

**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 JANUARY TO 31 DECEMBER 2020**



Photo Credit: Tiffany Whitsitt-Odell

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Table of Contents

Executive Summary.....	iii
1.0 Introduction	1
2.0 Operations	2
2.1 Rocket Launches	2
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 Acoustic Monitoring.....	5
3.3 Launch Monitoring.....	5
3.4 Fixed-wing Aircraft and Helicopter Operations	6
3.5 Monthly Surveys	6
4.0 Results.....	7
4.1 Sonic Boom Modeling.....	7
4.2 Acoustic Monitoring.....	7
4.3 Launch Monitoring.....	7
4.5 Monthly Marine Mammal Surveys	8
4.5.1 Pacific Harbor Seal	9
4.5.2 Northern Elephant Seal.....	12
4.5.3 California Sea Lion.....	13
4.5.4 Steller Sea Lion.....	14
4.5.5 Incidental Sightings.....	15
5 Discussion.....	16
5.1 Effects of Natural Factors	16
5.2 Effects of VAFB Operations.....	16
6 Conclusion.....	16
7 Literature Cited	17

Tables

Table 1. Rocket Launches in 2020.....	2
Table 2. Missile Launches in 2020.....	2
Table 3. Launch Monoring Requirements in 2020 ¹	7
Table 4. 2020 Monthly Pacific Harbor Seal Survey Results.	9
Table 5. Historic Pacific Harbor Seal and Northern Elephant Seal Survey Results at Amphitheatre Cove.....	10
Table 6. 2020 Monthly Pacific Harbor Seal Results by Haul-Out (North to South).	11
Table 7. 2020 Monthly Northern Elephant Seal Results.....	12
Table 8. 2020 Monthly California Sea Lion Results.....	13
Table 9. Historic and Current Summary of California Sea Lion Survey Results.	13

Figures

Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB.....	3
Figure 2. Launch Sites (many inactive) and Pinniped Haul-out Areas on North VAFB.	4
Figure 3. Steller Sea Lion Range and Rookeries (Alaska Fisheries Science Center 2015).	15

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) related to VAFB's request for unintentional take of marine mammals pursuant to the Marine Mammal Protection Act (MMPA) regulation.

This report summarizes results of monthly pinniped surveys in addition to describing pinniped monitoring conducted in association with space vehicle (rocket) and missile launches, first stage recovery ("boostback") of the SpaceX Falcon 9, together with fixed-wing aircraft, helicopter and unmanned aerial vehicle operations. Species of interest at VAFB 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 four species mentioned for VAFB.

During the reporting period (1 January to 31 December 2020), VAFB launched one rocket and four missiles. VAFB avoided launches when possible during the Pacific harbor seal pupping season (1 March through 30 June) or if they would produce a sonic boom over the Northern Channel Islands (NCI) during the Pacific harbor seal pupping season. Pinniped monitoring was not required for any rocket or missile launch. The Falcon 9 rocket first stage recovery ("boost back") required monitoring. During the reporting period, 5,792 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., 2020).

LOA monitoring requirements were followed during 2020 and no incidents of injury or mortality of a pinniped caused by VAFB operations were documented (MSRS 2020).

1.0 Introduction

This report presents information to satisfy the requirements of the LOA (NOAA 2019a) issued to VAFB 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," VAFB has agreed to send quarterly advisories and updates to NOAA. These quarterly advisories were submitted in January, April, July and October 2020 (R. Evans, pers. comm., 2020).

Historically, Pacific harbor seals (*Phoca vitulina*; hereafter harbor seal) have been the most abundant pinnipeds on VAFB, 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; all species except Steller sea lions increasing in recent years (MSRS 2014, CEMML 2016a, CEMML 2016b). 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 did not occur in 2020 for unknown reasons. During the latter half of 2016 and throughout 2019, elephant seal numbers had a marked increase and in 2017 established a rookery at Amphitheatre Cove. Elephant seal pups were first documented in January 2017, again observed in January-March 2018, 2019, and 2020. The revised 2017 LOA (NOAA 2017), required launch monitoring of the elephant seal rookery beginning 01 January 2018.

Potential impacts to pinnipeds on VAFB include harassment from noise, particularly sonic booms, generated from rocket or missile launches, Falcon 9 boostback, 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 VAFB. 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 2020 reporting period, monitoring on the Northern Channel Islands (NCI) was not required for any launch. Monitoring on VAFB was required for one rocket boostback landing event (Falcon 9 in November). This report describes the methods and results of the marine mammal monitoring efforts and discusses the impacts of Air Force operations. A new commercial launch entity plans to begin operations at Space Launch Complex 2 (SLC-2) in early calendar year 2021.

