

**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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Executive Summary

This report is prepared in accordance with [two](#) National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS; also called NOAA Fisheries Service) five-year permits for the incidental harassment of marine mammals (NOAA 2009, [NOAA 2014a](#)), and with two Letters of Authorization (LOAs) issued by NOAA to the U.S. Air Force, Vandenberg Air Force Base (VAFB), 30th Space Wing (NOAA 2013a and 2014b). [The report is also required in support of VAFB's pending request to renew the current LOA.](#)

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 LOAs include Pacific harbor seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*). At San Miguel Island (SMI), which is occasionally impacted by sonic booms from space vehicles, the northern fur seal (*Callorhinus ursinus*) is considered a species of concern in addition to the three species mentioned for VAFB.

During the reporting period (1 December 2013 to 31 December 2014) there were five space vehicles launched from VAFB. Pinniped monitoring was not required on VAFB for the Atlas V NROL-39, Delta II OCO, and Atlas V Worldview III launches since they fell outside of the harbor seal pupping season (1 March through 30 June). Pinniped monitoring was performed on VAFB and Santa Rosa Island (SRI) for the Atlas V DMSP-19 launch in April 2014. Pinniped monitoring was performed on San Miguel Island (SMI) for the Atlas V NROL-35 launch in December 2014. Sonic booms that would trigger monitoring requirements were not predicted to impact the NCI for the Atlas V NROL-39 (6 December 2013), Delta II OCO (2 July 2014), or the Atlas V Worldview III (13 August 2014) launches, therefore monitoring on the NCI was not required. Auditory Brainstem Response (ABR) testing was not required for any launches during the reporting period. The Atlas V DMSP-19 and Atlas V NROL-35 launches caused temporary disturbance, but no discernible affect to daily count numbers, which were similar or greater during post-launch monitoring, and no injury or mortality.

Three missile launches occurred from 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. Of the three missile launches, only the Missile Defense Agency (MDA) Flight Test Ground Based Interceptor – 06b (FTG-06b) occurred within the harbor seal pupping season, requiring pinniped monitoring on VAFB. There were no indications of disturbances, abnormal behavior, injury or mortality as a result of the MDA FTG-06b launch. No ABR studies were required for the missile launches because such testing had already been performed for this type of vehicle.

During the reporting period, 7,400 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.

1.0 Introduction

This report is prepared in accordance with ~~a~~two National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS; also called NOAA Fisheries Service) five-year permits for the incidental harassment of marine mammals (NOAA 2009, [NOAA 2014a](#)). This permit was issued on 7 February 2009 and was valid through 7 February 2014. [A renewal was issued on 24 February 2014 and is valid through March 26, 2019](#). This report is also in accordance with two Letters of Authorization (LOAs) issued by NOAA to the United States Air Force, Vandenberg Air Force Base (VAFB), 30th Space Wing. The LOAs cover the periods from 7 February 2013 through 6 February 2014, and from 26 March 2014 through 26 March 2019, respectively (NOAA 2013a and 2014b). The period covered by this report extends from 1 December 2013 through 31 December 2014, thus overlapping the two LOAs.

In accordance with the new term 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. ~~During 2014,~~ These quarterly advisories ~~have been~~were submitted in April, July, and October, ~~2014 and January 2015~~.

Harbor seals (*Phoca vitulina*) are the most abundant pinnipeds on VAFB. Northern elephant seals (*Mirounga angustirostris*), California sea lion (*Zalophus californianus*), and Steller sea lion (*Eumetopias jubatus*) are also present, with elephant seals increasing in recent years (MSRS 2014a). 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. The requirements of the incidental harassment permit and LOAs, including mitigation monitoring, ensure that such impacts are very unlikely to occur as a result of VAFB operations.

During this reporting period, monitoring was required at Santa Rosa Island (SRI) during the Atlas V DMSP-19 launch and at San Miguel Island (SMI) during the Atlas V NROL-35 launch. Pinniped monitoring was also required on VAFB for the Atlas V DMSP-19 launch since it fell within harbor seal pupping season (1 March through 30 June). Auditory brainstem response (ABR) testing was not required for any launches during the reporting period. Only one missile launch required pinniped monitoring on VAFB, the MDA FTG-06b. This report describes the methods and results of the marine mammal mitigation efforts and discusses the impacts of Air Force operations.

