

**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**

1 DECEMBER 2012 TO 30 NOVEMBER 2013



Submitted to:

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December 2013

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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 Service) five-year permit for the incidental harassment of marine mammals (NOAA 2009), 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 2012 and 2013a). 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 2012 to 30 November 2013) there were three space vehicles from VAFB. Pinniped monitoring was not required on VAFB for the Atlas V LDCM and Delta IV NROL-65 launches since they fell outside of the harbor seal pupping season (1 March through 30 June). Per the LOA, VAFB performed pinniped monitoring on VAFB for the Falcon 9 Cassiope launch in September 2013 (NOAA 2013a). There were no indications of disturbances, abnormal behavior, injury or mortality as a result of the Falcon 9 Cassiope launch (URS Group, Inc. [URS], in prep.).

Sonic boom modeling of the Atlas V LDCM launch (11 February 2013) indicated that pressures in excess of 1 pound per square foot (psf) would likely impact the western portion of San Miguel Island (SMI), therefore monitoring on SMI was required. The monitors did not observe a sonic boom on SMI and there were no indications of disturbances, abnormal behavior, injury or mortality as a result of the Atlas V LDCM launch (ManTech SRS Technologies, Inc. [MSRS] 2013). Sonic booms over one psf were not predicted to impact the NCI for either the Delta IV Heavy NROL-65 (28 August 2013) or the Falcon 9 Cassiope (29 September 2013) launches therefore monitoring on the NCI was not required. Auditory Brainstem Response (ABR) testing was only required for the Delta IV NROL-65 launch, however monitors were not able to capture harbor seals for testing due to low numbers of seals at appropriate haul out sites.

Five 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 five missile launches, only the Minuteman III (MMIII) GT-207GM 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 MMIII GT-207GM launch (Tetra Tech, Inc., 2013). 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, 2,118 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. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm. 2013).

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 Service) five-year permit for the incidental harassment of marine mammals (NOAA 2009). This permit was issued on 7 February 2009 and is valid through 7 February 2014. This report also is 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 2012 through 6 February 2013, and from 7 February 2013 through 6 February 2014, respectively (NOAA 2012 and 2013a). The period covered by this report extends from 1 December 2012 through 30 November 2013, thus overlapping the two LOAs.

Marine mammal 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), the northern fur seal (*Callorhinus ursinus*) is a species of concern in addition to the three species already mentioned for VAFB.

This report provides information on space vehicle and missile launches and fixed-wing aircraft and helicopter operations at VAFB that have the potential for harassment, injury or mortality of marine mammals. The report describes monitoring activities performed in support of these operations, an overview of the results of this monitoring and any significant findings.

Monitoring was required at San Miguel Island (SMI) during the Atlas V LDCM rocket launch because sonic boom modeling predicted that a pressure wave in excess of one pound per square foot (psf) could impact the island. Pinniped monitoring was not required on VAFB for the Atlas V LDCM and Delta IV NROL-65 launches since they fell outside of the harbor seal pupping season (1 March through 30 June). Per the LOA, VAFB performed pinniped monitoring on VAFB for the Falcon 9 Cassiope launch in September 2013 (NOAA 2013a; URS 2013). Auditory brainstem response (ABR) testing was required for the Delta IV Heavy NROL-65 launch, however capture attempts for harbor seals were unsuccessful. This report describes the methods and results of the marine mammal mitigation efforts and discusses the impacts of Air Force operations. Only one missile launch required pinniped monitoring on VAFB, the Minuteman III (MMIII) GT-207GM.

2.0 Background

2.1 VAFB Operations

2.1.1. Space Vehicle Launches

Three space vehicle launches occurred during the reporting period, from Space Launch Complexes (SLC) 3E, 4E and SLC-6 on south 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	Planned Launch Date	Actual Launch Date
Atlas V LDCM	SLC-3E	11 February 2013	11 February 2013
Delta IV NROL-65	SLC-6	28 August 2013	28 August 2013
Falcon 9 Cassiope	SLC-4E	5 September 2013	29 September 2013

2.1.2. Missile Launches

Five missile launches occurred during the reporting period from Launch Facilities (LF) on north VAFB (Table 2; Figure 2). Three of the five launch vehicles were Minuteman (MM) III launches. MM IIIs are Intercontinental Ballistic Missiles (ICBMs). The Missile Defense Agency (MDA) also conducted an interceptor-only flight test, GMD Controlled Test Vehicle-01 (CTV-01) and launched a Flight Test Ground-based Interceptor (FTG-07) associated with the Ground-based Midcourse Defense (GMD) program.

Table 2. Missile Launches

Missile Type	Facility	Launch Date
CTV-01 MDA	LF-23	26 January 2013
MMIII GT-207GM	LF-04	22 May 2013
GMD FTG-07	LF-24	5 July 2013
MMIII GT-209GM	LF-10	22 September 2013
MMIII GT-208-1GM	LF-09	26 September 2013

2.1.3. Fixed-wing Aircraft and Helicopter Operations

Various types of fixed-wing aircraft fly from VAFB. All aircraft are required to maintain a 1000-foot “bubble” around pinniped haul-out and rookery sites; in other words, they must stay 1000 feet above or around any pinniped site. Helicopters, used mainly for launch surveillance and search and rescue operations, must also maintain the same bubble. Exceptions can be made if an emergency search and rescue operation, a security breach or an aircraft emergency occurs. For example, trespass of an illegal drug-smuggling “Panga” boat onto VAFB in April 2013 resulted in many fixed and rotary-wing security flight operations. This was considered a combined “Search and Rescue” and “Security” operation.

During the reporting period, 2,118 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. No indications of significant disturbances, abnormal pinniped behavior, injury or mortality were reported as a result of these operations (R. Evans, pers. comm., 2013).