In 2020, Space Exploration Technologies (SpaceX) continued conducting their terrestrial "boost-back" action. This involves the first stage of the Falcon 9 rocket launched from SLC 4-East returned to SLC 4-West about 8 minutes later; the first stage of the rocket is refurbished and re-used. Starting in 2021 or 2022, significant modifications will be initiated at SLC's 3 and 6 for new rocket types and perhaps new launch proponents. 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 "constellations" are now commonplace.

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.

2.0 Operations

Operations that occur on VAFB covered by the LOA include rocket and missile launches as well as fixed-wing aircraft and occasional helicopter activities. Operations activities occurring in 2020 are detailed below. The locations of launch sites in relation to pinniped haul-out areas on VAFB are shown in Figures 1 and 2.

2.1 Rocket Launches

Only one rocket launch occurred during the reporting period, from SLC 4 on south VAFB (Table 1).

Table 1. Rocket Launches in 2020

Vehicle Type	Facility	Launch Date
Falcon 9 – Sentinel 6-MF ¹	SLC 4E	21 November

¹Included “boost back” and landing to the pad at SLC-4W

2.2 Missile Launches

Four missile launches occurred during the reporting period from Launch Facilities LF-04, LF-09 and LF-10 (Table 2); all of these facilities are on north VAFB. The locations of these sites in relation to pinniped haul-out areas on VAFB are shown in Figure 2. All launches were unarmed Minuteman III (MM-III) Intercontinental Ballistic Missile (ICBM) test launches.

Table 2. Missile Launches in 2020

Missile Type	Facility	Launch Date
MM III FTU-2	LF-04	5 February
MM III GT-235GM	LF-10	4 August
MM III GT-233GM	LF-04	2 September
MM III GT-236GM	LF-09	29 October

2.3 Fixed-wing Aircraft and Helicopter Operations

Various types of fixed-wing aircraft fly from VAFB. 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.