2.0 VAFB Operations

2.1 Space Vehicle Launches

Five space vehicle launches occurred during the reporting period, from Space Launch Complexes (SLC) 3E and SLC-2 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

Vehicle Type	Facility	Launch Date
Atlas V NROL-39	SLC-3E	6 December 2013
Atlas V DMSP-19	SLC-3E	3 April 2014
Delta II OCO	SLC-2	2 July 2014
Atlas V Worldview III	SLC-3E	13 August 2014
Atlas V NROL-35	SLC-3E	12 December 2014

2.2 Missile Launches

Three missile launches occurred during the reporting period from Launch Facilities (LF) on north VAFB (Table 2; Figure 2).

Table 2. Missile Launches

Missile Type	Facility	Launch Date
MMIII GT-219-GM	F-04	17 Dec 2013
MDA FTG-06b	LF-24	22 June 2014
MMIII GT-211GM	LF-09	23 September 2014

2.3 Fixed-wing Aircraft and Helicopter Operations

During the reporting period, 7,600 operations were conducted from the VAFB airfield. Most of these consisted of training exercises involving “touch and goes.” A few were logistics flights involving the transfer of supplies and personnel.

2.4 Delta Mariner Operations

In support of the upcoming Delta IV NROL-45 launch from SLC-6, the Delta Mariner cargo ship docked at the VAFB harbor on 5 November 2014 to offload flight hardware and again on 6 November 2014 to reload the container and other transport hardware for return to the manufacturing plant in Alabama. In preparation for the Delta Mariner docking, harbor maintenance dredging took place at the VAFB harbor from 25 August 2014 to 18 September 2014.

