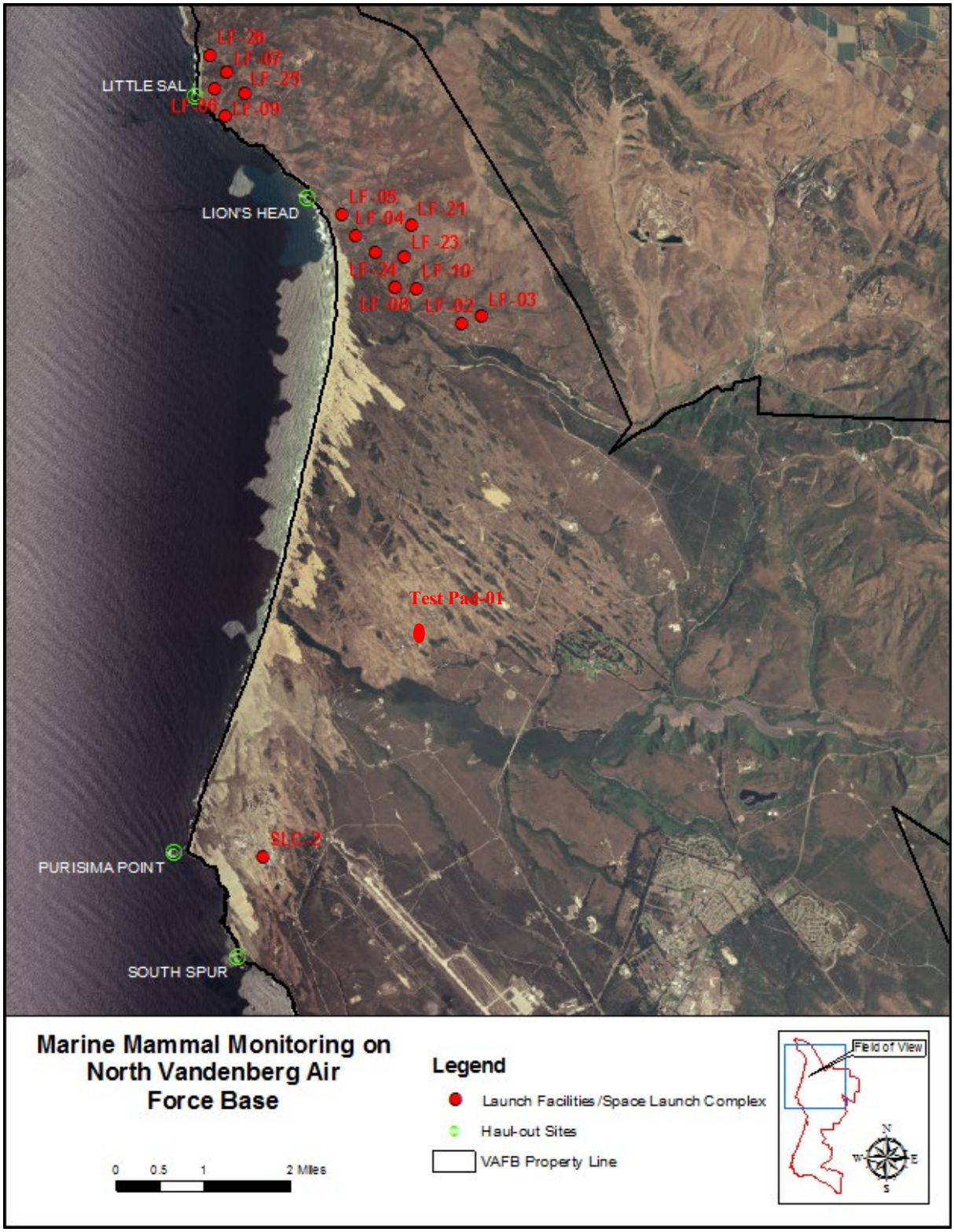

Figure 2. Launch Sites (many inactive) and Pinniped Haul-out Areas on North VSFB.

3.0 Methods

3.1 Sonic Boom Modeling

As required in the 2019 LOA, sonic boom modeling is performed prior to all rocket launches. Modeling is not necessary for the missile launches because these vehicles are launched with a westward trajectory and their sonic booms do not impact marine mammal haul-outs on VSFB or the NCI (NOAA 2014a). The modeling programs incorporate nominal flight trajectory information, rocket weight, length, engine thrust, engine plume drag, and meteorological conditions to predict the peak amplitude and impact location of potential booms. Among other factors, meteorological conditions include jet stream presence or absence, and if present, its direction, altitude, and velocity. Cloud type, altitude, and density are also considered. From these data, models predict peak amplitudes and impact locations.

3.2 Acoustic Monitoring

Acoustic monitoring is conducted on NCI when sonic boom modeling predicts impacts to the NCI in excess of the thresholds defined in the LOA. In order to record and analyze the level of the sonic boom that impacts the NCI as a result of the launch, monitors utilize a calibrated sound level meter with all the necessary accessories. Measurements could be downloaded to a laptop and analyzed. A separate system with a calibrated digital audio tracking (DAT) recorder, preamplifier, and specialized microphone is used to obtain sonic boom measurements. The microphone is mounted on a tripod and fitted with a windscreen. The DAT tapes are analyzed in the laboratory to determine various acoustic properties of the rocket noise and sonic boom. Monitoring on NCI was not required in 2020.

Acoustic monitoring is also required on VSFB for five landings of the Falcon 9 first stage (boostback) at SLC 4-W. Acoustic monitoring on south VSFB was required for the several Falcon 9 launches.

3.3 Launch Monitoring

With the current LOA (NMFS 2019a), monitoring on the NCI is required if sonic boom modeling predicts a sonic boom greater than 2 pounds per square foot (psf) is likely to impact one or more of the NCI between 1 March and 31 July, greater than 3.0 psf between 1 August and 30 September, and greater than 4 psf between 1 October and 28 February. Beginning 01 January 2018, pinniped monitoring was required on VSFB when launches occur during elephant seal pupping season (1 January through 28 February). A continuing requirement is pinniped monitoring during the harbor seal pupping season (1 March through 30 June). Note that elephant seal weaners are expected to still be present at their rookery for the first few weeks of March, therefore harbor seal monitoring will also incorporate this species. Starting in 2019, VSFB extended monitoring for launches until 31 July to account for recent increases in California sea lion numbers in the early summer months, though no successful pupping of this species has yet been documented on VSFB.

