

# Scripps's Murrelet and Cassin's Auklet Reproductive Monitoring and Restoration Activities on Santa Barbara Island, California in 2014

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## EXECUTIVE SUMMARY

- California Institute of Environmental Studies, partnering with the National Park Service, has been actively restoring the native shrub habitat of Santa Barbara Island since 2007, as funded by the Montrose Settlements Restoration Program. The goals of this project are to increase the amount of nesting habitat for Scripps's Murrelet (*Synthliborhamphus scrippsi*) and restore an historic nesting colony of Cassin's Auklet (*Ptychoramphus aleuticus*). This effort has resulted in approximately 7.7 acres of restored habitat on the island, utilizing nearly 30,000 island-sourced native plants.
- In the 2014 nesting season, 186 Scripps's Murrelet clutches in 141 active nest sites were monitored on Santa Barbara Island. We could reliably determine the fates for 182 nests.
- Nesting data were collected at five plots in 2014: Arch Point North Cliffs, Bunkhouse, Cat Canyon, Landing Cove, and the Landing Cove Dock.
- The 2014 Scripps's Murrelet breeding season lasted 4.5 months (131 days) from the first calculated clutch initiation (19 February) to the latest monitored hatching date (4 July).
- We estimate clutch success for 2014 at approximately 70% (n=182 clutches). 60% of all observed eggs laid in 2014 hatched, and 27% were recorded as depredated by mice
- Where fate and egg order was known, depredation rates were higher for first eggs (33%, n= 120) than second eggs (18%, n=120).
- Nest sites are sometimes reused through the season, either by the same or a different pair. Clutch success of first clutches was slightly lower than second clutches, 70% vs. 74%.
- Cassin's Auklet artificial burrows were inactive in 2014, and social attraction was not attempted. No nesting was observed in artificial habitat, though auklets were observed nesting at Arch Point North Cliffs and Elephant Seal Cove in natural burrows.

This report provides a summary of the results of monitoring efforts conducted for seabird species on Santa Barbara Island in 2014, in particular Scripps's Murrelet (*Synthliborhamphus scrippsi*), and Cassin's Auklet (*Ptychoramphus aleuticus*). Provided within are recommendations for the future protection and monitoring of these and other seabird species on Santa Barbara Island. This assessment is prepared for the benefit of future research and to aid in the eventual success of the restoration of Santa Barbara Island.

## INTRODUCTION

Historically, Santa Barbara Island has provided excellent breeding habitat for Scripps's Murrelets and has supported a large Cassin's Auklet breeding population (Howell 1917, Murray et al. 1983, Willet 1912, Burkett et al. 2003, Whitworth et al. 2011). While the abundant native shrub habitat provided excellent nesting cover, the island's lack of large mammalian predators (i.e. Island Fox, Island Spotted Skunk, and mainland predators) allowed the birds to nest in relative safety.

However, over a century of human impacts on the island's native plant cover, in combination with nonnative predator introduction, negatively impacted the breeding populations of Alcids. Sometime between 1897 and 1911 (Hunt et al. 1978, Willet 1912), house cats were introduced to the island, presumably to reduce the numbers of deer mice around human habitations. These predators did not focus solely on the island mouse population, and by 1911 had succeeded in substantially reducing the Cassin's Auklet colony on the island. The habitat destruction continued with ranching efforts in the early 1900's, when native habitat was cleared in favor of grazing land for sheep. Rabbits were introduced to the island, further reducing native plant cover (Junak et al. 1993). Ultimately, the habitat loss from homesteading, ranching, hay and potato farming, and military operations restricted the amount of usable seabird habitat to the remnant native populations found inconsistently on cliff sides and in canyons.

The California Institute of Environmental Studies has been actively restoring the native shrub habitat of Santa Barbara Island (SBI) since 2007 (Harvey and Barnes 2009). The goals of this project are to increase the amount of nesting habitat for Scripps's Murrelet and restore an historic nesting colony of Cassin's Auklet. Restoration locations were chosen based on likelihood of colonization (proximity to current nesting locations) and historic use by the targeted species (Harvey et al. 2012, 2013b, 2014, Howard et al. 2014). In eight years of habitat restoration efforts on SBI, approximately 7.7 acres of the island have been replanted with nearly 30,000 island-sourced native plants.