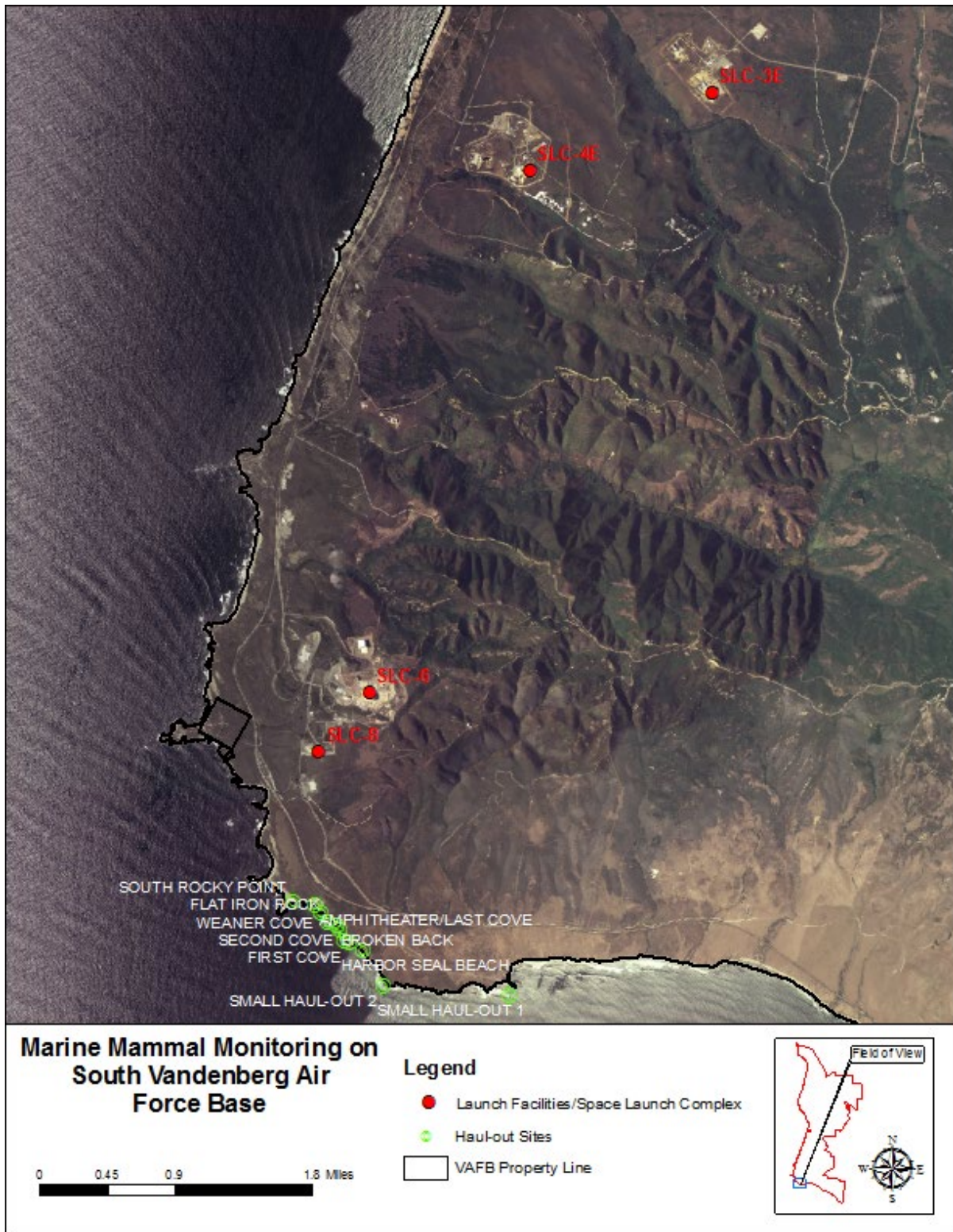


Figure 1. Launch Sites and Pinniped Haul-out Areas on South VAFB.

