

**ANNUAL REPORT
LETTERS 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**

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Photo Credit: <http://www.sealion-world.com/steller-sea-lion/>

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Table of Contents

Executive Summary.....	iii
1.0 Introduction	1
2.0 VAFB Operations.....	1
2.1 Space Vehicle Launches	1
2.2 Missile Launches	2
2.3 Fixed-wing Aircraft and Helicopter Operations	2
3.0 Methods.....	5
3.1 Sonic Boom Modeling	5
3.2 Launch Monitoring.....	5
3.3 Acoustic Measurements	5
3.4 Launch Mitigation Requirements Overview	5
3.5 Monthly Surveys	6
3.6 Fixed-wing Aircraft and Helicopter Operations	7
4.0 Results.....	6
4.1 Sonic Boom Modeling	6
4.2 Launch Monitoring.....	6
4.2.1. Atlas V NROL-55	Error! Bookmark not defined.
4.2.2. MM III GT-214 and MM III GT-215GM.....	Error! Bookmark not defined.
4.2.3. MM III GT-212GM	9
4.3 Monthly Marine Mammal Surveys	10
4.4 Fixed-wing Aircraft and Helicopter Operations	9
5.0 Discussion.....	9
5.1 Effects of Natural Factors	9
5.2 Effects of VAFB Operations.....	9
6.0 Conclusions and Recommendations.....	10
7.0 Literature Cited	10

Tables

Table 1. Space Vehicle Launches in 2016.....	2
Table 2. Missile Launches in 2016.....	2
Table 3. Launch Mitigation Requirements during the 2016 reporting period.	5
Table 4. Sonic Boom Modeling Results.....	6

Figures

Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB.....	3
Figure 2. Launch Sites and Pinniped Haul-out Areas on North VAFB.....	4
Figure 3. Monthly pinniped survey count totals for harbor seals from February 2015 through December 2016.....	7
Figure 4. Monthly pinniped survey count totals for Northern elephant seals, California sea lions, and Steller sea lions from January 2015 through December 2016	8

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 permit for the incidental harassment of marine mammals (NOAA 2014a), and with a Letter of Authorization (LOA) issued by NOAA to the U.S. Air Force, Vandenberg Air Force Base (VAFB), 30th Space Wing (NOAA 2014b). This report describes pinniped monitoring conducted in association with space vehicle and missile launches, together with fixed-wing aircraft and helicopter operations. Species of concern at VAFB listed in the LOA include 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 space vehicles, the Northern fur seal (*Callorhinus ursinus*) and Guadalupe fur seal (*Arctocephalus townsendi*) are considered species of concern in addition to the four species mentioned for VAFB.

During the reporting period (1 January 2016 to 31 December 2016) there were three space vehicles launched from VAFB. Pinniped monitoring was not required on VAFB for these three launches since they fell outside of the harbor seal pupping season (1 March through 30 June). Sonic booms that would trigger monitoring requirements were not predicted to impact the Northern Channel Islands (NCI) for any of the 2016 launches, therefore monitoring on the NCI was not required (R. Evans, pers. comm., 2016). No Auditory Brainstem Response (ABR) studies were required for any rocket launches because such testing had already been performed for these vehicles (SRS 1999).

Four missile or related vehicle launches occurred from Launch Facilities (LF) 04, 09, 10, and 23 on north VAFB during the reporting period. The westward trajectory of these launches did not necessitate sonic boom modeling for the NCI, so biological monitoring on the NCI was not required. None of these three unarmed Minuteman III (MM III) missiles or one Controlled Test Vehicle (CTV) launches occurred within the harbor seal pupping season, so no pinniped monitoring was required.

During the reporting period, 8,712 operations were conducted from the VAFB airfield. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm., 2017).

1.0 Introduction

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 permit for the incidental taking of marine mammals (NOAA 2014a). This rule was issued on 24 February 2014 and is valid through 26 March 2019. This report is also in accordance with a Letter of Authorization (LOA) issued by NMFS to the United States Air Force, Vandenberg Air Force Base (VAFB), 30th Space Wing. The LOA covers the period from 26 March 2014 through 26 March 2019 (NOAA 2014b).