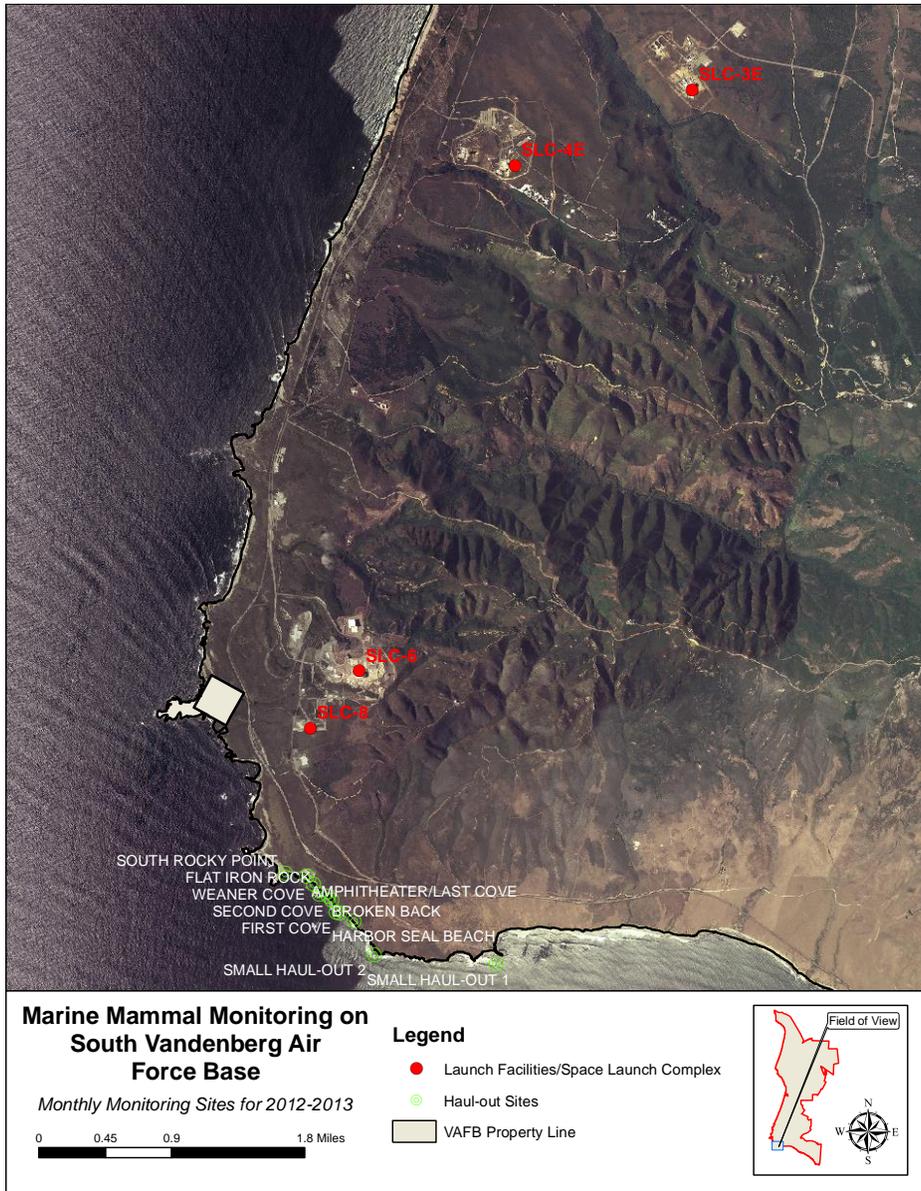


Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB.