Monitoring must begin at least 72 hours prior to each launch and continue 48 hours after the launch. During pupping season, follow-up monitoring must be conducted on VSFB once

approximately two weeks after each launch. Monitoring must be conducted as close to the launch window as possible, or at times with tides approximately equivalent to those expected during the launch window.

On VSFB, monitoring sites are selected based on proximity of the launch location to the nearest active haul-out sites. The haul-outs that are monitored for rocket launches from South VSFB include Amphitheater Cove and may include North and South Rocky Point (Figure 1). Amphitheater Cove has historically been utilized as a harbor seal rookery and is now also utilized as an elephant seal rookery. On the NCI, the monitoring location is selected based on the density and level of predicted sonic boom impacts and the nearest active haul-out of pupping pinnipeds.

Pinniped monitors used high quality binoculars and spotting scopes to make hourly counts and record species, number of individuals, sex, age class, and behavior within a predefined focal area. Several counts are conducted each day. Monitors may use night vision goggles (Exelis AN/PVS-7D or similar) if monitoring occurs during hours of darkness. Remarks are recorded, including the nature and cause of any natural or human-related disturbance, such as low-flying aircraft or boat traffic. Incidental information may be recorded for other wildlife species. Environmental data collected includes tide level and time, visibility, percentage and type of cloud cover, air temperature, wind direction and velocity, and swell direction and height. On VSFB, direct observations during launch events are usually not allowed due to safety concerns; therefore video is utilized during daytime launches on VSFB to record the reactions of pinnipeds to the launch. Post-launch, the video equipment is collected and video reviewed with responses noted such as alert or flushing into the water. Alert is usually considered insignificant. When flushing is observed, the amount of time it takes for the number of hauled-out animals to return to the pre-launch count is determined if recording length allows.

3.4 Fixed-wing Aircraft and Helicopter Operations

The VSFB airfield (30 OSS/OSAB) keeps records of the number and nature of all fixed-wing aircraft and helicopter operations completed at VSFB.

3.5 Monthly Surveys

The Center for Environmental Management of Military Lands (CEMML) and U.S. Air Force / Space Force personnel, 30th Civil Engineer Squadron (30 CES) biologists surveyed marine mammal haul-out sites on North and South VSFB (Figures 1 and 2) monthly from January to December 2023. For each survey, high quality binoculars and/or a spotting scope are utilized depending on conditions. Monthly surveys are ideally timed to coincide with the lowest weekday late morning or afternoon low tides. The location, species, number of individuals, age class, and sex (when possible) were recorded for each site and ocean and weather conditions are documented. On VSFB, most observations are made from cliffs overlooking haul-outs. Purisima Point has been omitted from all surveys throughout 2015-2022 because a permitted biologist must accompany anyone accessing Purisima Point during the California least tern and Western snowy plover breeding season (1 March to 30 September). The site was not included in the remaining months (1 October to 28 February) in order to keep data consistent throughout the year.

Starting in 2017, several haul outs on South VSFB (Harbor Seal Beach, First Cove, First Ledge, Second Cove, Broken Back, and Weaner Cove) were omitted from almost all surveys. This was due to significant decreased use of these sites starting in 2016, likely linked to increased cliff erosion in the area. This allowed for adequate time to survey more heavily utilized haul outs (Amphitheater, South Rocky, and North Rocky). In 2023, these locations were surveyed via spotting scope from the apex of South Rocky Point, a vantage point that allows surveyors to see most of the coastline. Additionally, three vantage points are now used to thoroughly survey North Rocky Point, which takes additional time.

4.0 Results

Based on modeling of launches and time of year, 19 monitoring efforts were required during 2023. Two monitoring efforts were required on the Northern Channel Islands. Launch mitigation requirements are presented in Table 3 and discussed in detail in the following subsections.

Table 3. Launch Monoring Requirements in 2023

Rocket or Missile	Launch Date	NCI	VSFB	Video[1]	Video Result	Boom Model
Falcon 9	19 January	No	Yes	Yes	No impact	Yes
Falcon 9	31 January	No	Yes	Yes	No impact	Yes
Falcon 9	17 February	No	Yes	Yes	No impact	Yes
Falcon 9	3 March	No	Yes	Yes	No impact	Yes
Falcon 9	17 March	No	Yes	Yes	No impact	Yes
Falcon 9	2 April	No	Yes	Yes	No impact	Yes
Falcon 9	14 April	No	Yes	Yes	No impact	Yes
Falcon 9	27 April	No	Yes	Yes	No impact	Yes
Falcon 9	10 May	No	Yes	Yes	No impact	Yes
Falcon 9	20 May	No	Yes	Yes	No impact	Yes
Falcon 9	31 May	No	Yes	Yes	No impact	Yes
Falcon 9	12 June	No	Yes	Yes	No impact	Yes
Falcon 9	22 June	Yes	Yes	Yes	No impact	Yes
Falcon 9	7 July	Yes	Yes	Yes	No impact	Yes
Falcon 9	19 July	No	Yes	Yes	No impact	Yes
Falcon 9	2 September	No	Yes	Yes	No impact	Yes
Falcon 9	11 November	No	Yes	Yes	No impact	Yes
Falcon 9	1 December	No	Yes	Yes	No impact	Yes
Falcon 9	24 December	No	Yes	Yes	No impact	Yes

Notes: 1 - “Video” may indicate that a series of still images were taken

4.1 Sonic Boom Modeling

Sonic boom modeling was conducted for all rocket launches that occurred during the 2023 reporting period. The boom model predicted impacts that would require monitoring on the NCI for only the 22 June and 7 July Falcon 9 launches.

4.2 Acoustic Monitoring

Modeling predicted sonic booms could impact the NCI as a result of two launches during the 2023 reporting period (22 June, 7 July); however, as discussed in additional detail below, in one case the actual boom was much lower than the modeled boom, and in the other case, equipment failure prevented recording and analysis of the actual boom.

4.3 Launch Monitoring

Nineteen launches required monitoring during the 2023 reporting period. All nineteen launches required monitoring on VSFB (since the mission occurred during the pinniped pupping season, 1 January through 31 July OR included a Falcon 9 terrestrial boost-back), and two on NCI. Full details of the monitoring for those launches can be found in the respective launch and landing monitoring reports sent to NMFS previously (refer to literature cited section), summaries follow.