In accordance with a new condition in the 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," VAFB has agreed to send quarterly advisories and updates to NOAA. These quarterly advisories were submitted in January, April, July, and October 2016 (R. Evans, pers. comm., 2017).

Harbor seals (*Phoca vitulina*) are the most abundant pinnipeds on VAFB. California sea lions (*Zalophus californianus*), Northern elephant seals (*Mirounga angustirostris*), and Steller sea lions (*Eumetopias jubatus*) are also present, with the latter two species increasing in recent years (MSRS 2014b, CEMML 2016a, CEMML 2016b). Potential impacts to these species on VAFB include harassment from rocket or missile launch or aircraft noise, particularly sonic booms, which may result in a startle response. In some cases, sudden disturbances from a variety of causes have resulted in the trampling of pups by adult animals, resulting in injuries or mortalities. Other potential noise impacts include temporary [hearing] 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 [hearing] threshold shift (PTS), in which the animal's hearing is permanently diminished over part or all of its hearing range.

During this reporting period, no monitoring was required for either space vehicle launches or missile launches. This report describes the methods and results of the marine mammal mitigation efforts and discusses the impacts of Air Force operations.

In July of 2016, "informal consultation" under the United States Endangered Species Act between the U.S. Air Force and NMFS concluded, with concurrence that VAFB space launch activities are "not likely to adversely affect" the Guadalupe fur seal on the Northern Channel Islands.

2.0 VAFB Operations

2.1 Space Vehicle Launches

Three space vehicle launches occurred during the reporting period, from Space Launch Complexes (SLC) 3, SLC-4, and SLC-6 on VAFB (Table 1). The locations of these sites in relation to pinniped haul-out areas on VAFB are shown in Figures 1 and 2.

Table 1. Space Vehicle Launches in 2016

Vehicle Type	Facility	Launch Date
Falcon 9 Jason-3	SLC 4	17 January
Delta IX NROL-45	SLC 6	10 February
Atlas V WORLDVIEW-4	SLC-3	11 November

2.2 Missile Launches

Four missile launches occurred during the reporting period from Launch Facilities (LF) on north VAFB from LF-04, LF-09, LF-10, and LF-23 (Table 2; Figure 2). Three of the launches were unarmed Minuteman III (MM-III) Intercontinental Ballistic Missiles (ICBMs) test launches and one was a Control Test Vehicle (CTV) launch by the Missile Defense Agency (MDA).

Table 2. Missile Launches in 2016

Missile Type	Facility	Launch Date
CTV-02	LF-23	28 January
MM III GT-217GM	LF-09	21 February
MM III GT-218GM	LF-10	26 February
MM III GT-219GM	LF-04	05 September

2.3 Fixed-wing Aircraft and Helicopter Operations

Various types of fixed-wing aircraft fly from VAFB. All aircraft are required to maintain a 1000-foot buffer, or “bubble,” around pinniped haul-out and rookery sites; in other words, they must stay 1000 feet above or around any pinniped site. Exceptions can be made if an emergency search and rescue operation, a security breach or an aircraft emergency occurs.