Nest monitoring of Scripps's Murrelets is conducted along with these restoration activities to add to the long-term data set and track changes in population and reproductive performance in response to the change in habitat. The metrics of egg productivity, depredation rate, and clutch success have been calculated each year as an index to the health of the murrelet colony island-wide. In 2014, land-based nest monitoring for Scripps's Murrelet and Cassin's Auklet continued at five plots: Arch Point - North Cliffs, Cat Canyon, Landing Cove, under the Dock and around the Bunkhouse. Limited at-sea banding of murrelets occurred late May to early June in 2014. Motion activated IR cameras were installed at 9 sites in and around Landing Cove for the ongoing murrelet nest behavior study, though not all sites were active in 2014.

The location of natural Cassin's Auklet burrows within Scripps's Murrelet monitoring plots occurs incidentally, though 100 artificial nest boxes on Santa Barbara Island were placed in locations to promote nesting. These artificial burrows are checked throughout the auklet nesting season for activity. The data collected through monitoring will be used to demonstrate the success of the restoration effort, and understand long-term population dynamics of nesting seabirds on the island.

Approximately 7500 new plants were planted in the restoration plots in 2014. This expanded Northeast Flats Restoration Plot by one acre, and increased the diversity and size of the Nature Trail Restoration Plot. Advances in plant propagation techniques, increased restored habitat area, and the location of more seabird monitoring sites have helped the project become closer than ever to meeting their original goals.

## **BASIC BIOLOGY OF STUDY BIRDS**

**Scripps's Murrelet.** Described in detail in Murray et al. 1983, this is a brief synopsis of the major events of the Scripps's Murrelet nesting season.

Scripps's Murrelets arrive at Santa Barbara Island between late November and early December. The seabirds will congregate below nesting habitat and call to each other, occasionally moving onto land to investigate and prepare nest bowls in crevices and under usable shrubs. As the nesting season approaches, the appearance of more well defined nest bowls indicates likely nesting locations. The nesting season begins in February with the first nests being occupied. Nesting continues through June, with the last eggs generally hatching toward the end of that month.

Upon successful nest site selection and copulation, the Scripps's Murrelet lays one egg in a small nest bowl of loose gravel or dirt. No improvements are made to the nesting site beyond the digging of the slight depression and some debris removal from the immediate vicinity. Once the first egg is laid, the adults return to the water to feed and develop the next egg. After approximately eight days, the female returns to lay the second egg, completing the clutch.

Incubation usually begins within 2 days of clutch completion, and will last for 34 days after the second egg is laid. Both sexes incubate, trading shifts every couple of days.

After the egg is incubated to term, the eggs hatch within hours of each other. The chicks are then brooded in the nest for two days until the partner adult returns and the whole family group goes to the water. The chicks aren't fed in the nest, and eggshells are left as evidence of occupancy.

Nest sites can be reused several times in a season. There has not been clear documentation as to whether these are replacement clutches due to at-sea chick mortality, or late breeders utilizing previously occupied nest sites.

**Cassin's Auklet.** Paraphrased from Ainley et al. 2011:

Cassin's Auklets are burrow nesting seabirds with a wide distribution from southern Baja California to the Aleutian Islands.

Though it is unknown which of the pair selects the site, both adults dig and prepare the burrow, and nesting pairs reuse the same burrow in consecutive seasons. A single egg is laid between January and May, and is immediately incubated. Incubation lasts approximately 38 days, with both adults taking approximately 24 hour incubation shifts.

After hatching, the chick is brooded for a short time, and then left in the nest during the day. Adults feed the chick only at night. After 30-35 days, the chick begins exercising its wings, and can exit the nest burrow. Fledging occurs after 41-51 days in the nest, and is not necessarily associated with any parental assistance. Newly fledged chicks look virtually identical to their adult parents, with fresher plumage and brown irises.