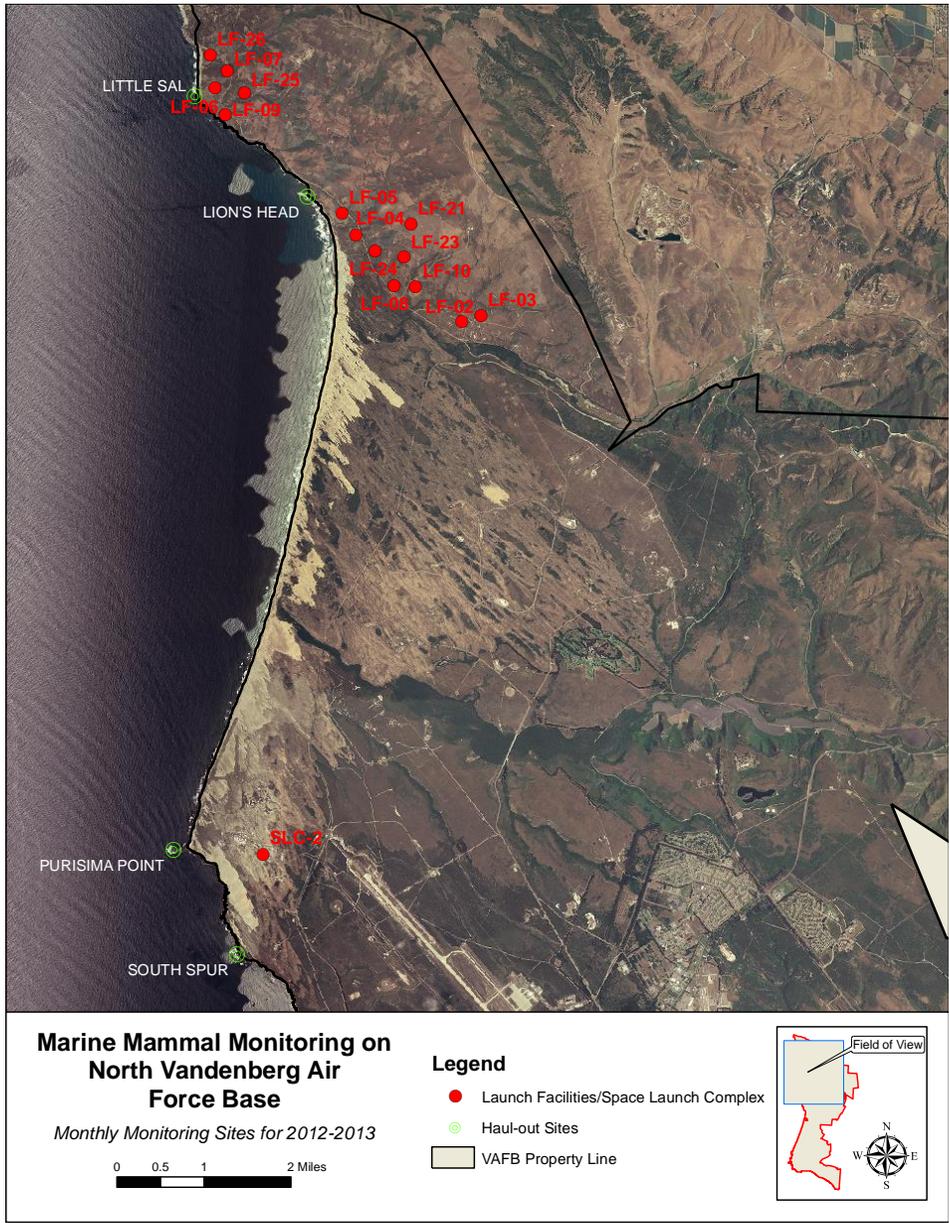


Figure 2. Launch Sites and Pinniped Haul-out Areas on North VAFB.

3.0 Methods

3.1 Sonic Boom Modeling

As required in the LOAs, sonic boom modeling was performed prior to each space vehicle launch. Modeling was not necessary for the missile launches because the trajectory of the vehicles were north and west of the NCI. 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

Monitoring on the Northern Channel Islands (NCI) is required if sonic boom modeling predicts a sonic boom greater than one psf is predicted to impact one 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). This 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 2013-2014 reporting period, monitoring on the NCI was required for the Atlas V DMSP-19 and Atlas V NROL-35 launches. Monitoring was required on VAFB for the Atlas V DMSP-19 and the MDA FTG-06b launches.

On VAFB, monitoring sites are selected based on the proximity of the launch location to the nearest active haul out sites. For the Atlas V DMSP-19 launch from SLC-3E, monitoring of northern elephant seals was performed at 12 haul-out locations on south VAFB (Figure 1). For the MDA FTG-06b, monitoring of harbor seals was performed at the Lion's Head haul out (Figure 2). 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. For the Atlas V DMSP-19 launch, modeling runs predicted sonic booms impacting the southwestern coast of SRI (MSRS 2014b). For the Atlas V NROL-35 launch, modeling runs predicted a boom impacting SMI and SRI. Since SMI has a greater number of active haul out sites, monitoring was conducted on the northeastern coast of SMI (MSRS, *in prep.*).

Monitors used high quality binoculars and spotting scopes to make hourly counts and recorded numbers of each species by sex and age class and behavior within a predefined focal area. Remarks were recorded as appropriate, including the nature and cause of any disturbance, including natural factors as well as human-related disturbances, such as people in boats or low-flying aircraft. Incidental information was recorded on other wildlife. Environmental data recorded included time and level of tides, visibility, percentage and type of cloud cover, air temperature, wind direction and velocity, and swell direction and height. On VAFB, direct observations during launch events are not conducted due to safety concerns; therefore video is utilized during day time launches on VAFB to record the reactions of the animals to the launch.

3.3 Acoustic Measurements

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 TEAC model RD-120T digital audio tape (DAT) recorder and a high quality Bruel and Kjaer type 4193 microphone, with a type UC0211 low frequency adapter, type 2669 pre-amplifier and type 5935 power supply. This system is specially tailored for recording the low frequency sound associated with rocket launches and sonic booms. This DAT system records the launch noise and sonic booms digitally to tape, which allows for detailed analysis of the frequency content, and the calculation of other acoustical metrics. Using Maxell DAT tapes, the DAT system recorded for just less than 30 minutes, providing ample time to record the ambient noise and sonic boom. The DAT recorder was calibrated with a Bruel & Kjaer sound level calibrator type 4220.

3.4 Launch Mitigation Requirements Overview

Table 3. Launch Mitigation Requirements during the 2013 – 2014 reporting period.