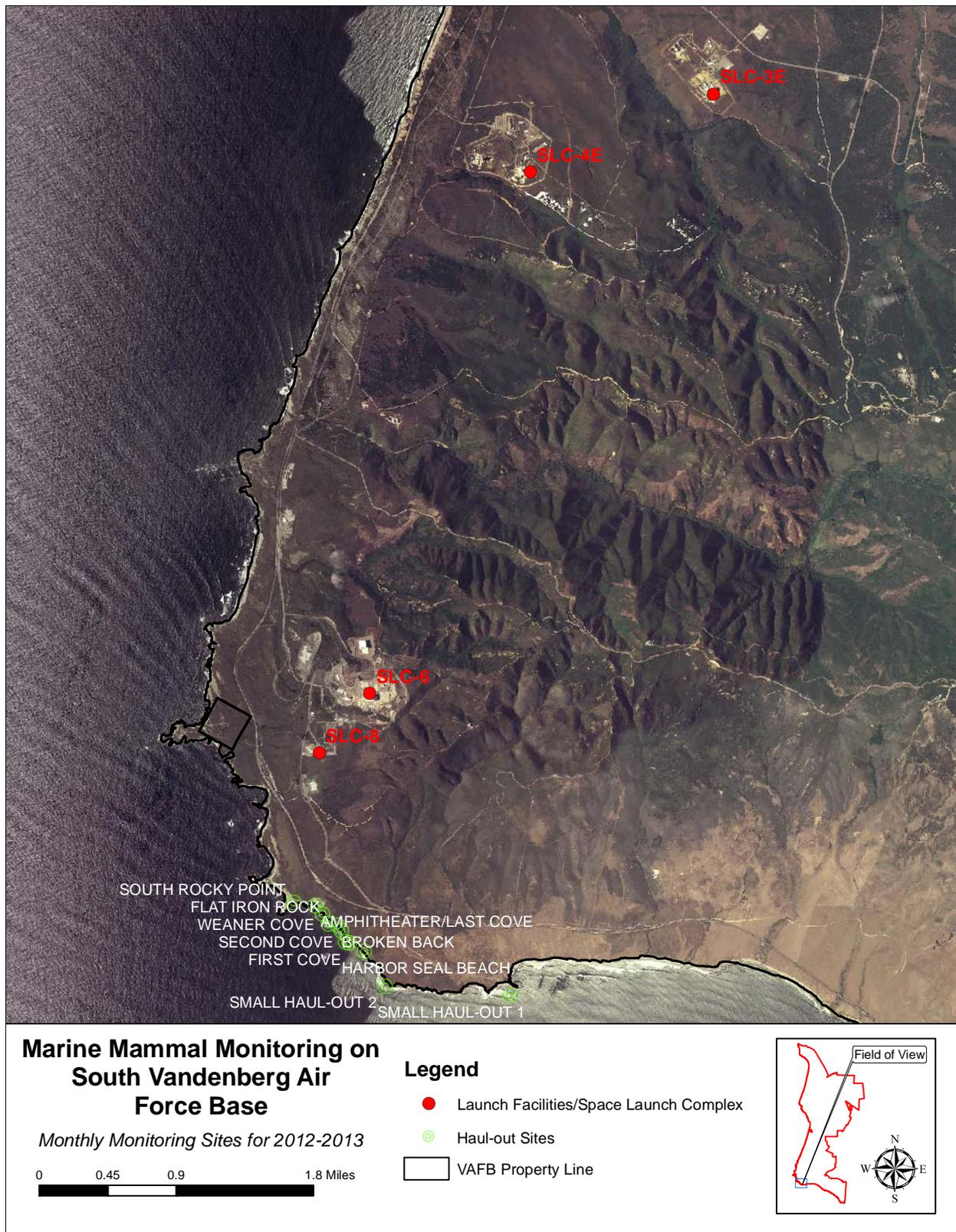
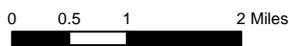


Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB



Marine Mammal Monitoring on North Vandenberg Air Force Base

Monthly Monitoring Sites for 2012-2013



Legend

- Launch Facilities/Space Launch Complex
- ⊙ Haul-out Sites
- VAFB Property Line

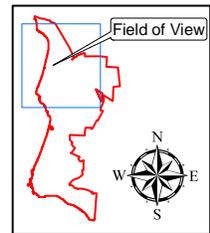


Figure 2. Launch Sites and Pinniped Haul-out Areas on North VAFB

2.2 Pinniped Species of Concern

NMFS is concerned about the potential impacts of anthropogenic noise on marine mammals (Carretta et al. 2011). Potential impacts 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.

Harbor seals are the most abundant pinnipeds at VAFB. The last estimate of total population size at VAFB was 274 for 2012 (MMCG and SAIC 2012a), while the greatest number seen hauled out at any one time so far in 2013 was 180 in April (MSRS 2013). Harbor seals regularly haul out on isolated sandy coves, ledges and rocks. On south VAFB (Figure 1), a small haul-out area exists on some rocks and ledges immediately offshore from the breakwater at the Vandenberg Harbor. Approximately 0.7 kilometers (km) to the west, a series of rockbound sandy coves, ledges and offshore rocks begins, extending for about 1.9 km northwest to south Rocky Point. Here, harbor seals haul out, bear their young and wander between individual sites depending upon tides, potential threats from land and other factors. This stretch is an almost continuous haul-out and rookery area; however, harbor seal use of this area appears to have been declining over the past several years (MMCG and SAIC 2012b). The decreases have been attributed primarily to natural landslide activity, not Air Force operations or other anthropogenic disturbances (See Section 5.1.3).

North Rocky Point, the northernmost haul-out site on south VAFB, lies about 1.5 km west of the nearest launch facility (SLC-6). This haul-out site is used by California sea lions, which haul out in greatest numbers in late spring and summer. A few pups have been born there some years, but these incidences likely represent aberrant events due to the effects of El Niño or domoic acid poisoning (MMCG 2013). Sea lions are frequently seen immediately offshore of VAFB and individuals occasionally haul out at various locations throughout the base. These are considered transients, or in some cases, stranded animals.

In the late spring and early summer of 2012 Steller sea lions (*Eumetopias jubatus*) were reported at North Rocky Point, the first record at VAFB in over 20 years of monitoring (MMCG and SAIC 2012a). Although up to 16 animals were observed in 2012, only two Steller sea lions were observed in 2013 at North Rocky Point on 14 April 2013 and 2 November 2013 (R. Evans, pers. comm., 2013). Steller sea lions once had two small rookeries on SMI, but these were abandoned following the 1982-1983 El Niño event. These rookeries once represented the southernmost colonies of the eastern stock of this species. The eastern stock of Steller sea lions, which until recently was threatened under the Endangered Species Act of 1973 (ESA), has been removed from the ESA (effective 4 December 2013; NOAA 2013b).

Four distinctly separate harbor seal haul-out sites exist on north VAFB. One is at the end of Spur Road, another at Purisima Point, a third at Lion's Head, and the last just west of LF-06

(Figure 2). The first two sites lie between 0.7 and 1.3 km from the nearest launch facilities, the third site (Lion's Head) is about 1.3 km from the nearest launch facility, and the last site (Little Sal) is 0.5 km from LF-06 (Figure 2).

In the past, northern elephant seals have occasionally been observed hauled out at VAFB, usually as single individuals. During 2013, numbers of northern elephant seals hauled out on VAFB increased substantially. Up to 126 individuals have been observed during monthly surveys 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. [URS], in prep.).