4.3.1 Falcon 9 (Starlink G2-4)

A SpaceX Falcon 9 launch on 19 January (7:43 a.m. PST) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred at 0700-1300 PDT on 16-18 January and 20-21 January and 0800-1400 on 2 February. The tide at the time of the launch was +2.47ft outgoing. Weather: temperatures were between 48.0 to 63.4°F, maximum windspeed ranged from 0.6 to 19.9mph. Camera visibility was slightly obscured on the southern end of the beach due to new camera location. This launch included boost-back of the first stage to an offshore autonomous barge. Results indicated that there was no impact on pinnipeds by the launch. There were no California or Steller sea lions observed during the launch monitoring period. Pacific harbor seal counts ranged from 0-48 adults and 0-8 juveniles. Northern elephant seals ranged from 15-35 unknown adults/females, 0-7 sub adult males, and 10-13 pups. One minute after launch three harbor seals fled the beach and one returned 35 minutes later; by end of video 30 harbor seals were on the beach. No elephant seals were observed to react more than a head raise to the launch. One adult Pacific harbor seal and three adult female Northern elephant seals were observed with minor injuries prior to the launch. A detailed report was provided to NMFS, dated 14 February 2023.

4.3.2 Falcon 9 (Starlink G2-6)

A SpaceX Falcon 9 launch on 31 January (11:17 a.m. PST) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-monitoring occurred at 0700-1300 PDT on 28-30 January and 1-2 February and between 1030 and 1630 on 13 February. The tide at the time of the launch was +4.42ft incoming. Weather: temperatures were between 51.5-5 and 68.2°F, maximum windspeed varied between 1.2 and 16.0 mph. Camera visibility was unimpaired during recording. This launch included boost-back of the first stage to an offshore autonomous barge. Results indicated that there was no impact on pinnipeds by the launch. Approximately 18-21 Pacific harbor seals and 55 norther elephant seals were counted. There was no reaction by either species, potentially due to the dense cloud cover during the launch. One adult female Pacific harbor seal with an injury to her tail (thought to be not life-

threatening) was observed prior to the launch. There were no California or Steller sea lions observed during the launch monitoring period. A detailed report was provided to NMFS, dated 6 March 2023.

4.3.3 Falcon 9 (Starlink G2-5)

A SpaceX Falcon 9 launch on 17 February (2:16 pm PST) did not require monitoring on San Miguel Island but monitoring was required on VSFB. Pre- and post-launch monitoring occurred 1030 and 1630 PDT on 13-16 February, 18-19 February, and 27 February. Tide at the time of launch was +6.29ft incoming. Weather: temperatures were between 48.6 and 67.0°F; maximum windspeed was between 12-30mph. Camera visibility was unimpaired from 1030-1600 but became impaired from 1600-1700. Results indicated that there was no impact on pinnipeds by the launch activities. No Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts ranged from 14-46 adults/immatures. Northern elephant seal counts ranged from 14-26 adults/females, 0-1 sub-adult male, 0-2 males, 0-4 juveniles, 9-33 weaners, and 14-24 pups. No reactions to the launch were observed by either species. One adult Pacific harbor seal was observed with two lacerations on its side two days after the launch, however neither injury was attributable to the launch, it was thought the injuries were probably the result of the seal scraping against rocks. A detailed report was provided to NMFS, dated 14 March 2023.

4.3.4 Falcon 9 (Starlink G2-7)

A SpaceX Falcon 9 launch on 3 March (10:38 a.m. PST) did not require monitoring on the Northern Channel Islands but monitoring was required on VSFB. Pre- and post-launch monitoring was conducted between 1030 and 1630 PDT on 27-28 February and 4 March and between 1100 and 1700 16 March. Tide at the time of the launch was +2.74ft incoming. Weather: temperatures were between 48.6-66.8°F; maximum windspeed varied between 1.2-7.7 mph. Camera visibility was unimpaired between 1000 to 1315, by 1900 visibility was fully impaired. Because this launch included boost-back of the first stage to an autonomous barge located west of Baja California (Mexico), no monitoring of the boost-back and landing was required. Results indicated that there was no impact on pinnipeds by the launch activities. No California or Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts ranged from 21-47 adults/immatures. Northern elephant seal counts ranged from 0-5 unknown adults/females, 0-2 adult males, 0-2 sub-adult males, 0-4 juveniles, and 28-33 weaners. Two minutes after the launch 16 harbor seals fled the beach. No northern elephant seals reacted to the launch more than a head raise. The same adult female harbor seal (see 4.3.3) with lacerations was observed again, and the injuries appeared to be healing. A detailed report was provided to NMFS, dated 6 April 2023.

4.3.5 Falcon 9 (Starlink G2-8)

A SpaceX Falcon 9 launch on 17 March (12:29 p.m. PST) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred between 1100 and 1700 PDT on 13-16 March and 18-19 March; 2-week post-launch monitoring occurred between 700 and 1300 on 29 March. The tide was +5.27 incoming. Weather:

temperatures were between 48.7-61.2°F, maximum windspeed was between 4.2-27.4 mph. Camera visibility was This launch included boost-back of the first stage to an autonomous barge located west of Baja California. Results indicated that there was no impact on pinnipeds by launch activities. No Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts varied between 21-52 adults/immatures and 1-13 pups. Northern elephant seal counts ranged from 0-11 unknown adults/females, 27-32 weaners, 0-2 sub-adult males, and 0-1 males. No reactions from the launch were observed from either species, most likely due to dense cloud cover during the launch. One dead Pacific harbor seal pup was observed on 13 March (before the launch) and reported to NMFS via the MMHRSP portal on 14 March. A detailed report was provided to NMFS, dated 3 May 2023.

4.3.6 Falcon 9 (SDA-0A)

A SpaceX Falcon 9 launch on 2 April (7:29 a.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred on 30 March-1 April between 0700 – 1300 PDT and on 3-4 April during the same time. The 2-week post monitoring occurred on 15 April. Tide at launch time was +2.25 outgoing. Weather: temperatures were between 49.5 to 61.9°F; windspeed maximum was between 1.7 to 22.8 mph. The camera was impaired due to heavy cloud cover and poor camera focus. Because this launch included boost-back of the first stage to the terrestrial landing zone at VSFB SLC-4W, monitoring of the boost-back and landing was required. Results indicated that there was no impact on the pinnipeds by the launch activities. One California sea lion was recorded, but no Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts ranged from 4-49 adults/immatures and 0-22 pups. Northern elephant seal counts ranged from 5-40 unknown adults/females, 1 adult male, and 10-36 juveniles. One adult female California sea lion was observed on 15 April. A group of harbor seals fled the beach one minute after the launch; first pinniped was seen returning to the beach 15 minutes after the launch. Four dead Pacific harbor seal pups were observed on 4 April, the last day of monitoring. The deceased pups did not appear to be emaciated, which indicates that they did not die of due to maternal abandonment or malnutrition. There was no evidence suggesting that the deaths were attributable to the SDA-0A mission. A detailed report was provided to NMFS, dated 18 May 2023.