During years of early spring conditions and good prey abundance, Cassin's Auklets have been known to raise more than one chick in a season. Once fledged, the chicks are apparently independent of their parents.

## METHODS

**Scripps's Murrelet Reproductive Monitoring.** Detailed descriptions of Scripps's Murrelet monitoring protocols can be found in past reports; see Harvey et al. 2013b and references therein. A basic overview of techniques follows:

The Scripps's Murrelet nesting season lasts from February through June (Murray et al. 1983, Harvey et al. 2014), and monitoring schedules within that timeframe were designed to record nest contents at approximately one-week intervals (Table 1). Transportation to and from the island was conducted based around a Wednesday-to-Wednesday boat schedule provided by the National Park Service, with periodic transportation and logistics contracted through Aspen Helicopters in Oxnard, California. Monitoring staff was housed at Channel Islands National Park housing on Santa Barbara Island.

In 2014, previously active nest sites were identified using a hand drawn map to locate small metal tags mounted on the rocks or branches immediately beside each nest bowl. All nesting habitat was explored with a small flashlight for signs of murrelet nesting activity. Individual nest sites were identified by the physical presence of murrelet eggs or a nesting bird. The appearance of a nest bowl structure in an appropriate location was noted and checked until occupied, but not considered an active nest site until occupancy was confirmed by the presence of eggs or an adult murrelet. New or previously unrecorded sites found while conducting checks were marked with a metal tag and checked weekly from that point forward.

Nest contents were recorded both on printed datasheets and in a PDA using Pendragon software. Eggs that were deemed accessible (within safe reach of researchers and without an adult attending) were photographed and marked with permanent marker for identification in egg order and fate determination. Each egg's length and width (at the widest point) were measured to the

nearest tenth of a millimeter using calipers. Adult birds were noted and not handled. Unattended eggshell fragments from depredated eggs or hatched eggs were recorded, collected, labeled appropriately, and are temporarily stored at Channel Islands National Park facilities. Eggshell fragments will be housed at the Western Foundation of Vertebrate Zoology in Camarillo, CA.

After the completion of the season, fate determinations were based on observed data and published timetables (Murray et al. 1983). Where eggs were determined to have failed (i.e., any fate but hatching), further fate determinations were based on the primary cause of failure. Murray et al. 1983 provided the required intervals of egg neglect, incubation and abandonment to determine the initial cause of failure versus any secondary causes. For example, the longest period of neglect Murray reported was 19 days, therefore any egg neglected for a shorter term that is then depredated is said to have been depredated as the cause of failure, not abandoned. An egg eaten after 20 days of neglect is considered failed due to abandonment, not depredation. Some egg fates could not be determined reliably, due to a range of circumstances. These eggs were excluded from analyses of fate determination.

The following metrics were used to describe seasonal reproductive parameters on Santa Barbara Island:

**Hatch Success** is determined as the number of hatched eggs divided by the total eggs laid. This measurement provides a percentage indicating how many young birds likely entered the population during the season.

**Egg Depredation** is reported as the percentage of eggs that failed as a direct result of depredation. Based on evidence recorded in the field, depredation is determined to have occurred where tooth marks are observed on an unhatched eggshell with a shiny adherent membrane. While this determination is not 100 percent certain, the existence of broken eggs and abandoned eggs within plots where depredation is evident lends support to the assumption that eggs that are broken or neglected are at risk, but can be detected before depredated as a secondary cause of failure.

**Clutch Success** is calculated as the proportion of all clutches which hatched, at minimum, one egg.

In 2014, a total of 382 tagged nest sites in five plots were monitored on a weekly basis throughout the murrelet nesting season. These plots were Arch Point-North Cliffs, Bunkhouse, Cat Canyon, Dock, and Landing Cove. The Elephant Seal Cove Restoration Plot, West Cliffs Plot and the Boxthorn Plot were not monitored for murrelet nesting activity due to safety and time constraints. We conducted 94 surveys on 88 individual days between 19 February and 24 June. Each survey included all potential habitat until June, late season surveys recorded only active nests, and a final all-habitat check was performed in the beginning of July (Table 1). The Northeast Flats, Landing Cove, and Beacon Hill Restoration plots were checked routinely for nesting evidence.