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

3.2.1. Timing

VAFB Monitoring

With the exception of the first Falcon 9 launch from SLC-4, pinniped monitoring is required on VAFB by the LOAs only if the launch occurs during harbor seal pupping season (1 March through 30 June). Although the Falcon 9 Cassiope launch (29 September 2013) occurred outside of this period, the LOA required monitoring on VAFB (NOAA 2013a), due to this being the first launch of the Falcon 9 from VAFB, and the first launch from SLC-4 in about 8 years. This monitoring must start at least 72 hours before each launch and continue to 48 hours after the launch. Follow-up monitoring must be conducted two weeks after each launch during pupping season. Monitoring must be conducted as close to the launch window as possible. Nighttime monitoring is not allowed because of personnel safety concerns—the bluffs overlooking the haul-out sites are unstable and subject to sudden collapse. Visual monitoring during launches on VAFB is not allowed because of safety concerns, but monitors return to the observation points as soon as the launch closure areas are reopened. Time-lapse video is required during day time launches to record the reactions of the animals to the launch. Of the missile launches that occurred during the 2012 – 2013 reporting period, only the MMIII GT-207GM occurred during the harbor seal pupping season (22 May 2013), and required pinniped monitoring on VAFB.

Northern Channel Islands Monitoring

Monitoring is required year round on the NCI if sonic boom modeling results predict a potential pressure wave greater than one psf to impact any NCI. This monitoring must start at least 72 hours before each launch and continue to 48 hours after the launch.

During the 2012 – 2013 reporting period, a sonic boom greater than one psf potentially impacting the NCI was only predicted for the Atlas V LDCM launch (11 February 2013) and required pinniped monitoring on SMI.

3.2.2. Site Selection

Pinniped monitoring sites on VAFB are selected based on the proximity of the launch location to the nearest active haul out sites. In general, monitoring is performed at the closest haul out site to the launch location, however counts are frequently performed at multiple haul out locations when it is likely that there may be launch related disturbances at all locations. For the Falcon 9 Cassiope launch from SLC-4, monitoring of northern elephant seals was performed at South Rocky Point (URS, in prep.). For the MMIII GT-207GM launch from LF-04, monitoring of harbor seals was performed at the Lion's Head haul out (Tetra Tech 2013).

When monitoring on the NCI is required, the specific location where monitoring will occur is selected based on the location of highest density of predicted sonic boom impacts greater than one psf and the nearest active haul-out of pupping pinnipeds. For the Atlas V LDCM launch, observations of California sea lions and northern elephant seals were made at East Adams Cove on the west side of SMI (MSRS 2013).

3.2.3. Pinniped Monitoring Data

Monitors observe and count pinnipeds from bluffs overlooking the haul-out sites. High quality binoculars (8 x 42 to 10 x 42) and spotting scopes (20-30 x 60) were used to make hourly counts. Monitors 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.

Because the Atlas V LDCM launch event occurred during daylight hours, monitoring of the pinniped reaction to the launch was easily discernible. All animals within the monitoring area were watched for 30 minutes prior to and following the launch. Reactions to the launch event or resulting sonic boom were recorded.

3.2.4. Acoustic Measurements

Atlas V LDCM

For the Atlas V LDCM launch, 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 was used to monitor the sound environment and measure the sonic boom. 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 post-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 placed at the biological monitoring site overlooking East Adams Cove on SMI and set up to record the potential sonic boom. Prior to the collection of data, the DAT recorder was calibrated with a Bruel & Kjaer sound level calibrator type 4220.

Delta IV NROL-65

For the Delta IV Heavy NROL-65 launch from SLC-6 (28 August 2013), two types of independent systems were used to monitor the sound environment and launch noise on south VAFB. The first system consisted of a TEAC model RD-120T DAT recorder and a Bruel and Kjaer type 4193 microphone with a type UC0211 low frequency adapter, type 2669 pre-amplifier and type 5935 power supply. The microphone was designed by the manufacturer to have a low frequency cut-off (3.0 decibels [dB]) at 0.015 Hertz (Hz). This DAT system records the launch noise and sonic booms digitally to tape, which allows for detailed post-analysis of the frequency content, and the calculation of other acoustical metrics. Using Maxell HS4/90 DAT tapes, the DAT system recorded for over 3 hours, providing ample time to record the launch noise. The digital data was directly downloaded from the DAT recorder to a computer using TEAC QuikVu software and hardware. The waveforms were then analyzed using custom routines programmed in MatLab, a technical computing language.

The second system used for acoustic monitoring was the Larson-Davis model 820 Type 1 (an acoustical accuracy standard) sound level meter (SLM). The SLM measures specific sound events that exceed a minimum sound level, background noise levels, and ambient noise levels. It does not make an actual recording of sound like the DAT recorder, but computes acoustic metrics used to describe specific events and the surrounding sound environment. For all sound monitoring using this system, the SLM was set to begin measurements of sound events when the sound exceeded a level of 70 dB. Because launch noise is variable in time and to prevent the SLM from ending its integration of the total launch noise (sound exposure level [SEL] measurement) prematurely, the system was set to stop calculating the SEL when the sound level drops 6.0 dB below the trigger level of 70 dB. This is called the hysteresis value, and in this case, it is at 64 dB.

3.3 Launch Mitigation Requirements Overview

Table 3. Launch Mitigation Requirements during the 2012 – 2013 reporting period.

Vehicle or Missile	Launch Date	Monitoring	ABR Testing	Boom Model	Acoustics	Video
Atlas V LDCM	11 February 2013	Required at SMI	N/R	Required	N/R	N/R
MMIII GT-207GM	3 April 2012	Required at VAFB	N/R	N/R	N/R	N/R
Delta IV NROL-65	28 August 2013	N/R	Required*	Required	Required	N/R
Falcon 9 Cassiope	29 September 2013	Required at VAFB	N/R	Required	N/R	Required

N/R = “not required”

* Required, however not conducted, see Section 4.2.2.

3.4 Monthly Surveys

Biologists surveyed marine mammal haul-out sites on north and south VAFB (Figures 1 and 2) on a monthly basis during the reporting period. For each survey, 10x40, 10x42, or 10x50 binoculars and a 20x60 spotting scope were utilized, depending on conditions. 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 Purisima Point and 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). This was not always possible, since tides occasionally occurred too close to sunrise or sunset or area closures were in effect for VAFB operations. The location, species, number of individuals, age class, and sex (when possible) was recorded. Ocean and weather conditions were also recorded.

3.5 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.