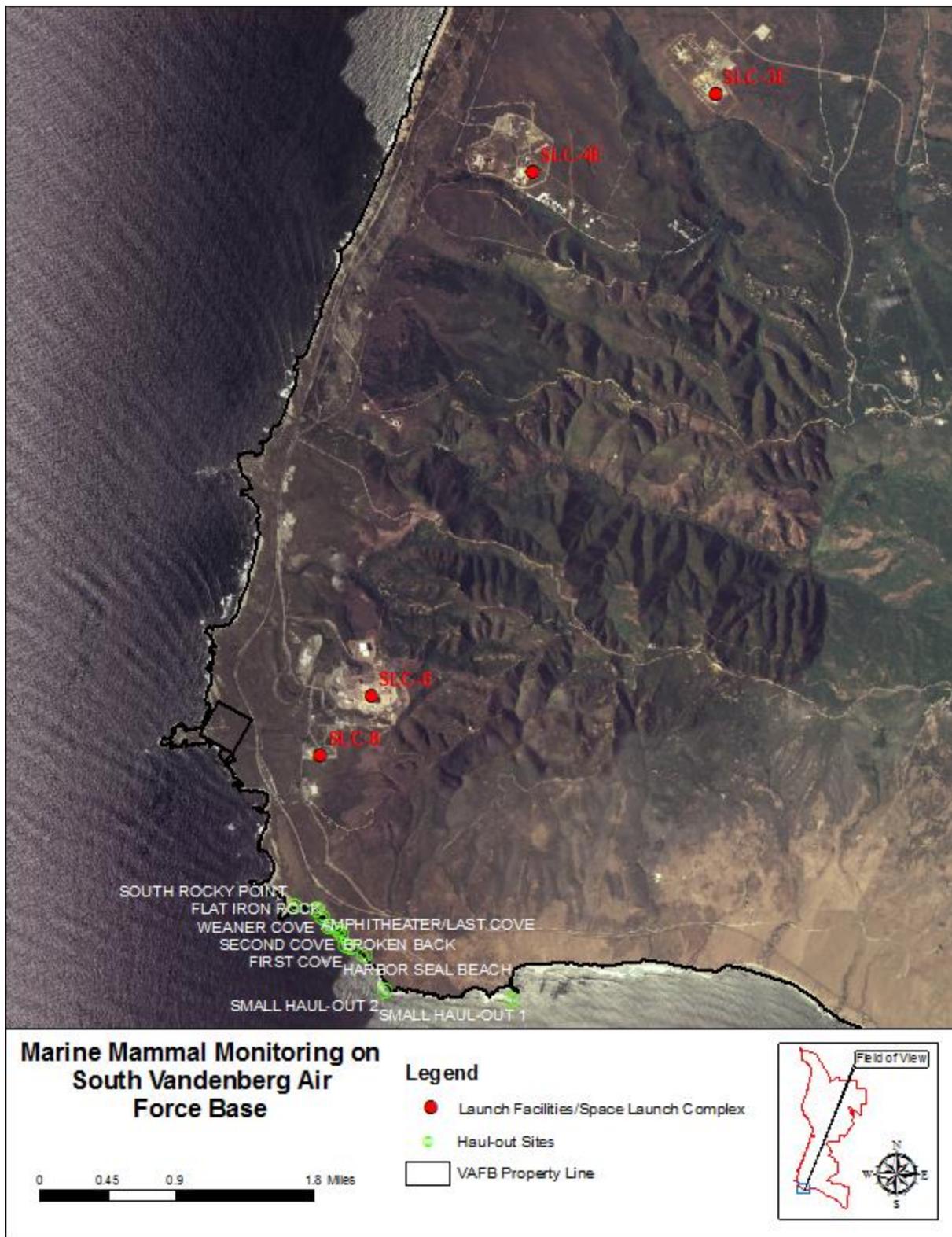


Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB.