4.3.7 Falcon 9 (Transporter 7)

A SpaceX Falcon 9 launch on 14 April (11:48 pm PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post- launch monitoring occurred between 0700 to 1300 PDT from 12-14 April and 15-16 April. The follow- up survey was conducted at 0630-1230 on 25 April. Tide at launch time was +4.95 incoming. Weather: temperatures was between 49.0 to 63.6°F; maximum windspeed was 4.2-24.3 mph. Because this launch included boost-back of the first stage to the terrestrial landing zone at VSFB SLC-4W, monitoring of the boost-back and landing was required. Results indicated that there was no

impact on the pinnipeds by the launch activities. One California sea lion was recorded, but no Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts ranged from4-49 adults, 1-17 pups. Northern elephant seal counts ranged from 1-9 unknown adults/females, 0-2 sub-adult males, and 46-98 juveniles. There was no video monitoring for this launch. One Pacific harbor seal pup with a minor injury on its back was observed prior to the launch. A detailed report was provided to NMFS, dated 8 June 2023.

4.3.8 Falcon 9 (Starlink G3-5)

A SpaceX Falcon 9 launch on 27 April (6:41 a.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred on 24-26 April and 28-29 April between 0630 and 1230 PDT. The follow-up survey was conducted on 7 May. Tide at launch time was +3.72 incoming. Weather: temperatures ranged from 49.0-64.1°F, maximum windspeed were between 1.0-20.0 mph. Camera visibility was impaired by dense fog. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. No Steller sea lions were observed during the launch monitoring period. One dead Pacific harbor seal pup was observed before the launch. One adult female Pacific harbor seal with a minor back injury was also observed prior to the launch. Pacific harbor seal counts varied between 2-59 adults and 1-16 pups. Northern elephant seal counts varied between 4-22 unknown adults/females, 0-4 sub-adult males, and 61-108 juveniles. One juvenile California sea lion was observed on 24 April. Immediately after the launch, harbor seals fled the beach while a group of elephant seals flailed around but did not flush. One dead juvenile California sea lion was observed on 29 April (after the launch), however there was no evidence suggesting that the death was attributable to the launch. A detailed report was provided to NMFS, dated 29 June 2023.

4.3.9 Falcon 9 (Starlink G2-9)

A SpaceX Falcon 9 launch on 10 May (1:09 p.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred on 7-9, 11-12 May between 1000 and 1600 PDT and the follow-up survey on 21 May. Tide at launch time was +1.02ft outgoing. Weather: temperatures were between 52.4-74.5°F, maximum windspeeds were between 6.4-25.2 mph. Camera visibility was unimpaired from 1000 to 1530pm. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. Results indicated that there was no impact on pinnipeds by launch activities. No California or Steller sea lions were observed during the launch monitoring period. Pacific harbor seals counts ranged from 0-71 adults and 0-18 young of the year. Northern elephant seal counts ranged from 0-50 unknown adults/females, 0-1 sub-adult male, 0-90 juveniles. Two minutes after the launch harbor seals fled the beach and all the elephant seals flailed around and 2 fled the beach. The harbor seals returned to the beach 3 minutes after the launch. Two injured adult Pacific harbor seals with what were believed to be shark bites were observed before the launch and none of the injuries appeared to be life-threatening. A detailed report was provided to NMFS dated 16 August 2023.

4.3.10 Falcon 9 (Iridium OneWeb)

A SpaceX Falcon 9 launch on 20 May (6:17 a.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred on 17-19 and 20-21 May between 0600-1200 PDT and the follow-up survey on 1 June. The tide at launch time was +5.63 ft outgoing. Weather: temperatures were between 52.3-65.8°F, maximum wind speeds were between 1.0-21.4 mph. Camera visibility was impaired by water droplets on the camera. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. Results indicated that there was no impact on pinnipeds by launch activities. No Steller sea lions were observed during the launch monitoring period. Pacific harbor seal counts ranged from 0-79 adults and 0-14 young of the year. Northern elephant seal counts ranged from 0-12 unknown adults/females, 0-2 sub-adult males, and 14-103 juveniles. Approximately three minutes after the launch harbor seals fled the beach, time of return unknown due to rain on the camera. One injured adult Pacific harbor seal (likely shark bite) was observed, and one dead California sea lion was recorded prior to the launch. A detailed report was provided to NMFS dated 16 August 2023.

4.3.11 Falcon 9 (Starlink G2-10)

A SpaceX Falcon 9 launch on 30 May (11:02 p.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred on 28-31 May and 1 June between 0700-1300 PDT, the follow-up survey on the 11 June. Tide at launch time was +2.63ft incoming. Weather: temperatures 55.8-68.8°F, maximum wind speeds were between 1.2-19.2 mph. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. Results indicated that there was no impact on pinnipeds by launch activities. Pacific harbor seal counts ranged from 23-85 adults and 0-4 young of the year. Northern elephant seals ranged from 2-13 unknown adults/females, 14-103 juveniles, and 0-3 sub-adult males. There was no video monitoring done for this launch. One adult Pacific harbor seal with a serious injury, assumed sharkbite, was observed prior to the launch. A dead juvenile California sea lion was also observed prior to the launch. No Steller sea lions were observed during the launch monitoring period. A detailed report was provided to NMFS dated 16 August 2023.

4.3.12 Falcon 9 (Transporter 8)

A SpaceX Falcon launch on 12 June (2:35 p.m. PDT) did not require monitoring on the Northern Channel Islands, but monitoring was required on VSFB. Pre- and post-launch monitoring occurred during 9-11 and 13-14 June between 0700-1300 PDT with the follow-up survey on 23 June. Tide at launch time was +3.4ft outgoing. Weather: temperatures were between 61.3-81.7°F, maximum wind speed was between 4.6-13.1 mph. Camera visibility was impaired. Because this launch included boost-back of the first stage to the terrestrial landing zone at VSFB SLC-4W, monitoring of the boost-back and landing was required. Pacific harbor seal counts ranged from 10-51 adults/immatures and 0-5 young of the year. Northern elephant seal counts ranged from

2-8 unknown adults/females, 1-8 sub-adult males, and 42-64 juveniles. At the time of the launch there were no harbor seals on the beach and the elephant seals had no reaction to the launch. Three injured adult Pacific harbor seals and one dead "young of the year" harbor seals were observed, however none of the injuries or deaths were attributable to the launch. A detailed report was provided to NMFS dated 22 August 2023.