4.0 Results

4.1 Sonic Boom Modeling

Sonic boom modeling was conducted for three rocket launches. Detailed reports that include sonic boom modeling results were prepared for two launches (MSRS 2013a, 2013b), with a third report pending (URS 2013) The following table summarizes the results of the three sonic boom models.

Table 4. Sonic Boom Modeling Results

Vehicle	Launch Date	Sonic Boom Modeling Results
Atlas V LDCM	11 February 2013	> 1 psf at northern Channel Islands
Delta IV NROL-65	28 August 2013	No booms impacting NCI
Falcon 9 Cassiope	29 September 2013	< 1 psf at northern Channel Islands

Modeling was not required for the missile launches because of their westerly trajectories and known acoustic characteristics.

4.2 Space Vehicle Launch Monitoring

4.2.1. Atlas V LDCM

Further details of the following summary for monitoring of the Atlas V LDCM launch on 11 February from SLC-3 can be found in the launch monitoring report (MSRS 2013a). Monitoring was performed at East Adams Cove on SMI between 8 February 2013 and 11 February 2013. California sea lion numbers ranged from a low count of 259 to a high count of 512 individuals (Figure 3). Sea lion count totals were highest on the day of the launch with numbers remaining stable through the launch window. Elephant seals maintained relatively consistent numbers during the three days preceding the launch with numbers slightly lower on the day of the launch (Figure 4). This dip in numbers was documented during monitoring preceding the launch, and therefore, was not launch related. High and low counts ranged from 530 to 473 individuals.

The biological monitors first visually observed the rocket at 10:03 PST and first heard a faint crackling noise associated with the rocket boosters at 10:06 PST on 11 February. There was no discernible response from sea lions to the launch leading to the cessation of monitoring following a final count of animals at 11:00 PST. No sonic boom was heard. The behavior of California sea lions and elephant seals remained completely unchanged during the launch and monitoring ceased after a final count of animals at 11:00 PST on 11 February.

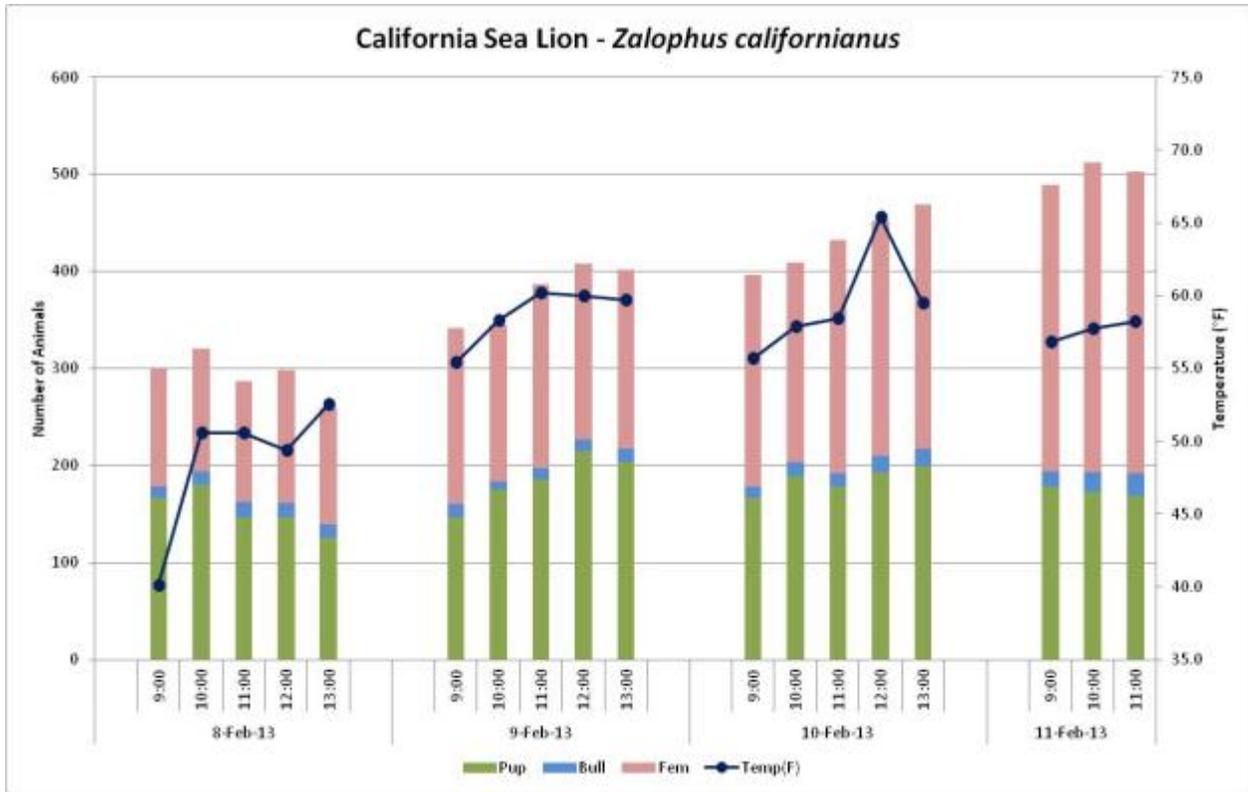


Figure 3. Atlas V LDCM, total numbers of California sea lion by sex/age class (MSRS 2013a).