Vehicle or Missile	Launch Date	NCI Monitoring	VAFB Monitoring	ABR Testing	Boom Model	Acoustics	Video
Atlas V NROL-39	6 December 2013	N/R	N/R	N/R	Required	N/R	N/R
Atlas V DMSP-19	3 April 2014	Required	Required	N/R	Required	N/R	Required
MDA FTG-06b	22 June 2014	N/R	Required	N/R	N/R	N/R	Required
Delta II OCO	2 July 2014	N/R	N/R	N/R	Required	N/R	N/R
Atlas V Worldview III	13 August 2014	N/R	N/R	N/R	Required	N/R	N/R
Atlas V NROL-35	12 December 2014	Required	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. 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 Environmental Conservation Project Manager (30 CES/CEIEA, R. Evans) to determine the number and nature of flights performed during the reporting period (R. Evans, pers. comm., 2015).

3.7 Delta Mariner Operations

The Delta Mariner and associated tugboats follows a predetermined route during and after the completion of dredging when transiting through or anchoring in the Harbor. This route limits traversing through kelp beds and prevents vessels from anchoring within kelp or hard bottom habitat outside of the dredge footprint. In addition, the Delta Mariner arrives [and usually departs](#)

during high tide, thus minimizing potential disturbance to marine mammals. As a result, monitoring of the Delta Mariner arrival and departure is unnecessary.

Prior to the initiation of dredging, a baseline pinniped count was performed at the VAFB harbor on 18 August 2014. During dredging operations, MSRS performed pinniped counts and behavioral observations when the tide height was below 2 ft during dredging activities and when pinnipeds were hauled out, regardless of tide. During dredging, monitoring was performed 25 August to 28 August and 8 September to 11 September. Hourly pinniped counts were performed and environmental conditions were recorded. In addition, when changes to pinniped numbers or behavior occurred, monitors recorded the changes and the cause of the stimulus, natural, human-caused, or unknown.

4.0 Results

4.1 Sonic Boom Modeling

Sonic boom modeling was conducted for five space vehicle launches. The following table summarizes the results of the modeling effort.

Table 4. Sonic Boom Modeling Results.

Vehicle	Sonic Boom Modeling Results
Atlas V NROL-39	No booms impacting NCI
Atlas V DMSP-19	>1 psf impacting SRI
Delta II OCO	No booms impacting NCI
Atlas V Worldview III	No booms impacting NCI
Atlas V NROL-35	> 2 psf impacting SRI & SMI

4.2 Launch Monitoring

4.2.1. Atlas V DMSP-19

Full details of the following summary for monitoring of the Atlas V DMSP-19 launch on 3 April from SLC-3E can be found in the launch monitoring report (MSRS 2014b). Monitoring was performed near Bee Rock on the south western coast of SRI from 31 March 2014 through 5 April 2014. Total pre-launch counts for harbor seals at the SRI monitoring location ranged from 0 to 138. Post-launch harbor seal totals ranged from six to 88. Between zero and 64 pups were observed prior to the launch and two to 46 pups were observed after the launch. Time of day, rather than tide height appeared to correspond to the number of harbor seals hauled out. During the launch, one adult lifted its head with vigilance and flushed to the water. None of the other seals at the haul-out at the time of the launch showed a discernible reaction and, within five minutes, the adult that had flushed returned to the haul-out. A sonic boom was recorded at the monitoring location, with peak overpressure measured at 0.744 psf (125.0 dB).

Total pre-launch counts for harbor seals at the south VAFB haul-outs ranged from nine to 24. Post launch harbor seal totals ranged from 13 to 80. Between 0 and 4 pups were observed prior to the launch and five to 14 pups were observed after the launch. Unlike previous launch

monitoring on VAFB, tide height did not appear to correlate to harbor seal numbers, likely because the lowest tide height during each daily count period were relatively high (2.16 to 4.26 ft). Video monitoring of one haul-out location showed that the launch caused a temporary disturbance of harbor seals: all but two harbor seals flushed into the water within a minute and a half of the launch. However, within 20 minutes, half of the harbor seals had returned to the haul-out and by 40 minutes post launch, more seals were hauled out than prior to the launch. Overall, the launch appeared to have no significant effect on either long term or short term count totals at the south VAFB haul-out sites and caused only temporary behavioral disturbance.