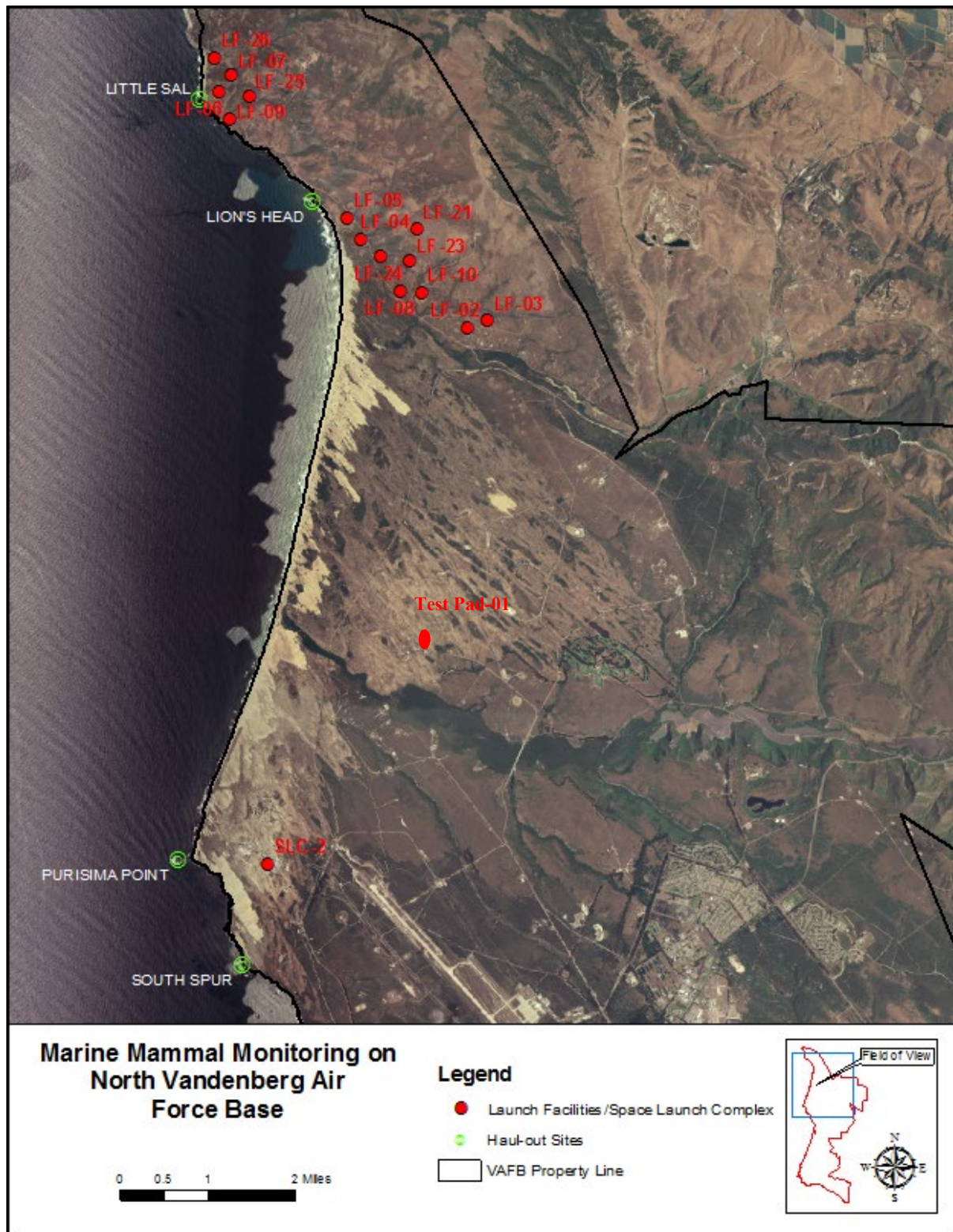


Figure 1. Launch Sites (many inactive) and Pinniped Haul-out Areas on North VAFB.

3.0 Methods

3.1 Sonic Boom Modeling

As required in the LOA, sonic boom modeling 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 VAFB 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 VAFB for the landing of the Falcon 9 first stage (boostback) at SLC 4-W. Acoustic monitoring on south VAFB was required for the November Falcon 9 launch.

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 VAFB 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, VAFB 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 VAFB.

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 VAFB 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 VAFB, 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 VAFB include Amphitheatre Cove and may include North and South Rocky Point (Figure 1). Amphitheatre 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 VAFB, direct observations during launch events are usually not allowed due to safety concerns; therefore video is utilized during daytime launches on VAFB 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 VAFB Airfield (30 OSS/OSAB) keeps records of number and nature of all fixed-wing aircraft and helicopter operations completed at VAFB.

3.5 Monthly Surveys

The Center for Environmental Management of Military Lands (CEMML) and U.S. Air Force personnel, 30th Civil Engineer Squadron (30 CES) biologists surveyed marine mammal haul-out sites on North and South VAFB (Figures 1 and 2) monthly from January to December 2020. For each survey, high quality binoculars and 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 VAFB, observations are made from cliffs overlooking haul-outs. Purisima Point has been omitted from all surveys throughout 2015-2020 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 VAFB (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 (Amphitheatre Cove, South Rocky, and North Rocky). In 2020, 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 coast line. 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, only one monitoring effort was required during 2020. Launch mitigation requirements are presented in Table 3 and discussed in detail in the following subsections.

Table 3. Launch Monitoring Requirements in 2020¹

Rocket or Missile	Launch Date	NCI	VAFB	Video	Video Result	Boom Model
MMIII-FTU2	5 February					
MM III GT-235-GM 1	4 August					
MM III GT-233-GM	2 September					
MM III GT-236-GM 1	29 October					
Falcon 9-Sentinel 6-MF	21 November		Required ²	Required ²	Success	Required ²

¹ Blank Cell = action not required.

² Monitoring was required for the “Boostback” landing of the first stage, not the launch; boom modeling was required for both the launch and the landing.

4.1 Sonic Boom Modeling

Sonic boom modeling was conducted for the one rocket launch that occurred during the 2020 reporting period. The boom model did not predict impacts that would require monitoring on the NCI, however the Falcon 9-Sentinel 6 (Michael Freilich) mission required monitoring of the first stage re-entry and landing at Space Landing Complex 4-West. The model predicted an overpressure (sonic boom) greater than 2 psf would result from the landing on VAFB.

4.2 Acoustic Monitoring

Modeling predicted no sonic booms would impact the NCI in the 2020 reporting period, therefore no acoustic monitoring was required on the NCI. Acoustic monitoring on VAFB for the landing of the Falcon 9-Sentinel 6 (Michael Freilich) mission was required.

4.3 Launch Monitoring

No launches required monitoring on NCI during the 2020 reporting period. One launch/boostback required monitoring on VAFB. Full details of the monitoring for that launch can be found in the launch and landing monitoring report sent to NMFS previously (MSRS, 2020), a summary follows.