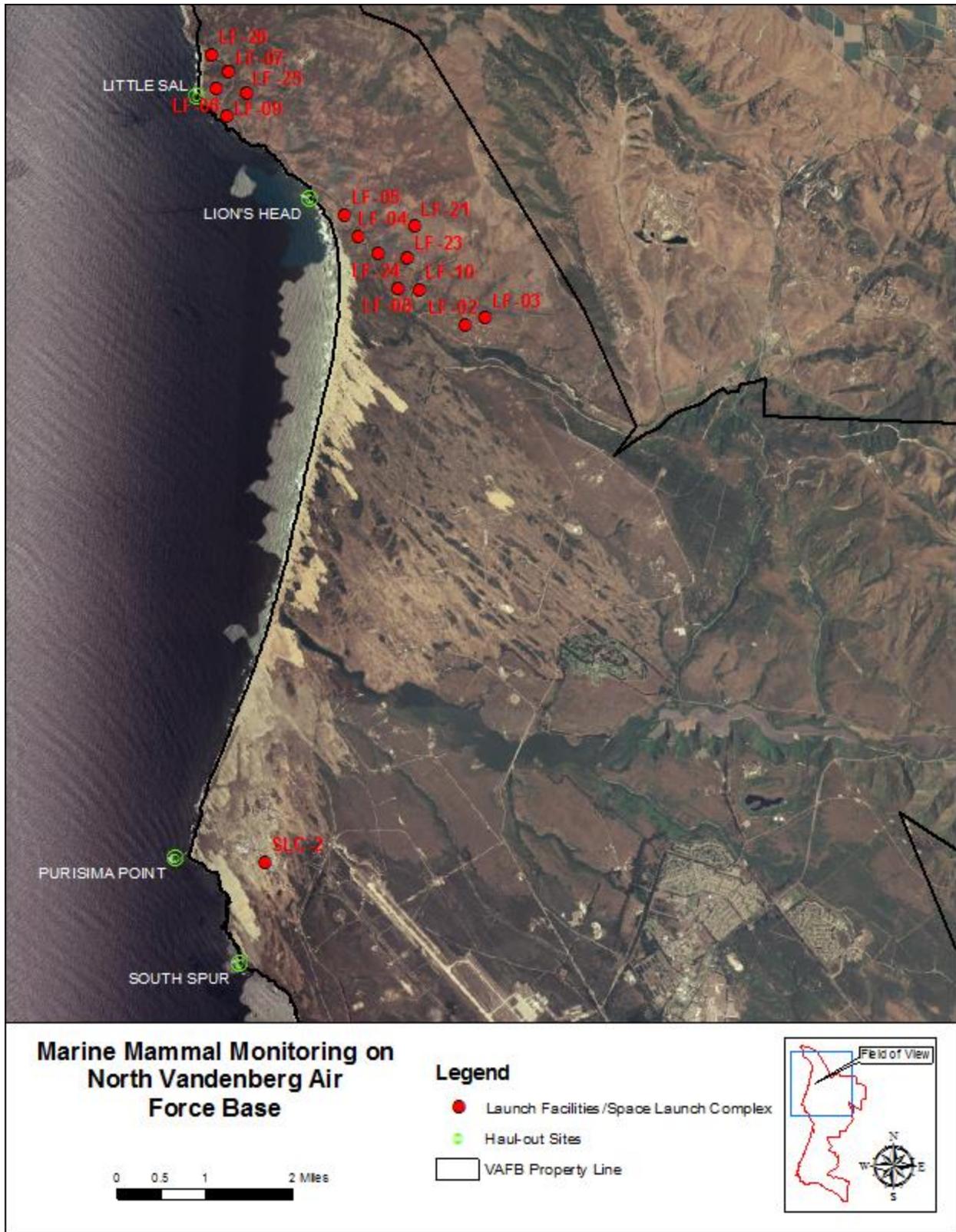


Figure 2. Launch Sites (several of which are inactive) and Pinniped Haul-out Areas on North VAFB.

3.0 Methods

3.1 Sonic Boom Modeling

As required in the LOA, sonic boom modeling was performed prior to all three space launches. Modeling was not necessary for the missile launches because GT and CTV vehicles are launched with a westward trajectory and their sonic booms do not impact marine mammal haul-outs on VAFB or the NCI (NOAA 2014b). The modeling programs incorporated 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 included the presence or absence of the jet stream, and if present, its direction, altitude, and velocity. The type, altitude, and density of clouds were also considered. From these data, the models predicted peak amplitudes and impact locations.

3.2 Launch Monitoring

Per the 2014 LOA, monitoring on the NCI is required if sonic boom modeling predicts a sonic boom greater than 1 psf is likely to impact one or more of the NCI between 1 March and 30 June, greater than 1.5 psf between 1 July and 30 September, and greater than 2 psf between 1 October and 28 February. Pinniped monitoring is required on VAFB if a launch occurs during harbor seal pupping season (1 March through 30 June). Monitoring must begin at least 72 hours prior to each launch and continue to 48 hours after the launch. During pupping season, follow-up monitoring must be conducted on VAFB two weeks after each launch. Monitoring must be conducted as close to the launch window as possible. During the 2016 reporting period, monitoring on NCI and VAFB was not required for any launches.

3.3 Acoustic Measurements

Acoustic monitoring was not required for any of the launches during the 2016 reporting period.