4.3.13 Falcon 9 (Starlink G5-7)

A SpaceX Falcon launch on 22 June (12:19 a.m. PDT) required monitoring on the Northern Channel Islands and on VSFB. Pre- and post-launch monitoring occurred on 18-21 and 22-23 June between 0700-1300 PDT; the follow-up survey on 5 July. Tide at the time of the launch was +3 ft incoming. Weather: temperatures were between 57.4-75.5°F, maximum wind speeds were between 1.4-18.2 mph. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. The launch was modeled to impact the NCI with a boom above the 2.0 psf LOA threshold requiring monitoring, however the actual recorded boom was only 1.09 psf. Results indicated that there was no impact on pinnipeds by launch activities. Pacific harbor seal counts ranged from 3-31 adults/immatures. Northern elephant seal counts ranged from 1-20 unknown adults/females, 0-9 sub-adult males, and 5-35 juveniles. California sea lions ranged from 0-6 unknown adult/females. There was no video monitoring for this launch. One dead Pacific harbor seal and three dead California sea lions were observed on VSFB and two dead California sea lions were observed on NCI, however none of these were attributable to launch. A detailed report was provided to NMFS dated 11 September 2023.

4.3.14 Falcon 9 (Starlink G5-13)

A SpaceX Falcon launch on 7 July (12:29 p.m. PDT) required monitoring on the Northern Channel Islands and on VSFB. Pre- and post-launch monitoring occurred on 4-7 and 7-8 July between 1000-1600 PDT; follow-up monitoring occurred on 20 July. Tide at time of the launch was +0.99 ft outgoing. Weather: temperatures varied between 56.3-79.5°F, maximum wind speeds were between 2.1-10.9 mph. Camera visibility was unimpaired during the launch. This launch included boost-back of the first stage to an autonomous barge located west of Baja California. The sonic boom on NCI was modeled to exceed 2 psf, however equipment failure resulted in our inability to capture the intensity of the actual boom. Results indicated that there was no impact on pinnipeds by launch activities. Pacific harbor seal counts ranged from 2-26 adults/immatures and 0-2 young of the year. Northern elephant seal counts ranged from 9-17 unknown adults/females, 0-2 adult males, 0-9 sub-adult males, and 5-13 juveniles. California sea lion counts ranged from 1-4 unknown adults/females. Three minutes after the launch harbor seals fled the beach and returned 25 minutes later. The elephant seals reacted with head lifts but did not flee the beach. One injured Pacific harbor seal and one deal California sea lion were observed on VCFB before the launch, and eight injured California sea lions were observed on NCI during pre-launch monitoring, thus none were attributable to the launch. A detailed report was provided to NMFS dated 10 October 2023

4.3.15 Falcon 9 (Starlink G6-15)

A SpaceX Falcon launch on 19 July (9:09 p.m. PDT) required monitoring on VSFB, only. Results indicated that there was no impact on pinnipeds by launch activities. Pre- and post-launch monitoring occurred on17-19 and 20-21 July at 1000-1700 PDT; the follow-up survey occurred on 2 August. Tide was +3.6 outgoing at the time of the launch. Weather: temperature was between 59.9-75.9°F, maximum wind speed was between 1.8-19.6 mph. There was no camera monitoring for this launch. Pacific harbor seal counts ranged from 3-27 adults/immatures. Northern elephant seal counts ranged from 12-18 unknown adults/females, 1-2 males, 4-7 juveniles. One dead adult California sea lion was observed during pre-launch monitoring. A detailed report was provided to NMFS dated 18 October 2023

4.3.16 Falcon 9 (SDA-0B)

A SpaceX Falcon 9 launch on 2 September 2023 (7:25 a.m. PDT) required monitoring on VSFB because the first stage boost-back returned to Space Landing Complex 4-W. Pre- and post-launch surveys occurred on 28 August to 1 September, and 3-4 September at 0700-1300 PDT. Tide was +6 ft (high tide) at the time of the launch. Weather: temperatures were between 61.1-75.9°F, maximum wind speeds were between 2.1-18.7 mph. Camera visibility was unimpaired. Results indicated that there was no impact on pinnipeds by launch activities. Pacific harbor seal counts ranged from 6-28 adults/immatures. Northern elephant seal counts ranged from 12-18 unknown adults/females, 4-6 juveniles, and 1 male. No harbor seals could be discerned hauled-out for the entire duration of the video. A badly injured juvenile California sea lion (assumed shark bite) was observed during pre-launch counts. We determined that it was not likely to survive, however we presume the carcass was washed out to sea by high tides post mortem. This was reported to NMFS via the MMHRSP portal. A detailed report was provided to NMFS dated 16 November 2023.

4.3.17 Falcon 9 (Transporter 9)

A SpaceX Falcon 9 launch on 11 November (10:49 a.m. PST) required monitoring on VSFB because the first stage boost-back returned to Space Landing Complex 4-W. Pre- and post-launch monitoring occurred 8-10 November and 12-13 November, respectively, between 0930 and 1530. Tide at the time of launch was approximately +2.2 feet (outgoing). Weather: temperatures ranged between 61.7 and 76.0 degrees F; maximum windspeed varied between 1 and 22.7 mph. Visibility was unimpaired, however the focus on the camera was somewhat impaired (possibly when placing the camera into a waterproof box). Results indicated that there was no impact on pinnipeds by launch activities. No injured or dead pinnipeds were recorded during pre- or post-launch counts. Pacific harbor seal counts varied between 3-21 adults and 0-5 juveniles. Northern elephant seal counts ranged from 25-50 unknown adults/females, 1 to 10 subadult males, 20 to 39 juveniles. No California or Steller sea lions were observed. One minute after the launch, several harbor seals fled the beach and started to return 7 minutes later. No northern elephant seals reacted more than “head lift.” A detailed report was provided to NMFS dated 19 December.