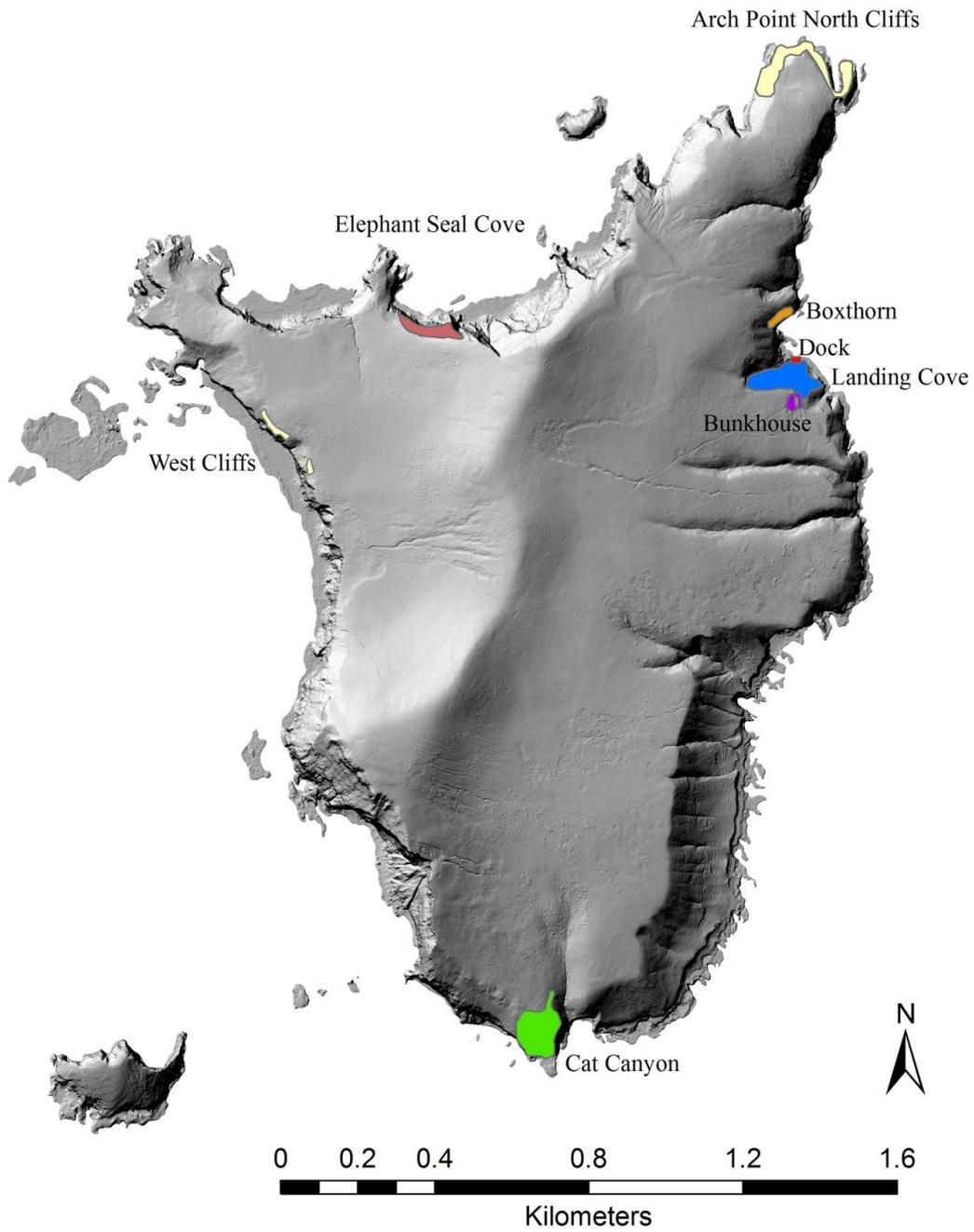


Figure 1. Overview map of all monitoring plots on Santa Barbara Island. Boxthorn, Elephant Seal Cove and West Cliffs plots were not monitored in 2014.