3.4 Launch Mitigation Requirements Overview

Table 3. Launch Mitigation Requirements during the 2016 reporting period

Vehicle or Missile	Launch Date	NCI Monitoring	VAFB Monitoring	ABR Testing	Boom Model	Acoustics	Video
Falcon 9 Jason-3	17 January	N/R	N/R	N/R	Required	N/R	N/R
CTV-02	28 January	N/R	N/R	N/R	N/R	N/R	N/R
Delta IX NROL-45	10 February	N/R	N/R	N/R	Required	N/R	N/R
MM III GT-217GM	21 February	N/R	N/R	N/R	N/R	N/R	N/R
MM III GT-218GM	26 February	N/R	N/R	N/R	N/R	N/R	N/R
MM III GT-219GM	05 September	N/R	N/R	N/R	N/R	N/R	N/R
Atlas V WORLDVIEW-4	11 November	N/R	N/R	N/R	Required	N/R	N/R

N/R = "not required"

3.5 Monthly Surveys

Monthly pinniped surveys were performed at all significant haul-out sites on north and south VAFB (Figures 1 and 2) during the reporting period, except for Purisima Point. Purisima Point was omitted because the Center for Environmental Management of Military Lands (CEMML) and U.S. Air Force 30th Civil Engineer Squadron (30 CES) biologists conducting the surveys were not permitted Western snowy plover monitors and are not authorized to enter snowy plover breeding habitat during breeding season (1 March to 30 September) (FWS, 2014). The site was not included in the remaining months in order to keep data consistent throughout the year. On north VAFB, observations were made from the cliff overlooking the Lion’s Head and Little Sal haul-outs and from the sand dunes adjacent to the haul-out site at Spur Road. On south VAFB, observations at each haul-out site were made from several vantage points on the cliffs overlooking the site. Observers kept a low profile near all haul-out sites to reduce disturbances to the animals. To the extent possible, surveys were timed to coincide with the lowest monthly afternoon low tides (time of day with highest number of animals hauled out). The location, species, number of individuals, age class, and sex (when possible) was recorded. Ocean and weather conditions were also recorded.

3.6 Fixed-wing Aircraft and Helicopter Operations

Records were obtained from the VAFB Airfield (30 OSS/OSAB) by the CEI Staff to determine the number and nature of flights performed during the reporting period (R. Evans, pers. comm., 2017).

4.0 Results

4.1 Sonic Boom Modeling

Sonic boom modeling was conducted for the three space vehicle launches that occurred during the 2016 reporting period. The following table summarizes the results of the modeling effort.

Table 4. Sonic Boom Modeling Results

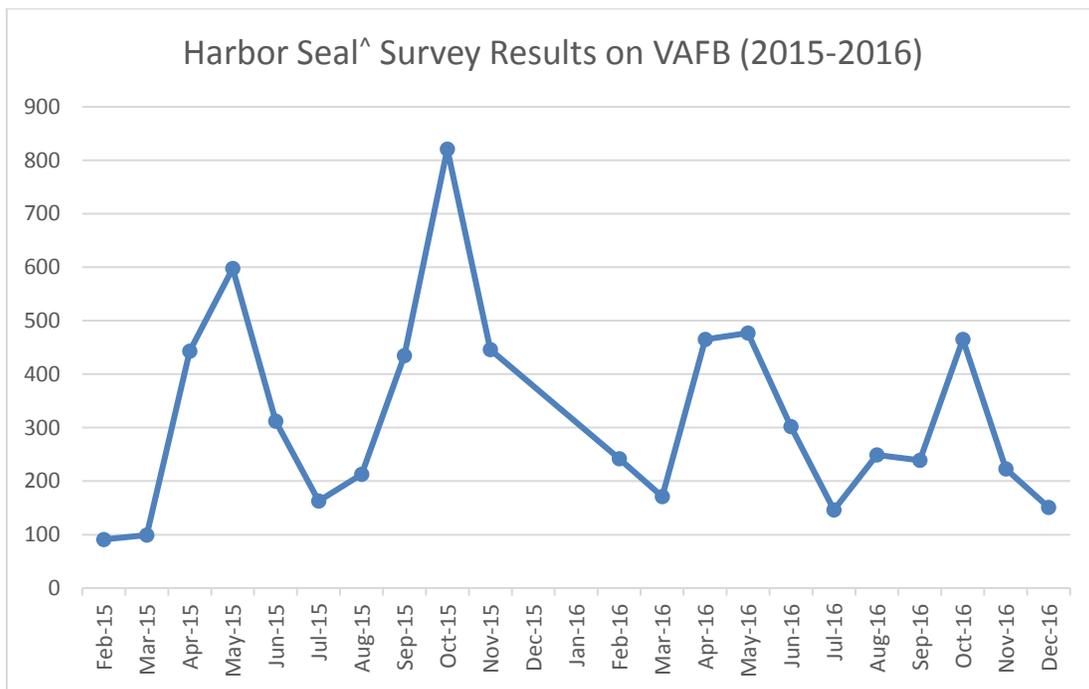
Vehicle	Sonic Boom Modeling Results
Falcon 9 Jason-3	No booms impacting NCI
Delta IX NROL-45	No booms impacting NCI
Atlas V WORLDVIEW-4	No booms impacting NCI