4.3.18 Falcon 9 (EROISat)

A SpaceX Falcon 9 launch on 1 December (10:20 a.m. PST) required monitoring on VSFB because the first stage boost-back returned to Space Landing Complex 4-W. Pre- and post-launch

monitoring occurred on 26-30 November to 2-3 December from 0700-1300 PDT. Tide at launch time was +3.9 ft outgoing. Weather: temperature ranged from 57.7-67.5°F, maximum wind speeds were between 0-19.2 mph. Camera visibility was unimpared during the launch. Pacific harbor seal counts ranged from 0-20 adults and 0-4 juveniles. Northern elephant seal coutnts ranged from 33-58 adults. Immediately after the launch harbor seals were observed flushing from the beach and returned 1 hour and 56 minutes after the sonic boom. The elephant seals showed some movement but did not leave the beach. Results indicated that there was no impact on pinnipeds by launch activities. A detailed report was provided to NMFS dated 3 January 2024.

4.3.19 Falcon 9 (SARah-2)

A SpaceX Falcon 9 launch on 24 December (5:41 a.m. PST) required monitoring on VSFB because the first stage boost-back returned to Space Landing Complex 4-W. Results indicated that there was no impact on pinnipeds by launch activities. Pre-launch monitoring occurred on 18-23 December from 0715-1315 PDT. Tide at the time of the launch was +3.9 ft outgoing. Weather: temperatures ranged from 50.0-69.3°F, maximum wind speeds were between 0.8-11.8 mph. No video monitoring was conducted during this launch. No post-launch counts were conducted on December 24 or 25 due to the Federal holiday, however sufficient counts were conducted on 26 and 28 December. Pacific harbor seal counts ranged from 0-28 adults. Northern elephant seal counts ranged from 22-29 adults. One dead juvenile California sea lion was observed during the pre-launch count. A detailed report was provided to NMFS dated 25 January 2024.

4.4 Fixed-wing Aircraft, Helicopter and Unmanned Aerial Vehicle Operations

During the reporting period, 7,822 operations were conducted from the VSFB airfield. Most of these consisted of overflights or training and proficiency flights involving practice approaches and touch and goes. Some were logistics flights involving the transfer of supplies, equipment and personnel. The total number of take-offs and landings (including touch and goes) was 4,102; additionally, 3,720 overflights below 2,500 feet in altitude (but not above the coastline), and 349 Unmanned Aerial Systems ("drone") operations were recorded. Distinguished Visitor flights included the Space Systems Command and United States Space Force Commanders.

No indications of significant disturbances, abnormal pinniped behavior, injury, or mortality were reported as a result of these operations (R. Evans, pers. comm. 2024).

4.5 Monthly Marine Mammal Surveys

Monthly surveys were conducted throughout 2023. None of the monthly surveys suggested any changes in haul-out patterns as a result of launches. Table 4 displays the monthly survey results of harbor seals and Table 5 presents the monthly survey results of harbor seals and elephant seals on VSFB from 2014-2023.

4.5.1 Pacific Harbor Seal

Harbor seals use many of the locations along the VSFB coastline to haul out throughout the year. Harbor seals regularly utilize Amphitheater Cove as a rookery, give birth and nurse young from 1 March to 30 June. Mating occurs in the water after pups are weaned. Because harbor seals are not all hauled out on shore at one time, a 1.54 correction factor is applied to the number of hauled out harbor seals observed to account for individuals in the water (Harvey and Goley 2011). All harbor seal counts in this document are calculated and reported based on this correction factor, unless otherwise stated.

Harbor seal totals in 2023 varied from a low of 21 in November to a high of 82 in May (Table 4), with an average monthly count of 47 for the survey period. Pups were observed only in March and April, with a peak of 15 in March 2023. Two adult and 4 pup harbor seal mortalities were recorded in 2023.

On North VSFB, the Spur Road haul out had the most individuals observed with a peak of 11 in both July and December 202e (Table 6) and Little Sal had the least individuals observed. On South VSFB, Amphitheater consistently had the most individuals observed. Amphitheater had a peak of 62 in May 2022 (Table 6). East Islet and South Arguello Ridge were not surveyed. North Rocky Point, South Rocky Point, First Cove, and Harbor Seal Beach were among several surveyed locations with no harbor seals recorded.

Table 4. 2023 Monthly Pacific Harbor Seal Survey Results[1]

Month	Adult	Juvenile	Pup	Total
January	69	0	0	69
February	52	0	0	52
March	51	0	15	66
April	37	0	12	49
May	79	3	0	82
June	46	1	0	47
July	50	0	0	50
August	34	2	0	36
September	29	0	0	29
October	24	0	0	24

November	21	0	0	21
December	39	0	0	39

[1]Numbers reflect 1.54x correction factor

There has been significant variation in the number of harbor seals utilizing Amphitheater Cove from 2014 through 2023 (Table 5). A drastic increase occurred from 2014 to 2015 and a decrease occurred from 2016 to 2023. This is not a product of survey intensity as a survey was conducted nearly every month for all 8 years at Amphitheater Cove. One explanation could be the increased use of Amphitheater by elephant seals, discussed further in Section 4.5.2. When looking at the data presented in Tables 5 and 6, it is notable that from 2014 to 2015 when harbor seal numbers increased, the elephant seal numbers remained relatively similar. From 2015 to 2016 harbor seal numbers stayed relatively similar while elephant seal numbers significantly increased. From 2016 to 2020 the harbor seal numbers decreased dramatically and the elephant seal numbers dramatically increased, a significant increase was noted in 2021 and 2022. It is not directly known if use of Amphitheater by elephant seals is affecting the number of harbor seals utilizing the site, or if another unknown factor is contributing to this affect. In 2017-2022, both harbor seals and elephant seals utilized the Amphitheater haul out for giving birth and weaning pups.