4.3.1 Falcon 9 – Sentinel 6 (Michael Freilich) - 21 November)

One launch of the Falcon 9 rocket occurred in the reporting period. Technically, only the landing component of the action required pinniped monitoring on VAFB (MSRS 2020), however as the landing occurs only 8 minutes after the launch, landing monitoring is conducted simultaneously. Sonic boom modeling of Sentinel 6 determined that the launch would not generate a boom that would impact the NCI.

The Sentinel 6 launch (MSRS 2020) occurred at 0917 hours on 21 November. The “boost back” landing required pinniped monitoring. Video recording of the pinnipeds during the launch and landing window was successful. The landing produced an overpressure (sonic boom) calculated to be 2.35 psf at the pinniped monitoring location.

Monitoring at VAFB was conducted at all haul-outs between North Rocky Point and Small Haul-Out 2, with a focus on South Rocky Point and Amphitheatre Cove. Pre-launch counts were recorded several times per day, from 18-20 November. Post launch surveys were conducted 22-23 November. Detailed counts are presented in MSRS 2020.

Elephant seal pre-launch counts ranged from 139-276 adults and juveniles. Post-launch counts ranged from 44-248 adults and 19 juveniles. Although harbor seal counts were not required, they ranged from 2-24 before and 1-47 after the launch. Pups were not present for either species, as expected.

During all monitoring, no pinnipeds were observed to have any injuries, mortality, or abnormal behavior.

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

During the reporting period, 5,792 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. VAFB had 755 operations that were either unmanned vehicles or helicopters, which are not allowed to fly lower than 1,000 feet over the coastline. 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 2761; additionally, 3027 overflights below 2,500 feet in altitude (but not above the coastline), and 132 Unmanned Aerial Systems (“drone”) operations were recorded. Distinguished Visitor flights included the Command Sergeant of the Air Force and the Commander of the United State Space Force.

No indications of significant disturbances, abnormal pinniped behavior, injury, or mortality were reported as a result of these operations (R. Evans, pers. comm. 2020).

4.5 Monthly Marine Mammal Surveys

Monthly surveys were conducted throughout 2020. 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 indicates the monthly survey results of harbor seals and elephant seals at Amphitheater Cove on VAFB from 2014-2020.

4.5.1 Pacific Harbor Seal

Harbor seals use many of the locations along the VAFB coastline to haul out throughout the year. Harbor seals regularly utilize Amphitheatre 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 2020 varied from a low of 79 in December to a high of 196 in June (Table 4), with an average monthly count of 108 for the survey period. Pups were observed in March, April, May and June, with a peak of 28 in April 2020. Only two harbor seal mortalities were detected (and reported to NMFS) in 2020.

On North VAFB, the Spur Road haul out had the most individuals observed with a peak of 29 in October 2020 (Table 6) and Lion’s Head had the least individuals observed. On South VAFB, the Small Haul Out 2 and Amphitheatre locations regularly had the most individuals observed. Amphitheatre had a peak of 50 in April 2020 and Small Haul Out 2 had a peak of 22 in December (Table 6). East Islet and South Arguello Ridge were not surveyed. North Rocky Point, South Rocky Point, First Cove and Harbor Seal Beach were surveyed locations with no harbor seals recorded; First Cove only had harbor seals observed in two months in 2020 (April and May).

Table 4. 2020 Monthly Pacific Harbor Seal Survey Results.

Month	Adult [^]	Juvenile [^]	Pup [^]	Total [^]
January	79	9	0	88
February	112	0	0	112
March	91	15	14	120
April	74	8	43	125
May	132	0	14	146
June	179	0	17	196
July	88	0	0	88
August	91	0	2	93
September	72	11	0	83
October	91	3	0	91
November	79	3	0	82
December	79	0	0	79

[^]Numbers reflect 1.54x correction factor

There has been significant variation in the number of harbor seals utilizing Amphitheatre Cove from 2014 through 2020 (Table 5). A drastic increase occurred from 2014 to 2015 and a decrease occurred from 2016 to 2020. This is not a product of survey intensity as a survey was conducted nearly every month for all five years at Amphitheatre Cove. One explanation could be the increased use of Amphitheatre 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. It is not directly known if use of Amphitheatre by elephant seals is affecting the number of harbor seals utilizing the site, or if another unknown factor is contributing to this affect. In 2017-2020, both harbor seals and elephant seals utilized the Amphitheatre haul out for giving birth and weaning pups.