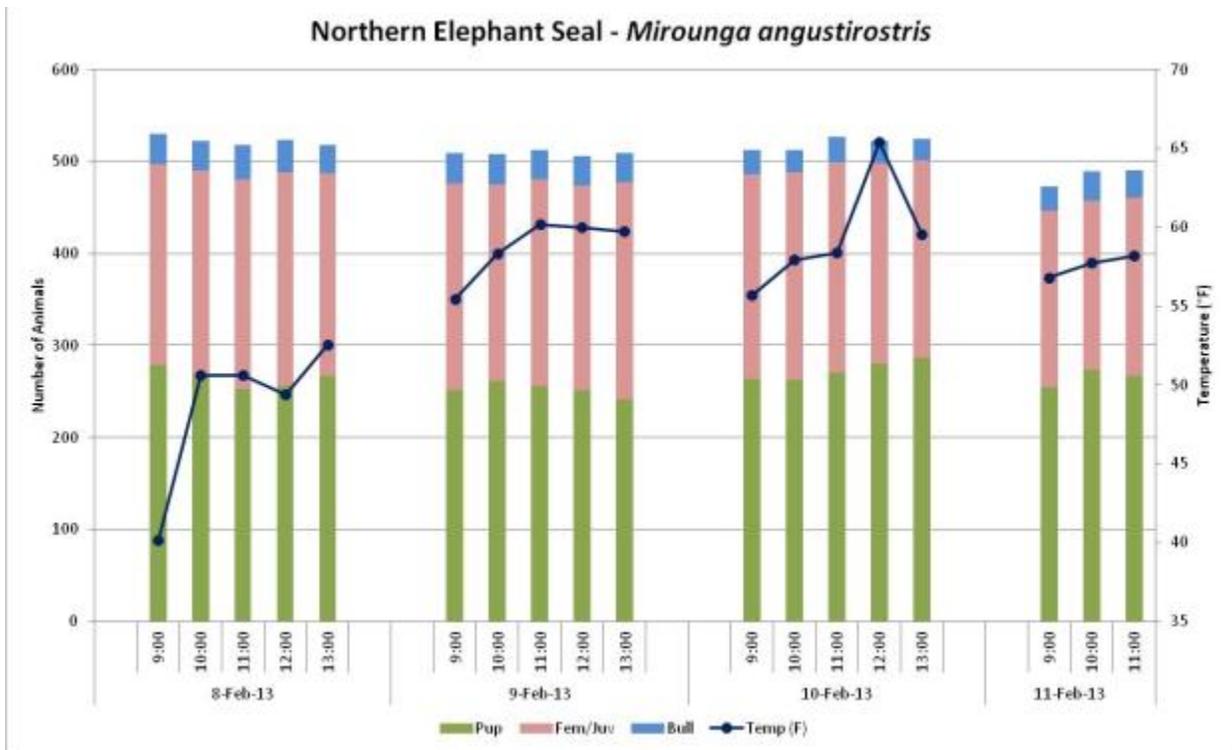


Figure 4. Atlas V LDCM, total numbers of northern elephant seals by sex/age class (MSRS 2013a).

4.2.2. Delta IV Heavy NROL-65

Further details of the following summary can be found in the launch monitoring report (MSRS 2013b). Pinniped monitoring on VAFB and NCI was not required for the 28 August 2013 launch from SLC-6. ABR testing was required; however researchers were unable to capture any harbor seals for testing. This was primarily due to the timing of high tides converging on mid-day resulting in very few seals hauling out at the capture locations. Launch metrics were recorded at two locations near SLC-6.

The launch noise generated by the Delta IV NROL-65 was similar to the noise produced by the previous Delta IV launches. The Delta IV NROL-65 unweighted SEL (TSEL) was 0.6 dB higher, the ASEL was 0.6 dB lower, and the CSEL was 0.5 dB lower than the Delta IV NROL-49. It was also louder than the Delta IV DMSP-17 launch. The Delta IV NROL-65 TSEL was 2.8 dB higher, the ASEL was 1.4 dB higher, and the CSEL was 0.3 dB higher than the Delta IV DMSP-17 measurement. The noise from the previous Delta IV launches was similar in the frequency domain, with the Delta IV Heavy NROL-49 launch noise being the loudest.

From the measurements on south VAFB and the perspective of the harbor seal haul-out sites on south VAFB, the Delta IV NROL-49 vehicle was the loudest measured to date (Table 5). This is due to the relatively close proximity of SLC-6 to the harbor seal haul-out sites on south VAFB. At a distance of approximately 2.7 km, SLC-6 is 3.5 times closer to the seals' haul-out sites on south VAFB than the previous Titan IV launch complex (SLC-4).

Table 5. Sound levels for launch vehicles on VAFB (MSRS 2013b).

Launch Vehicle	Satellite	Launch Complex	Launch Date	Dist. to Haul-out (km)	TSEL (dB)	CSEL (dB)	ASEL (dB)	TPeak (dB)	Lmax (dB)
Delta IV	NROL-65	SLC-6	28-Aug-13	2.7	134.1	127.8	112.7	131.0	100.1
Delta IV	NROL-49	SLC-6	20-Jan-11	2.7	133.5	128.3	113.3	131.7	106.0
Delta IV	DMSP-17	SLC-6	4 Nov-06	2.7	131.3	127.5	111.3	129.0	102.6
Titan IV	B-34	SLC-4E	5-Oct-01	8.5	130.2	124.2	104.5	125.0	100.6
Athena II	Ikonos-1	SLC-6	27-Apr-99	2.8	127.9	123.7	107.3	125.6	99.9
Delta IV	NROL-22	SLC-6	27-Jun-06	2.7	127.7	122.9	106.2	130.0	103.1
Titan IV	B-12	SLC-4E	22-May-99	8.5	127.6	121.9	103.6	123.7	97.0
Athena I	Lewis	SLC-6	22-Aug-97	2.8	127.0	121.3	107.3	126.8	101.0
Titan IV	B-28 NRO	SLC-4E	17-Aug-00	8.5	126.8	119.9	99.0	123.5	91.5
Athena II	Ikonos-2	SLC-6	24-Sep-99	2.8	125.9	123.4	107.8	124.6	102.2
Titan IV	A-18	SLC-4E	23-Oct-97	8.5	125.9	119.0	96.6	121.8	88.2
Atlas IIAS	AC-141 Terra	SLC-3E	18-Dec-99	9.9	124.2	113.6	87.3	120.3	76.4
Minotaur	MightySat	CS	19-Jul-00	2.3	122.9	117.9	107.0	122.0	101.7
Titan II	G-7	SLC-4W	19-Jun-99	8.5	120.3	112.3	87.7	121.4	79.1
Minotaur	JAWSAT	CS	26-Jan-00	2.3	119.4	116.6	105.4	125.0	103.4
Titan II	G-12	SLC-4W	13-May-98	8.5	119.3	115.0	95.4	113.0	85.9
Delta II	MS-9	SLC-2	17-May-98	22.0	118.1	103.1	72.4	113.9	61.8
Atlas IIAS	MLV-10	SLC-3E	8-Sep-01	9.9	118.0	112.1	88.5	112.6	80.8
Titan II	G-6	SLC-4W	4-Apr-97	8.5	116.5	112.4	88.5	111.3	76.1
Titan II	G-13	SLC-4W	21-Sep-00	8.5	116.3	109.6	83.5	109.5	74.9
Taurus	KOMPSAT	SLC-576	20-Dec-99	20.3	106.4	101.3	76.4	102.9	65.0

4.2.3. Falcon 9 Cassiope

Further details of the following summary will be found in the launch monitoring report (URS, in prep.). Monitoring on VAFB was required and was performed at South Rocky Point (Figure 1) between 26 September 2013 and 1 October 2013. The number of elephant seals within the focal group ranged from 83 to 163 seals during pre-launch counts, while post-launch counts were very similar but fell to within a range of 100 to 155 juvenile seals (Figure 5). Only one harbor seal and one California sea lion were observed hauled out at South Rocky Point during the launch monitoring period. No animals flushed to the water as a result of the launch or associated launch noise. There was no evidence of injury, mortality, or abnormal behavior as a result of the Falcon 9 Cassiope launch.