Table 5. Historic Pacific Harbor Seal and Northern Elephant Seal Survey Results at Vandenberg Space Force Base

	Pacific Harbor Seals[1]			**Northern Elephant Seals[2]**		
Year	**Average**	**Total**	**Highest Count (Month)**	**Average**	**Total**	**Highest Count (Month)**
2014	4	37	23 (December)	3	31	24 (April)
2015	178	1962	590 (October)	1	12	10 (June)
2016	130	1428	339 (May)	19	213	84 (November)
2017	37	450	80 (February)	58	692	197 (October)
2018	35	414	131 (June)	77	919	209 (November)
2019	26	310	57 (April)	100	1202	300 (May)
2020	32	382	77 (April)	78	930	302 (May)
2021	57	685	162 (June)	85	931	195 (May)
2022	83	998	154 (June)	84	1007	209 (October)
2023	47	564	82 (May)	53	633	122 (May)

1-Numbers reflect 1.54x correction factor for PHS, rounded to nearest whole number
2-More than 90% of NES observations are limited to "Amphitheater Cove"

4.5.2 Northern Elephant Seal

Elephant seals historically hauled out in low numbers on VSFB beaches, with a total of 10 elephant seals observed on monthly counts between 2007 and 2010. Beginning in 2013, greater than average numbers of elephant seals were observed at South Rocky Point with numbers peaking for the decade at 191 individuals, primarily sub-adult males, in November 2013 (MSRS 2014). Greater than average numbers were again reported in 2014, with a total of 237 observations. There were smaller numbers in 2015 with a total of 41 individuals observed (likely due to South Rocky Point not being surveyed during the majority of months), and again, an increase in 2016 with a total of 288. A very significant increase began in 2017, with a total of 916 animals observed in 2017, 919 in 2018, 1,345 in 2019, 1,396 in 2020, and 1,015 in 2021. This trend showed a minor decrease in 2021 and 2022, with a total of 633 elephant seals detected during 2023 surveys (Table 7). These numbers peaked in May with 122 elephant seals counted. Two confirmed elephant seal mortalities were recorded (July and August) reported to NMFS (R. Evans, pers. comm., 2024). No formal surveys occurred at Point Conception in 2023, primarily due to access restrictions deemed necessary by The Nature Conservancy, land managers for the Jack and Laura Dangermond Preserve (which is located between VSFB and Point Conception).

Table 6. 2023 Monthly Northern Elephant Seal Results.

Month	Adult	Juvenile	Pup	Total
January	32	0	10	42
February	27	6	29	62
March	35	0	19	54
April	7	72	7	86
May	0	122	0	122
June	47	0	0	47
July	20	0	0	20
August	1	0	0	1
September	19	0	0	19
October	68	0	0	68
November	76	0	0	76
December	17	19	0	36

Elephant seal pupping was first documented at Amphitheater Cove in January 2017, with pups documented on 09 Jan 2017 during routine monthly surveys. In 2017, a maximum of 19 pups were observed. Twenty-five elephant seal pups were observed in 2018, 31 in 2019, 34 in 2020

33 in 2021, 20 in 2022 and about 46 in 2023. Since 2018, the Air Force has conducted additional surveys of Amphitheater Cove in order to document pupping in late December and early January with intent to record the first pup each season, which we then compare to other regional pupping locations. As of February 2024, we have not observed elephant seal pups on any Vandenberg rookery earlier than 3 January.

In early March 2019, VSFB and scientists affiliated with the California Polytechnic State University, San Luis Obispo (Cal Poly-SLO) flipper tagged 25 elephant seal pups under authority of permit 19108-01, issued to Dr. Daniel Costa (University of California at Santa Cruz). Dr. Heather Liwanag (Cal Poly-SLO) obtained a permit under her name (#22187); her team tagged 34 elephant seal pups on 29 February 2020; and 35 tagged in late Feb 2021. A fifth year of flipper tagging occurred in late February 2023, and VSFB has secured funding for a three-year satellite telemetry tagging project in cooperation with Dr. Liwanag, which started in 2022.

4.5.3 California Sea Lion

During 2023, the highest number of California sea lion observations was 82 adults and 9 juveniles in June (Table 8). This is a decrease from 2022, for unknown reasons (Table 9). Typically California sea lions haul out at North Rocky Point, recently with more frequent hauled-out individuals observed at Amphitheater and South Rocky Point. The large increase in sub-adult California sea lion counts, as seen in 2018 and 2019 (Table 9) did not occur in 2020-2023, for reasons unknown (but not believed to be in any way related to Vandenberg operations).

Table 7. 2023 Monthly California Sea Lion Results

Month	Adult	Juvenile	Pup	Total
January	1	0	0	1
February	4	0	0	4
March	9	0	0	9
April	3	0	0	3
May	56	0	0	56
June	84	0	0	84
July	82	9	0	91
August	0	0	0	0
September	9	0	0	9
October	7	0	0	7
November	0	0	0	0
December	2	0	0	2

Table 8. Historic and Current Summary of California Sea Lion Survey Results

Year	Average	Total	Highest Count (Month)

2011	4	45	21 (Jul & Sep)
2012	33	398	150 (Aug)
2013	4	53	25 (Jan)
2014	136	1366	416 (May)
2015	18	201	156 (Jan)
2016	11	118	39 (Sep)
2017	21	255	68 (Sep)
2018	175	2103	980 (May)
2019	259	3111	1122 (June)
2020	14	167	62 (July)
2021	12	126	72 (June)
2022	18	216	112 (May)
2023	22	266	91 (July)

Historically, stillborn pups have been irregularly detected at North Rocky Point and pregnant California sea lions observed were usually sick or in poor condition (MSRS 2015); therefore, North Rocky Point is not considered a rookery.

As detailed above, from 2017-2019, the Air Force observed enormous increases in early summer use of (primarily) the South Rocky Point haul-out by (mostly) juvenile and sub-adult California sea lions. It is possible that a majority of these animals are "displaced" as a result of increasingly high numbers of both California sea lions and elephant seals at the NCI. Also as noted above, this phenomenon has NOT reoccurred since 2019.

In 2023, at least 31 California sea lion mortalities were confirmed and reported, This contrasts with 2019, in which more than 80 California sea lions were found dead on VSFB beaches, and more than 1,600 were found dead between San Luis Obispo and Orange Counties (NMFS, J. Greenman, 2019, unpublished data). However it is significantly higher than 7 mortalities recorded at VSFB in 2021. These deaths were primarily attributed to domoic acid toxicity, though a smaller number were likely due to natural causes, predation by great white sharks and other factors.

4.5.4 Steller Sea Lion

Steller sea lions were first reported on VSFB at North Rocky Point in April 2012 during a monthly count (MMCG and SAIC 2013). Since May 2012 they have been observed irregularly in low numbers on North Rocky Point (MMCG and SAIC 2013, MSRS 2014, 2015; prior year LOA reports). There are approximately 65 breeding rookeries and more than 300 haul-outs utilized by Steller sea lions across their range (Fisheries and Oceans Canada 2010) (Figure 3). The range of the Steller sea lion stretches from Japan to Alaska to southern California, and there are two distinct populations, the western population and the eastern population (separated at 144° W longitude

(near Cape Suckling, just east of Prince William Sound, Alaska (Alaska Fisheries Science Center 2015; Figure 5).