Table 5. Historic Pacific Harbor Seal and Northern Elephant Seal Survey Results at Amphitheatre Cove.

Year	Pacific Harbor Seals			Northern Elephant Seals		
	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)

[^]Numbers reflect 1.54x correction factor for PHS, rounded to nearest whole number

Table 6. 2020 Monthly Pacific Harbor Seal Results by Haul-Out (North to South).

Haul-Outs	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Little Sal	0	0	0	3	0	9	0	3	8	0	2	0
Lion's Head	2	6	6	0	2	0	0	0	0	0	0	0
Purisima Point	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Spur Road	29	40	23	9	11	6	0	28	23	45	26	11
East Islet	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
S. Arguello Ridge	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
North Rocky Point	0	0	0	0	0	0	0	0	0	0	0	0
South Rocky Point	0	0	0	0	0	0	0	0	0	0	0	0
Amphitheatre	15	28	49	77	55	46	26	3	17	14	25	26
Weaner Cove	0	0	0	0	0	6	0	0	0	0	0	0
Flat Iron Rock	0	0	14	0	40	119	42	32	18	15	0	3
Broken Back	0	0	0	0	3	6	0	0	0	0	0	0
Second Cove	0	0	0	3	0	0	0	0	0	0	0	0
First Ledge	0	0	0	0	0	0	0	0	0	0	0	0
First Cove	0	0	0	12	2	0	0	0	0	0	0	0
Harbor Seal Beach	0	0	0	0	0	0	0	0	0	0	0	0
Small Haul Out 2	28	18	23	20	29	2	20	26	17	17	28	72
Small Haul Out 1	14	20	5	0	5	2	0	0	0	0	2	5
Total	88	112	120	125	146	196	88	92	83	91	82	79

^aNumbers reflect 1.54x correction factor, rounded to nearest whole number

*NS = Not Surveyed

4.5.2 Northern Elephant Seal

Elephant seals historically hauled out in low numbers on VAFB 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 and 1,345 in 2019. This trend has continued into 2020 with a total of 1,396 elephant seals detected during 2020 surveys (Table 7). These numbers peaked in May with 302 elephant seals counted. Two elephant seal mortalities (one adult, one subadult) were documented and reported to NMFS in June and November 2020 (R. Evans, pers. comm., 2020). No surveys occurred at Point Conception in 2020.

Table 7. 2020 Monthly Northern Elephant Seal Results.

Month	Adult	Juvenile	Pup	Total
January	26	11	5	42
February	11	10	24	45
March	1	0	31	32
April	117	56	0	173
May	280	22	0	302
June	0	78	0	78
July	20	0	0	20
August	1	9	0	10
September	0	82	0	82
October	0	228	0	228
November	0	251	0	251
December	10	123	0	133

Elephant seal pupping was first documented at Amphitheatre 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, and 34 in 2020. Since 2018, the Air Force has conducted additional surveys of Amphitheatre 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 early 2021, we have not observed elephant seal pups on any Vandenberg rookery earlier than 3 January.

In early March 2019, VAFB 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. A third year of tagging is planned for late February 2021, and we hope to secure funding for a three-year satellite telemetry tagging project in cooperation with Dr. Liwanag, which would start in 2022.

4.5.3 California Sea Lion

During 2020, the highest number of California sea lion observations was 62 adults and juveniles in July (Table 8). This is a very significant decrease from 2019, for unknown reasons (Table 9). Typically California sea lions haul out at North Rocky Point, recently with more frequent hauled-out individuals observed at Amphitheatre 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, for reasons unknown (but not believed to be in any way related to Air Force operations).

Table 8. 2020 Monthly California Sea Lion Results.

Month	Adult	Juvenile	Pup	Total
January	6	0	0	6
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	35	0	0	35
June	14	0	0	14
July	62	0	0	62
August	1	0	0	1
September	16	0	0	16
October	0	0	0	0
November	28	0	0	28
December	5	0	0	5

Table 9. 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)

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 did NOT reoccur in 2020.

In 2020, 9 California sea lion mortalities were confirmed and reported, and four additional “unknown pinniped, likely California sea lion” mortality reports were submitted, when either decomposition or distance (e.g. only viewed through binoculars) prevented certain identification. This contrasts greatly with 2019, in which more than 80 California sea lions were found dead on VAFB beaches, and more than 1,600 were found dead between San Luis Obispo and Orange Counties (NMFS, J. Greenman, 2019, unpublished data). 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 VAFB at North Rocky Point in April 2012 during a monthly count (MMCG and SAIC 2013). Since May 2012 they have been observed regularly 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).