4.2.2. Atlas V NROL-35

Further details of the following summary for monitoring of the Atlas V NROL-35 launch on 12 December 2014 from SLC-3E can be found in the launch monitoring report (MSRS, *in prep.*). Monitoring was performed at Cardwell Point on the north eastern coast of SMI from 9 December 2014 through 13 December 2014. Total pre-launch counts for California sea lions ranged from 206 to 1067. Post-launch California sea lion totals ranged from 606 to 729. Between 17 and 67 pups were observed prior to the launch and 66 to 96 pups were observed after the launch. During the launch, five adults lifted their heads with vigilance. None of the other sea lions at the haul-out at the time of the launch showed a discernible reaction. None flushed. A sonic boom was recorded at the monitoring location, with peak overpressure measured at 1.175 psf (123.0 dB).

4.2.3. MDA FTG-06b

Further details of the following summary for the **MMIII FT-207GM** launch on 22 May 2013 from LF-04 can be found in the launch monitoring report (MSRS 2014c). Monitoring on VAFB was required and was performed at Lion's Head (Figure 2) between 19 June 2014 and 6 July 2014. During pre-launch monitoring, between zero and seven adult harbor seals were counted. Post-launch counts ranged between zero and 16 adult harbor seals. No pups were observed during pre- and post-launch monitoring.

The MDA FTG-06b launch may have caused a short term effect to harbor seal numbers at the Lion's Head haul out on north VAFB, since the number of harbor seals hauled out 48 hours after the launch was lower than pre-launch numbers. However, inundation of the haul out by high tides during post-launch monitoring may also have affected harbor seal behavior. The launch did not appear to have caused long term effects on harbor seals as the highest number of harbor seals hauled out (16) was observed two weeks post-launch. No evidence of injury or mortality was observed during launch monitoring. Therefore, it does not appear that the launch caused injury or harm to any pinnipeds or long term effects to the population.

4.3 Monthly Marine Mammal Surveys

The results of monthly marine mammal surveys on VAFB are reported to 30 CES quarterly and annually to CES and NOAA Fisheries in separate reports. None of the monthly surveys suggested any changes in haul-out patterns as a result of the launches (MSRS 2014a, 2014d, and 2014e). Surveyors in 2011-2012 noted a decline in harbor seal numbers from historic levels (MMCG & SAIC 2012b); however count totals have been increasing over the past two years and potentially show an overall increasing trend (Figures 3 and 4).

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In 2013, the number of northern elephant seals hauled out on VAFB were observed to increase substantially. Up to 126 individuals (mostly juveniles) were observed at South Rocky Point (MSRS, unpubl. data) and up to 163 individuals, were observed at South Rocky Point during monitoring for the Falcon 9 Cassiope launch (URS Group, Inc. 2013). These observations have been almost entirely juvenile animals, which commonly haul out in large numbers during late summer and early fall throughout their range in California (P. Thorson, pers. comm.). If patterns in other parts of California apply here, they are expected to leave between late November and December to move to off shore foraging areas (P. Thorson, pers. comm., 2013).

In addition to harbor seals and elephant seals, routine observations of California sea lions and relatively low numbers of Steller sea lions were recorded throughout the reporting period at South and North Rocky Points (MSRS 2014a, 2014d, and 2014e).