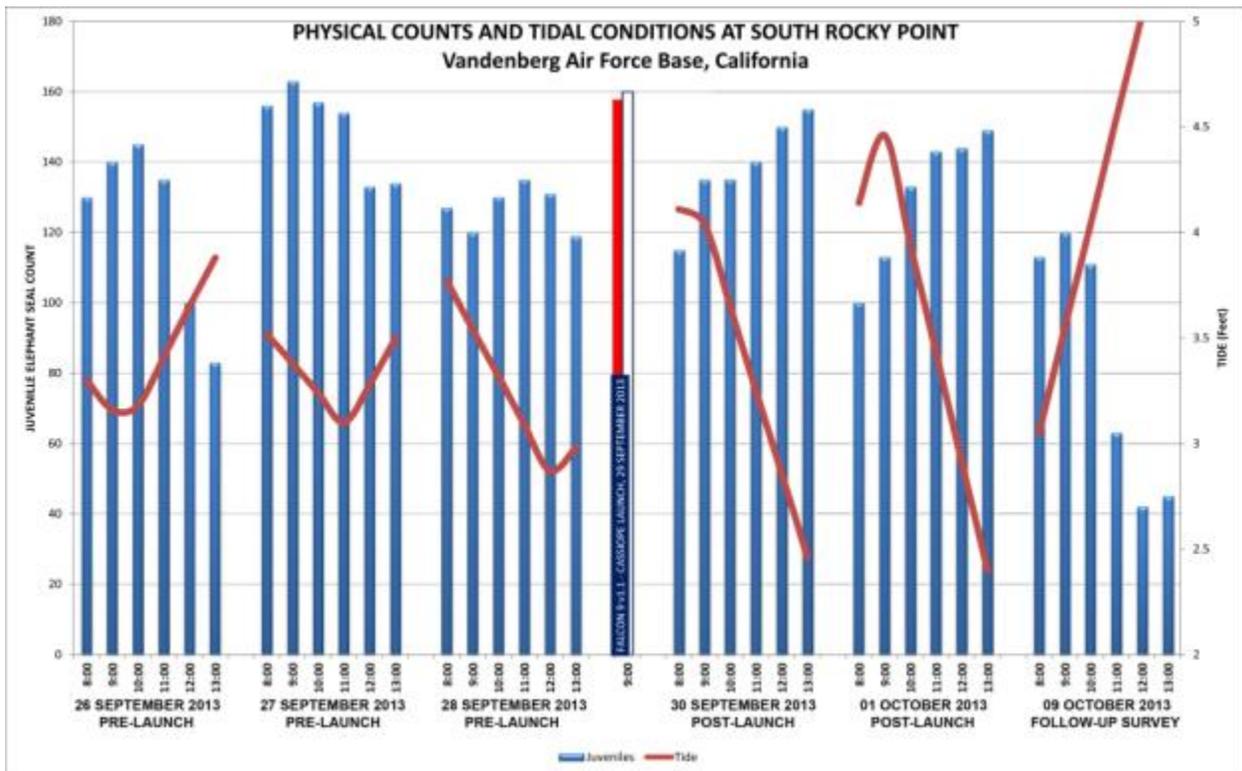


Figure 5. Falcon 9 Cassiope, total numbers of juvenile northern elephant seals (URS, in prep.).