4.2 Launch Monitoring

No launch monitoring was required for either space launch vehicles or missiles during the 2016 reporting period.

4.3 Monthly Marine Mammal Surveys

The results of monthly marine mammal surveys on VAFB are reported to NOAA Fisheries annually in a separate report. Further details of the following summary can be found in the marine mammal annual report [CEMML] 2016b). None of the monthly surveys suggested any changes in haul-out patterns as a result of the launches. Figure 3 indicates the monthly survey results of harbor seals on VAFB during 2015 and 2016 and Figure 4 indicates the monthly survey results of Northern elephant seals, California sea lions, and Steller sea lions during 2015 and 2016 on VAFB. Harbor seal numbers appear to be generally steady, with monthly and seasonal variation. Data from the past two years indicates a general peak in numbers around October with the lowest numbers generally in July (Figure 3).



^Numbers reflect a 1.54 correction factor to correct for animals in the water that were not counted during the survey. This correction factor is also utilized by NMFS.

Figure 3. Monthly pinniped survey count totals for harbor seals from February 2015 through December 2016 (CEMML 2016a, 2016b, unpublished data).

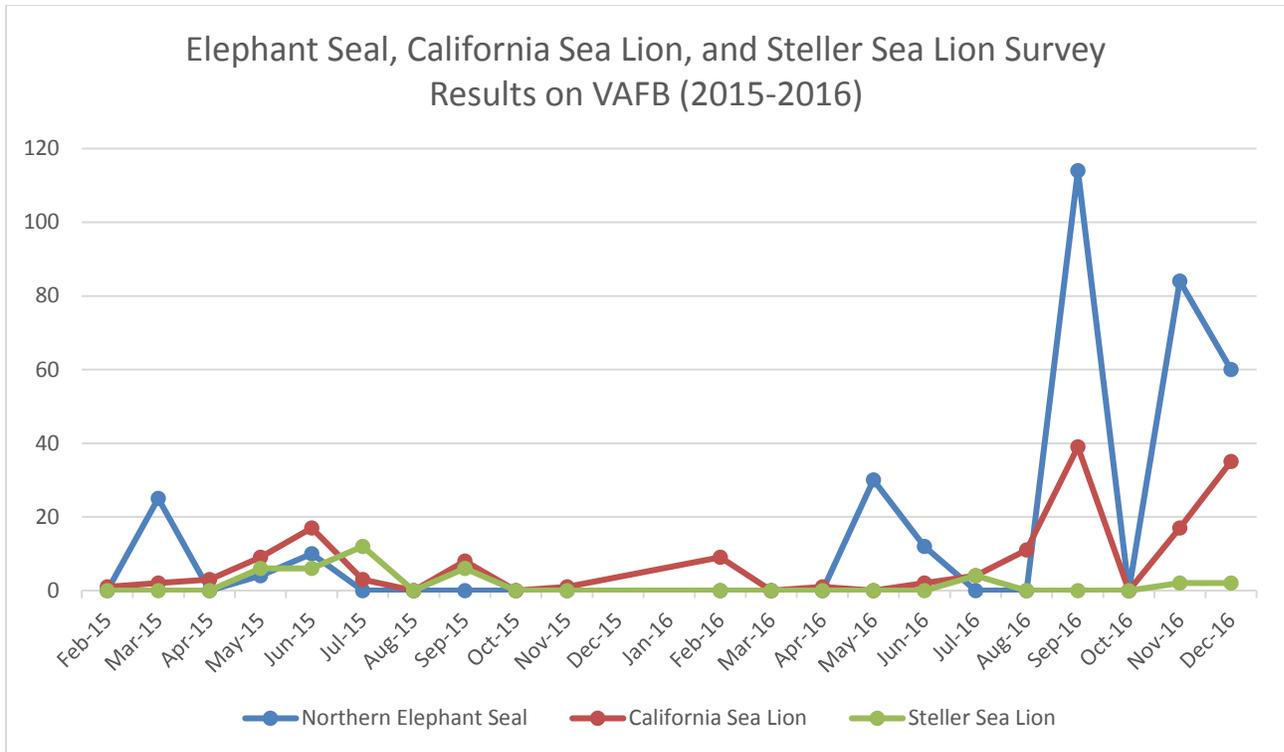


Figure 4. Monthly pinniped survey count totals for Northern elephant seals, California sea lions, and Steller sea lions from January 2015 through December 2016 (CEMML 2016a, 2016b, unpublished data).

The number of Northern elephant seals observed during monthly pinniped surveys on VAFB increased during the 2016 survey period with the largest number observed in September 2016 with 114 individuals and the total for the year being 300. There has been a steady increase in the number of Northern elephant seals observed during surveys with 2007-2010 only finding 10 during monthly surveys (MSRS 2015a). In 2013 numbers of Northern elephant seals increased to 191 individuals (MSRS 2015a) and 163 individuals (URS 2013) observed at South Rocky Point during different times. In 2014 increased numbers were again reported, with a total of 239 Northern elephant seal observations (MSRS 2015a). Only 39 individuals were observed during 2015 surveys, but this is likely due to South Rocky Point not being included in the survey (CEMML 2016a). So far, observations have been almost entirely of either juvenile males and/or juvenile/adult females (MSRS 2015a, CEMML 2016a, CEMML 2016b).

Routine observations of California sea lions were recorded throughout the 2015 and 2016 reporting period primarily North Rocky Point (CEMML 2016a, 2016b, unpublished data). Numbers have increased in 2016, partially due to surveying the western end of North Rocky Point via spotting scope from the western end of South Rocky Point. This location was discovered when vocalizations could be heard but sea lions (both California and Steller) were not readily visible. This new area was surveyed in the last few months of 2016.