**Scripps's Murrelet at-sea captures.** Mark-recapture efforts for Scripps's Murrelets were conducted on a limited basis in late May through early June 2014. Based from the Landing Cove Dock, and following standardized methods as in previous years (Whitworth et al. 1997, Harvey et al. 2013a, 2013b), spotlight captures occurred on 6 survey nights in 2014 (Table 2). These captures involved a three-person team consisting of a driver, a spotlight operator and a net handler. Congregating murrelets were located by sight and sound from a 14ft Zodiac inflatable boat with 20 hp Yamaha outboard engine. Once the birds were located, the individual birds were captured with a dip net. Once captured, incubation status was assessed by brood patch, and the bird was banded (USGS size 2) and released. An on-island radio relay to Sequoia-Kings Canyon National Park Dispatcher was used in lieu of a support vessel. All banding was conducted in the capture boat. All capture and banding of birds was conducted under United States Geological Survey's Bird Banding Lab Permit #22539.

**Cassin's Auklet Artificial Burrows.** 100 artificial burrows are located at three locations on Santa Barbara Island. The 60 artificial nest burrows in Landing Cove were checked on 5 individual days between 25 February and 10 July. The 20 Northeast Flats sites were checked on 5 individual days between 20 February and 16 May. The 20 Elephant Seal Cove sites were checked 3 times between 24 February and 7 July. All original data are stored on site at Channel Islands National Park.

There were no attempts to capture or band auklets in 2014 on Santa Barbara Island.

**California Brown Pelican.** Reproductive monitoring for California Brown Pelican (*Pelecanus occidentalis californicus*) was conducted through the nesting season. Discrete groups of nesting Brown Pelican were identified and counted every two weeks between 1 March and 1 June 2014. Numbers of adults, occupied and empty nests, and numbers and stages of chicks were collected from vantage points located far enough away as to not visibly affect the birds.

**Storm-Petrel mist-netting.** Storm-Petrel mist net capturing efforts were conducted on ten nights between 2 July and 22 August. Ten Black Storm-Petrels (*Oceanodroma melania*) and 177 Ashy Storm-Petrels (*Oceanodroma homochroa*) were captured and banded as a result. See below for Storm-Petrel species encountered in Scripps's Murrelet monitoring plots.

# RESULTS

## INDIVIDUAL MONITORING PLOT STATUS

Each plot was analyzed separately to allow for comparisons to the previous year's nesting effort. All data used to compare to the 2013 nesting season is taken from Howard et al. 2014.

**Table 1. Survey intervals in monitoring plots in 2014.**

Monitoring Plot	Survey Date Range	Interval (days)	Final Survey	Total Surveys
APNC	2/21 – 6/20	7 (8-6)	7/4	19
BH	2/19 – 6/19	7 (9-6)	7/5	19
CC	2/23 – 6/23	7 (8-6)	7/6	19
DO	2/19 – 6/11	7 (8-6)	6/11	17
LACO	2/25 – 6/24	7 (8-6)	7/8	20

APNC=Arch Point-North Cliffs; BH=Bunkhouse; CC=Cat Canyon; DO=Dock; LACO=Landing Cove

**Arch Point-North Cliffs** .Located on the northernmost point of the island, Arch Point - North Cliffs monitoring plot is comprised solely of rocky crevice habitat. Restoration activities between 2010 and 2013 have resulted in future shrub site habitat for this area, but no sufficient cover was available in the Beacon Hill Restoration Plot during the 2014 season (Figure 2)