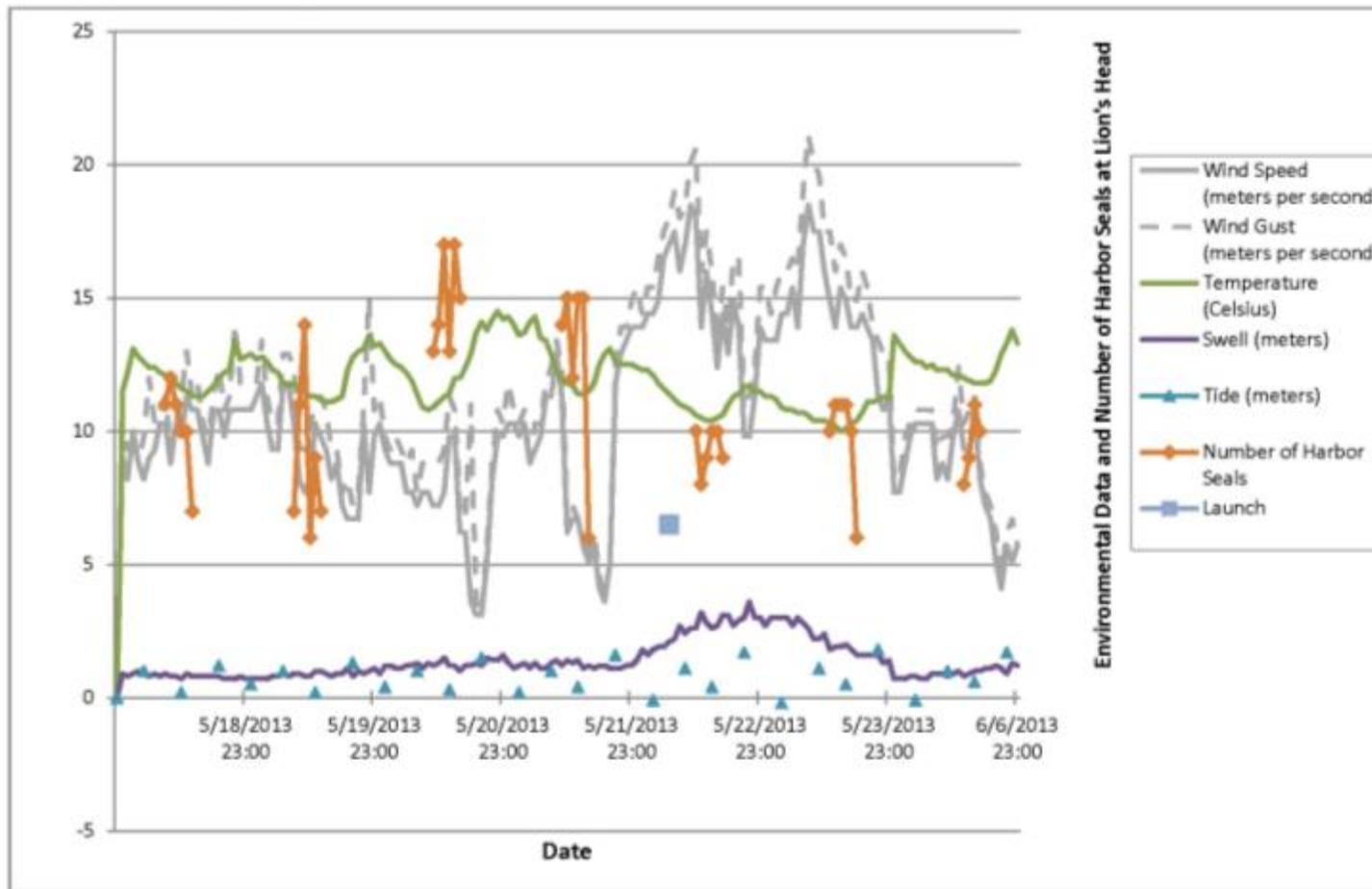
4.2.4. MMIII FT-207GM

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 (Tetra Tech 2013). Monitoring on VAFB was required and was performed at Lion's Head (Figure 2) between 18 May 2013 and 6 June 2013. The number of adult harbor seals observed during monitoring ranged between six and seventeen (Figure 6). During pre-launch monitoring, between six and seventeen adult harbor seals were counted. Post-launch counts ranged between eight and eleven adult harbor seals. No pups were observed during pre- and post-launch monitoring. As required, a follow-up survey was conducted on 6 June 2013 at the Lion's Head haul-out site. During this follow-up survey, between eight and eleven adult harbor seals and no pups were observed.

The first day of pre-launch adult harbor seal maximum counts were similar to the first day of post-launch maximum counts, with a difference of two adults. The second post-launch maximum count and follow-up survey count exceeded the first day of post-launch counts. Therefore, it is likely that if the launch affected any of the seals, effects were negligible and temporary. No evidence of injury, mortality, or abnormal behavior was observed as a result of the MMIII GT207-GM launch.

4.2.5. Additional Missile launches

Two additional launches of the MMIII and two launches conducted by the Missile Defense Agency did not require pinniped monitoring, due to their occurring outside of pupping season.



Note: Environmental data recorded at Point Arguello and Santa Maria weather stations (PTGCI and 46011). Swell data recorded at Harvest weather station (46218) (NOAA 2013).

Figure 6. MMIII GT-207GM, harbor seal counts at Lion's Head (Tetra Tech 2013).

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. The results of these surveys can differ from the launch monitoring reports since the monthly surveys are typically conducted during the lowest daytime tides of each month, when the greatest numbers of animals are usually hauled out, whereas the launch surveys are conducted 72 hours before each launch, during each launch itself when possible, and for 48 hours after each launch. Thus, the launch dates and times do not coincide with the lowest tides of the month.

None of the monthly surveys suggested any changes in haul-out patterns as a result of the launches (MMCG and SAIC 2012a and b; MSRS 2013c and unpubl. data). Surveyors in 2011-2012 noted a decline in harbor seal numbers from historic levels (MMCG and SAIC 2012b); however count totals were greater in the 2012-2013 surveys than in the 2011-2012 surveys (MMCG and SAIC 2012a and b; MSRS 2013c and unpubl. data) and potentially show an overall increasing trend (Figure 7).

During 2013, the number of northern elephant seals hauled out on VAFB increased 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. [URS], in prep.). 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.).

Six California sea lions were observed in April 2013 and two in May 2013 at North Rocky Point. During 2012 and repeating in 2013, occasional sightings of Steller sea lions were also reported, at North Rocky Point.

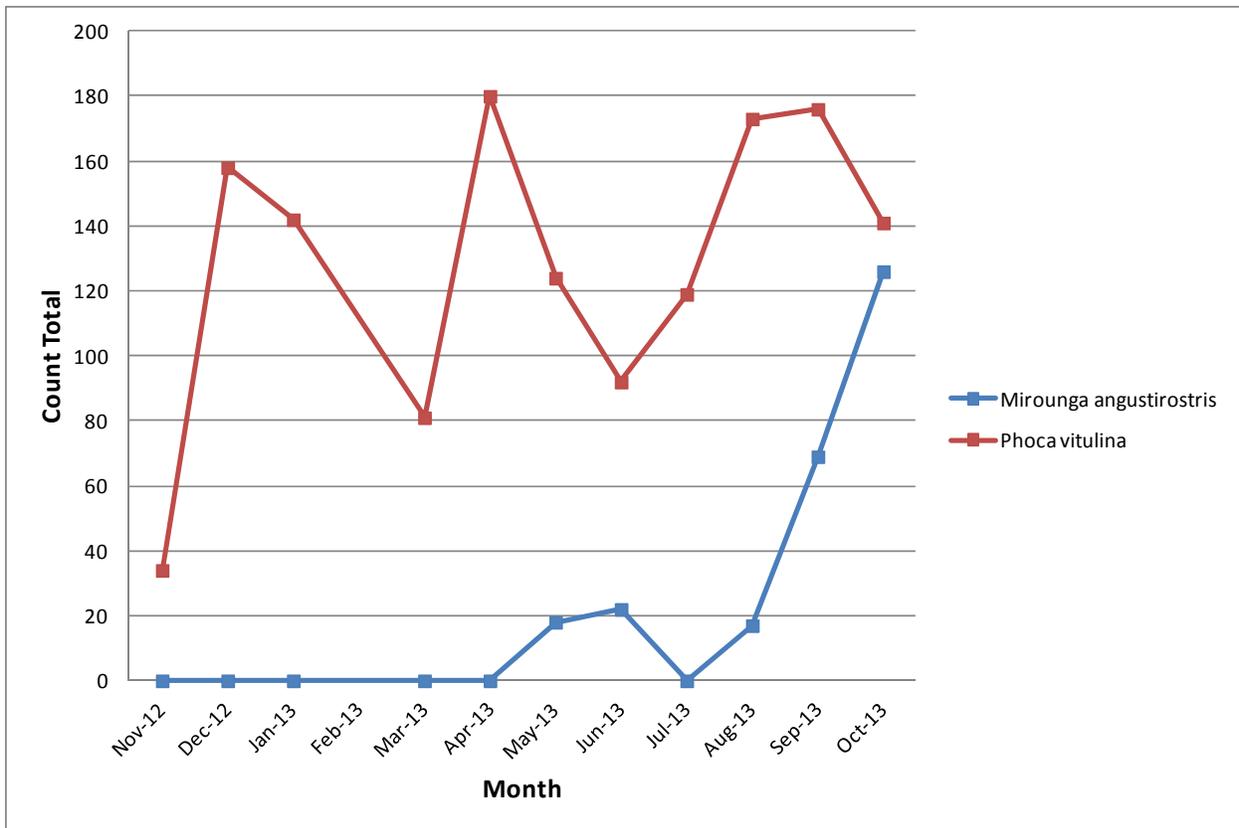


Figure 7. Monthly pinniped survey count totals for Northern elephant seals and harbor seals from November 2012 through October 2013 (MMCG and SAIC 2012a; MSRS 2013c; MSRS unpubl. data).