A total of 8 Steller sea lions were recorded during 2016 surveys (CEMML 2016b, unpublished data), this is a slight decrease from previous years. In 2015 there were a total of 30 Steller sea

lions observed (CEMML 2016a) and in 2014 a total of 14 observed. It is unlikely that launch activity on VAFB negatively affected Steller sea lion populations, as North Rocky Point has become an increasingly popular haul-out location over the past two years (MSRS 2015a, CEMML 2016a, 2016b)

4.4 Fixed-wing Aircraft and Helicopter Operations

During the reporting period, 8,712 operations were conducted from the VAFB 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. Many were also overflights, which were below 2,500 feet in altitude. The total number of take-offs and landings (including touch and goes) was 3,034. The total number of low altitude flights that did not use our airfield was 5,678. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm. 2017).

5.0 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 2014a, 2015a, CEMML 2016). 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 seals in the region, which may be a contributing factor in the declining number of harbor seals observed on VAFB (MMCG & SAIC 2011 and 2012b); however, more study would be required to determine if sharks are having a significant impact on this population. In 2016, VAFB Natural Resources staff reported 6 southern sea otter (*Enhydra lutris nereis*) mortalities to the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife.

5.2 Effects of VAFB Operations

There was no evidence of injury, mortality, or abnormal behavior as a result of the rocket, missile, or control test vehicle launches. Though no active monitoring was required for these launches, no abnormal activity or mortalities were observed in general or during monthly marine mammal surveys. Activities associated with airfield operations did not cause any significant effects on pinniped counts, nor cause injury, mortality, or significant abnormal behavior.

6.0 Conclusions and Recommendations

No launch monitoring was required for the report period and monthly surveys provided routine assessment potential effects of launch operations on pinniped populations at VAFB. In previous 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. In the past, responses to launches, when they did occur, were short-lived and of no significance. 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 VAFB show a cyclical, but stable population of harbor seals hauled out on VAFB (Figure 3).

There has been ongoing discussions between VAFB and NMFS regarding possibly eliminating all pinniped monitoring during and after ballistic missile test launches. It is anticipated that this requirement will be eliminated in early 2017.

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