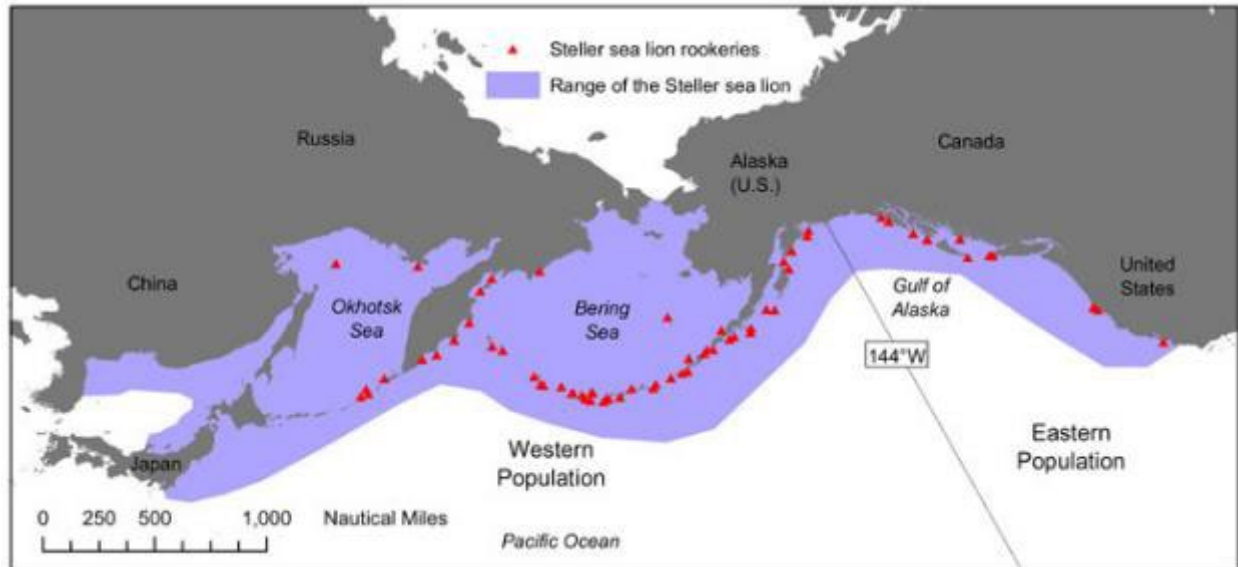


Figure 3. Steller Sea Lion Range and Rookeries (Alaska Fisheries Science Center 2015).

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 VAFB 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 2020 monthly surveys on VAFB. No Steller sea lion mortalities were documented in 2020 (R. Evans, pers. comm., 2020).

4.5.5 Incidental Sightings

One deceased delphinid, believed to be a striped dolphin, was found on a Vandenberg beach in 2020. The Air Force reported this to NMFS.

After obtaining a permit from NMFS, the Air Force donated the skull and a few ribs of one humpback whale (which died in 2018) to the aquarium at nearby Cabrillo High School, northwest of Lompoc (many teenagers who are affiliated with and/or live on VAFB attend this school).

Several incidental sightings of non-pinniped marine mammals or other notable observations occurred during 2020 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: one in February, nine in March, and between one and two each month between June and October.

In November, four dolphins (likely bottlenose dolphins [*Tursiops truncatus*]) were sighted near South Rocky Point.

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 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 VAFB (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 Amphitheatre Cove as they have established rookery. It is unknown what effect this is having or may have on harbor seals' use of Amphitheatre Cove in the future; they continue to use this site as a rookery.

5.2 Effects of VAFB Operations

The third SpaceX “boost back” and terrestrial landing occurred at VAFB in 2020. These are likely to become more frequent in the near future, with at least three planned for 2021. There was no evidence of injury, mortality, or abnormal behavior as a result of missile launches or of one rocket launch/terrestrial landing. No abnormal activity or mortalities were observed during the active monitoring of one rocket launch 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.

6.0 Conclusion

One rocket launch/landing required monitoring; it concluded that no abnormal behavior, injuries, or mortalities resulted from the launch or the terrestrial boost-back of a Falcon 9, and 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. VAFB 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 VAFB. 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 and an unusually high number of California sea lions hauled out on VAFB during the summer months. Elephant seal pupping continued for a fourth year

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