Arch Point North Cliffs was surveyed 19 times between 21 February and 20 June 2014, at an interval of 6-8 days (Table 1). A total of 56 marked sites at Arch Point North Cliffs were checked each week, and no new sites were discovered in 2014. Nest searching located 25 active sites at Arch Point North Cliffs, which housed 35 Scripps's Murrelet clutches (Table 5). Of these 25 active sites, 8 sites were reused at least once during the season for a 32% rate of reuse (Table 6). Clutch Success at Arch Point North Cliffs was 59% (n=34 clutches with known fates, Table 5). Clutch success of second clutches was higher than first clutches (Table 6). Hatch success and depredation rates were 46% and 42%, respectively (n=52 eggs, Table 5). First eggs were found to be depredated more often than second eggs (Table 8).

Arch Point - North Cliffs had lower attendance in 2014 than in 2013, with 5 fewer active sites, and 11 fewer clutches in 2014. Higher depredation rates than last year were observed (42% in 2014 vs. 33% in 2013), and a lowered hatch success as a result. Slightly more nests hatched at least one egg (Clutch success) in 2014 than in 2013.

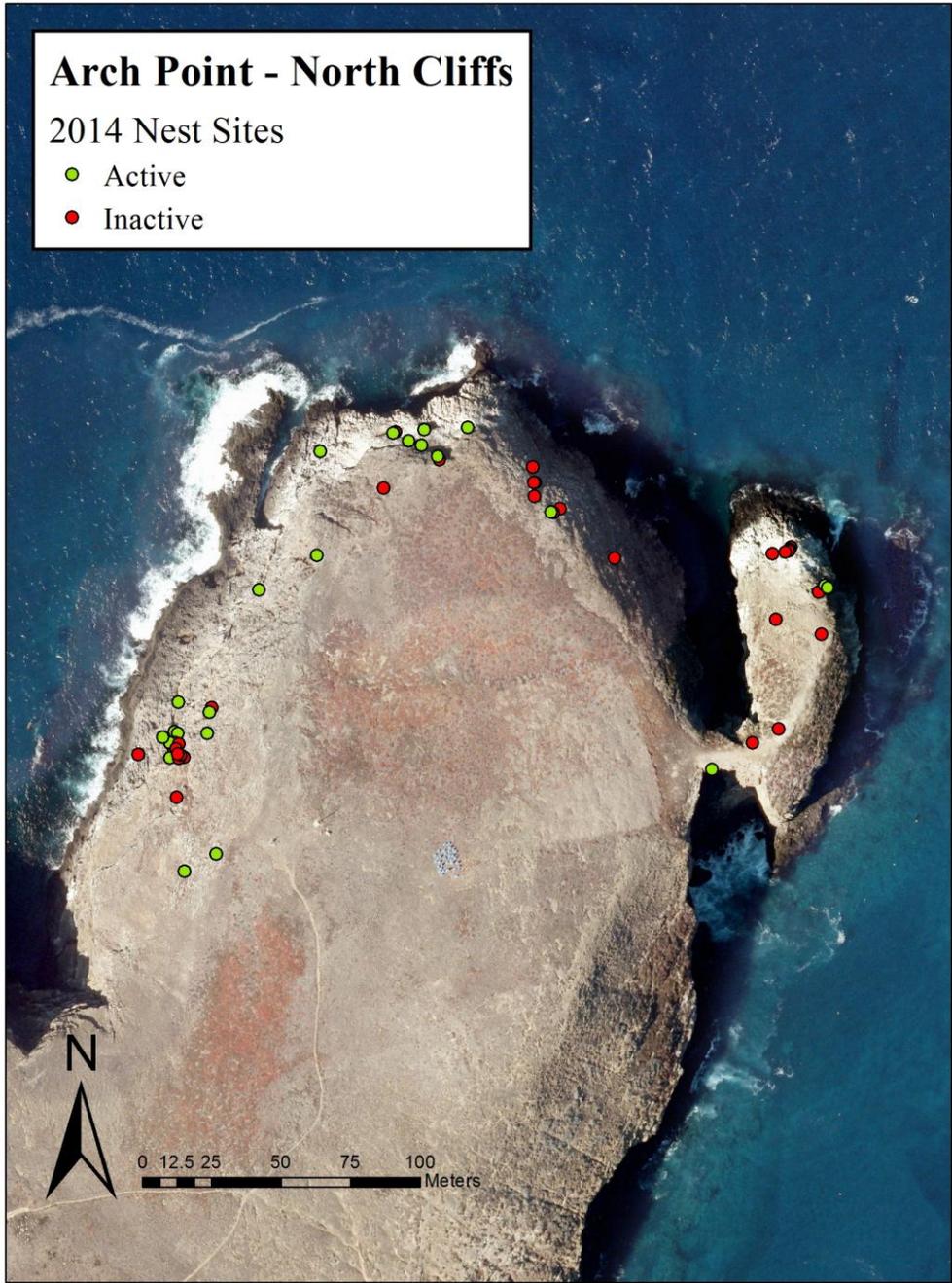


Figure 2. Overview map of Arch Point-North Cliffs depicting activity status of all monitored sites.

**Cat Canyon.** Cat Canyon is located at the southernmost point of the island, and contains both rocky crevice and shrub habitat. Shrub cover is comprised mostly of California Boxthorn and Island Buckwheat. No habitat restoration is currently underway at Cat Canyon or in its vicinity (Figure 3).

Cat Canyon was surveyed 19 times between 23 February and 23 June 2014, at an interval of 6-8 days (Table 1). A total of 180 marked sites at Cat Canyon were checked each week, including one new site discovered in 2014; site 620 was discovered to contain at least one hatched egg. The 49 active sites at Cat Canyon housed 62 Scripps's Murrelet clutches (Table 5). Two habitat types are present at Cat Canyon, and 74% of nests were located in crevice habitat, while 26% in shrub habitat (Table 9). Of the 49 active sites located, 12 were reused at least once during the season for a 24% rate