4.4 Fixed-wing Aircraft and Helicopter Operations

During the reporting period, 2,118 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. 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. 2013). An incident involving an illegal drug-smuggling “Panga” boat landing on VAFB in April 2013 resulted in many fixed and rotary-wing security flight operations, as discussed in Section 2.1.3.

5.0 Discussion

5.1 Natural Effects on Haul-out Patterns

5.1.1. Environmental Conditions

Numerous environmental factors affect pinniped haul-out patterns, summarized from previous reports (MMCG and SAIC 2012a and 2012b):

- Higher tides reduce or eliminate haul-out areas at VAFB;
- More haul-out area is available when surf is small;
- In undisturbed areas, more harbor seals haul out in afternoons, regardless of tides and surf, provided adequate haul-out space is available out of reach of waves and tides;
- Where haul-out space is limited, tides and breakers can limit haul-out patterns;
- Wind and wind chill, along with temperature, combine either to make haul-out sites desirable or untenable;
- Abundant prey may cause animals to remain offshore longer. If abundant prey remains nearby, the opposite the opposite may be true;
- In areas subject to chronic daytime disturbance, harbor seals often shift to a nighttime haul-out pattern to avoid harassment (Howorth 1995), go to other haul-out areas or rest in offshore kelp beds (MMCG and SAIC 2011 and 2012b).

5.1.2. Seasonal and Cyclic Effects

Seasonal and cyclic effects have been discussed in previous documents (MMCG and SAIC 2012a and 2012b) and are summarized below:

- In winter, unusually high tides, large surf and strong currents can strip sand from beaches, resulting in less haul-out area;
- When sand builds beaches back up in mild conditions, tides must be higher to reach the same point because the beach is higher from sand build-up. More haul-out area is available;
- Sand deposition from landslides can make rocks normally isolated by water accessible from land or even bury the rocks, making such areas less desirable as haul-outs;
- Harbor seals generally haul out in substantial numbers during the pupping and breeding season, from March through June at VAFB and;
- In general, the largest numbers of harbor seals haul out during molting season, from May into summer.

5.1.3. Landslides

Starting in late July or early August 2010, a series of landslides continued at Weaner Cove (MMCG and SAIC 2012b). Slides have also occurred at Amphitheatre, immediately to the north. Weaner Cove once had a sizable beach for seals, but became buried as a result of the slide. The sediment deposition also caused down-current haul outs to become accessible to terrestrial predators as sand built up (MMCG and SAIC 2012b). As a result, Weaner Cove has been virtually abandoned by the harbor seals. Only up to seven individuals have been observed in Weaner Cove since the slide. The seals likely dispersed to other sections of the coast to the north and south of Weaner Cove. This dispersal may include apparent increased harbor seal haul-out activity at nearby Point Conception (anecdotal observations). The landslide event continues to be monitored through photo documentation during monthly marine mammal surveys (Figure 8).



Amph_Cove_North_2013Mar07



Amph_Cove_North_2013Apr04-2



Amph_Cove_North_2013May02



Amph_Cove_North_2013Jun03-2



Amph_Cove_North_2013July



Amph_Cove_North_2013Aug08-3

Figure 8. Landslide at Weaner Cove looking north towards Amphiteater.

5.1.4. Effects of Predation

Coyotes (*Canis latrans*) sometimes prey upon harbor seals, especially pups. Such behavior has been documented at VAFB (MMCG and SAIC 2012a) and in other parts of California (Howorth 1995) as well as in Washington State (Gearin *et al.* 1990). Coyotes are commonly observed along the top of the bluffs and on the beaches on VAFB. Behavioral observations of the seals suggest their wariness of coyotes. The seals quickly react to any movement from shore or from the bluffs. As a result, they generally haul out only at the most secure locations protected from land access by terrestrial predators.

Some evidence suggests that there may be an increase in white shark (*Carcharodon carcharias*) predation on harbor seals in the region. Increased numbers of dead seals, sea lions and sea otters killed by white sharks have been reported at VAFB by U.S. Geological Survey biologists and by observers during launches and monthly surveys from 2010 into 2012 (MMCG and SAIC 2011 and 2012b; MSRS 2012). Unusual numbers of live-stranded seals and sea lions with bite wounds inflicted by great white sharks were recorded in other parts of Santa Barbara County from 2010 into 2012 (Santa Barbara Marine Mammal Center 2010-2012). This has been suggested as a contributing factor in the decline to the harbor seal population on VAFB (MMCG and 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 Human Activities

5.2.1. Effects of Launches

During monitoring on SMI, there was no discernible response from sea lions to the Atlas V LDCM launch on 11 February 2013. The behavior of California sea lions and elephant seals remained completely unchanged during the launch and monitoring ceased after a final count of animals at 11:00 PST on 11 February because no sonic boom was observed. Pinniped monitoring was not required on the NCI or on VAFB for the Delta IV NROL-65 launch on 28 August 2013. On VAFB, no animals flushed to the water as a result of the Falcon 9 Cassiope launch or the associated launch noise on 29 September 2013. Pre-launch counts were similar to post-launch counts suggesting that there was no long term effect from the launch either. There was no evidence of injury, mortality, or abnormal behavior as a result of the Falcon 9 Cassiope launch. For the MMIII GT207-GM launch on 22 May 2013, 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.

5.2.2. Human Activities near Haul-out Areas

Other than launch noise impacts, no other human-related impacts were reported during monitoring on VAFB for the MMIII GT-207GM and Falcon 9 Cassiope launches. Human presence/disturbance was noted during four monthly surveys at the Spur and Little Sal haul outs during 2012-2013. Of the four incidences, one was noted to be researchers conducting other work in the tide pools at the haul out location (under authority an Incidental Harassment Authorization issued to the University of California, Santa Cruz) and another were fishermen on

the rocks adjacent to the haul out. The surveyors noted that three of the incidents likely had an effect, noting that no harbor seals were hauled out on these dates. Surveyors noted that the fourth observation of human presence did not seem to disturb the seals, since the people were in the vicinity but not readily visible to the seals at the haul out.

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.

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