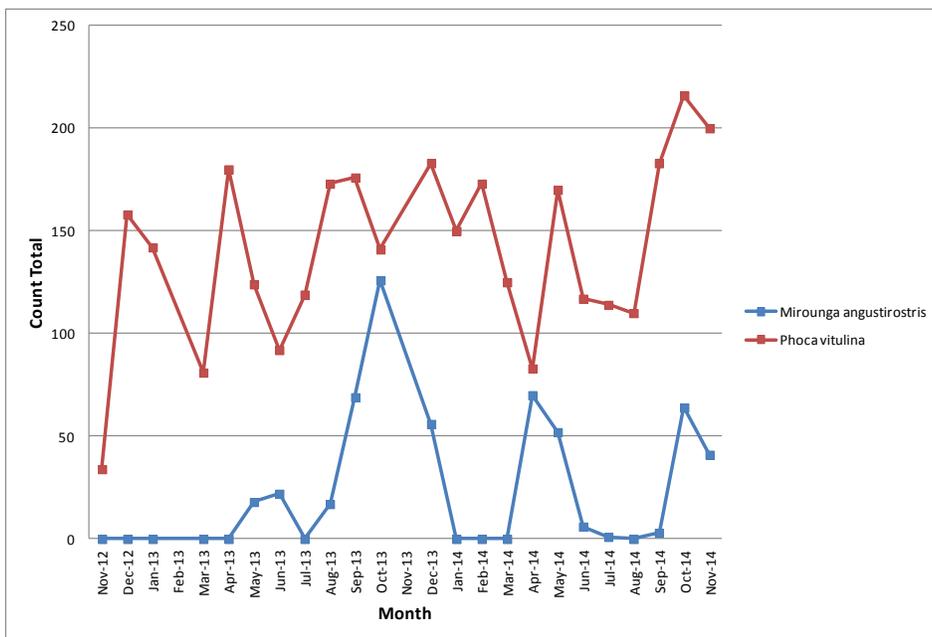


Figure 3. Monthly pinniped survey count totals for Northern elephant seals and harbor seals from November 2012 through November 2014 (MSRS 2014a, 2014d, 2014e).

4.4 Fixed-wing Aircraft and Helicopter Operations

Most of the 7,400 operations conducted at the VAFB airfield consisted of [overflights](#) or training exercises involving “touch and goes.” A few were logistics flights involving the transfer of supplies and personnel. Many were also overflights which did not descend below 5,000 feet in altitude. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm. 2015).

4.5 Delta Mariner Operations

Full details of the following summary of monitoring results for the Delta Mariner and associated harbor maintenance activities can be found in the monitoring report (MSRS 2014f). During harbor maintenance dredging activities, hauled out Pacific harbor seals alerted to both auditory and visual disturbances from dredging activities. Although noises associated with equipment start up and dredging activities caused harbor seals to alert, auditory disturbances were less likely to cause flushing than visual disturbances (movement from crane and excavator arms). Active dredging from the barge was typically not visible to hauled out pinnipeds, however support activity on the dock was visible and the source of most alerting and flushing.

No pinnipeds were hauled out during baseline monitoring on 18 August 2014. The highest number of harbor seals observed during dredging operations was 16 when tides were 1.07 ft. The number of harbor seals present on any given day appeared to be largely dependent on tide and swell height. During the first week of monitoring from 25 August to 28 August, swells reached an average height of 6.7 ft as a result of high swells generated from Hurricane Marie. The average number of harbor seals recorded on hourly counts during this week was 2.4 compared to 5.9 harbor seals per hourly count on the week of 8 September to the 11 September.

During the Delta Mariner operations and cargo unloading and loading activities on 5 and 6 November, 2014, there were no indications of disturbance, abnormal behavior, injury, or mortality to pinnipeds.

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 haulout locations, such as the continued landslide at Weaner Cove (MMCG & SAIC 2012b), which continues to be monitored (MSRS 2014a). 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 react 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 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.

5.2 Effects of VAFB Operations

There was no evidence of injury, mortality, or abnormal behavior as a result of the Atlas V DMSP-19, Atlas V NROL-35, or MDA FTG-06b launches on VAFB or the NCI (MSRS 2014b, 2014c, and *in prep.*). For each launch, pre-launch counts were similar to post-launch counts suggesting that if the launch had any effect on the seals, these effects were negligible and temporary. Activities associated with the docking of the Delta Mariner and air-field operations did not cause any

significant effects on pinniped counts, nor cause injury, mortality, or significant abnormal behavior.

6.0 Conclusions and Recommendations

The launch monitoring and monthly surveys were effective at assessing the effects of launch operations on pinniped populations at VAFB. Consistent results were obtained showing no indications of significant disturbances, abnormal behavior, injury, or mortality were reported as a result of launch or aircraft operations. Responses to launches, when they did occur, were short-lived and of no significance. Monthly pinniped counts across VAFB show a cyclical, but stable population of harbor seals hauled out on VAFB (Figure 3).

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