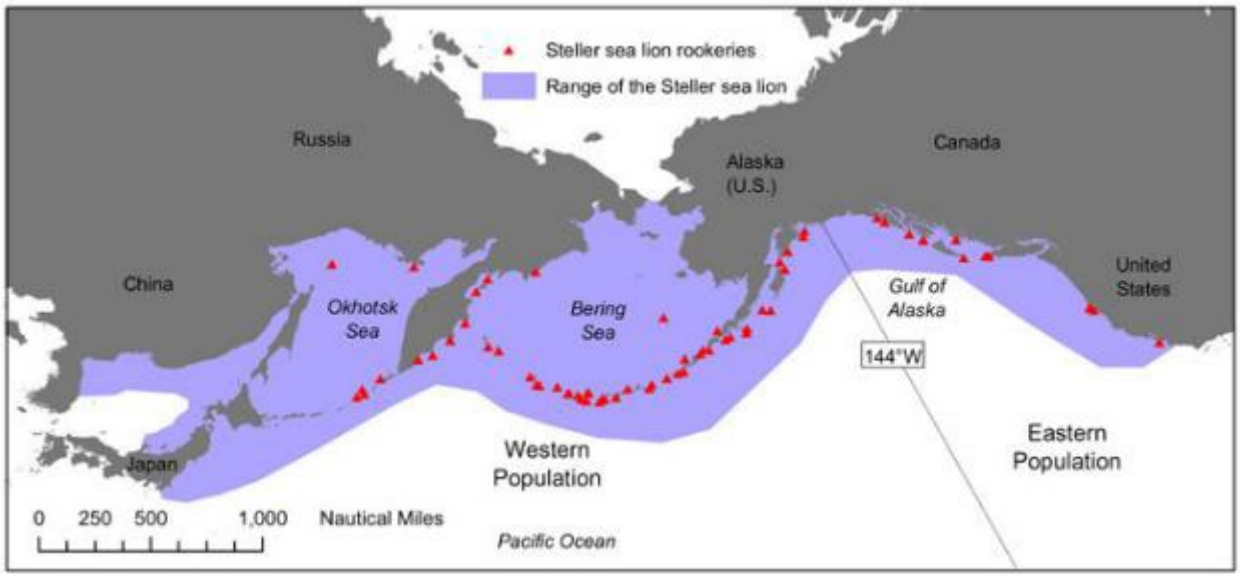

Figure 3. Steller Sea Lion Range and Rookeries (Alaska Fisheries Science Center 2015).

Steller sea lions are non-migratory, but they will disperse long distances from natal rookeries throughout the year (Bigg 1985). Availability of forage fish is likely the primary factor driving Steller sea lion use of widely dispersed haul-outs like North Rocky Point (Fisheries and Oceans Canada 2010). Prior to May 2012, Steller sea lions had not been observed during VSFB monthly counts for 20 years). Studies in British Columbia document Steller sea lions returning to historical haul outs after decades of abandonment or extirpation (Bigg 1985).

No Steller sea lions were observed during 2023 monthly surveys on VSFB. No Steller sea lion mortalities were documented in 2023 (R. Evans, pers. comm., 2023).

4.5.5 Incidental Sightings

One deceased Olive ridley sea turtle was observed in April and one deceased Northern fur seal was detected in May. Vandenberg reported both of these mortalities to NMFS.

Several incidental sightings of non-pinniped marine mammals or other notable observations occurred during 2023 surveys. One of the more common incidental observation is of southern sea otters (*Enhydra lutris nereis*) which are often detected using the boat harbor kelp bed area. Sea otters documented in this area include: seven in May.

5 Discussion

5.1 Effects of Natural Factors

Both seasonal and cyclic effects have been discussed in previous documents with haul-out numbers being affected by high tides, strong surf, pupping, breeding, and molting seasons (MMCG & SAIC 2012a and 2012b). Landslides also affect available haul-out locations, such as the continued landslide at Weaner Cove (MMCG & SAIC 2012b), which continues to be monitored (MSRS 2014, 2015, CEMML 2016a, 2018). Predation risk from coyotes (*Canis latrans*) can make harbor seals wary of hauling out (Gearin *et al.* 1990; MMCG & SAIC 2012a), causing them to haul out in fewer numbers and quickly reacting to any movement from shore or from the bluffs. Some evidence suggests that there may be an increase in white shark (*Carcharodon carcharias*) predation on harbor and elephant seals in the region, which may be a contributing factor in the declining number of harbor seals observed on VSFB (MMCG & SAIC 2011 and 2012b); however, more study would be required to determine if sharks are having a significant impact on this population. Additionally, elephant seals have become more prevalent at Amphitheater Cove as they have established rookery. It is unknown what effect this is having or may have on harbor seals' use of Amphitheater Cove in the future; they continue to use this site as a rookery.

5.2 Effects of VSFB Operations

Five SpaceX "boost back" and terrestrial landings occurred at VSFB in 2023. These are likely to become more frequent in the near future, with as many as 12 planned for 2024. There was no evidence of injury, mortality, or abnormal behavior as a result of missile or any rocket launches. No abnormal activity or mortalities were observed during the active monitoring of seven rocket launches this year or during monthly marine mammal surveys. No observations indicated that activities associated with airfield operations caused any significant effects on pinniped counts, or have caused injury, mortality, or significant abnormal behavior.

6 Conclusion

Nineteen rocket launches required monitoring; all concluded that no abnormal behavior, injuries, or mortalities resulted from the launch of any rocket, landing of Falcon 9 first stages, and their associated sonic booms. In prior years, consistent results have been obtained showing no indications of significant disturbances, abnormal behavior, injury, or mortality as a result of launch or aircraft operations. Responses to launches, when they did occur, were short-lived and insignificant. VSFB recommends that we continue to discuss reduction of future monitoring requirements.

Monthly surveys provided routine assessment of potential effects of launch operations on pinniped populations at VSFB. Fluctuations in monthly counts were mostly due to environmental conditions, such as natural landslides and changing tides, rather than the disturbances associated with the launches. Monthly pinniped counts across VSFB show a cyclical, but stable population of harbor seals hauled out on VSFB and an unusually high number of California sea lions hauled

out on VSFB during early summer months, however not since 2020. Elephant seal pupping continued for a seventh year.

7 Literature Cited

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