of reuse (Table 6). Clutch Success at Cat Canyon was 70% (n=61 clutches, Table 5). Clutch success of second clutches was higher than first clutches (Table 6). Hatch success and depredation rates were 60% and 33%, respectively (n=108 eggs, Table 5). First eggs were found to be depredated more often than second eggs (Table 8).

Cat Canyon had lower attendance in 2014 than in 2013, with 18 fewer active sites, and 29 fewer clutches. Despite the lower numbers of nests, Cat Canyon had higher rates of success in 2014 than 2013, with 70% of nests hatching at least one egg. Depredation was lower in 2014 by almost half the previous years' rate: 33% in 2014 vs. 69% in 2013. Approximately 65 chicks successfully fledged from Cat Canyon in 2014.

**Landing Cove.** Landing Cove is located on the northeast coast of the island, and contains mostly shrub habitat. Restoration activities began in 2007, and have resulted in potentially suitable habitat for seabird nesting, but no nesting was observed within the restoration plot in 2014 (Figure 4).

Landing Cove was surveyed 20 times between 25 February and 24 June 2014, at an interval of 6-8 days (Table 1). A total of 87 marked sites were checked at Landing Cove, and 6 new sites were located in 2014. Two habitat types are used by murrelets in Landing Cove, and 5% of nests were located in crevice habitat, with 95% in shrub habitat (Table 9). The 40 active sites at Landing Cove housed 52 Scripps's Murrelet clutches (Table 5). Of these 40 active sites, 10 were reused at least once during the season for a 25% rate of reuse (Table 6). Clutch success at Landing Cove was 75% (n=51 clutches, Table 5). Clutch success of first clutches was slightly higher than second clutches (Table 6). Hatch success and depredation rates were 69% and 14%, respectively (n=84 eggs, Table 5). Second eggs were depredated slightly more often than first eggs (Table 8)

Attendance at Landing Cove was slightly lower in 2014 than in 2013, with 8 fewer active sites and 3 fewer clutches. This location did have higher clutch success and lower depredation rates than in 2013. Approximately 58 chicks successfully fledged from Landing Cove in 2014

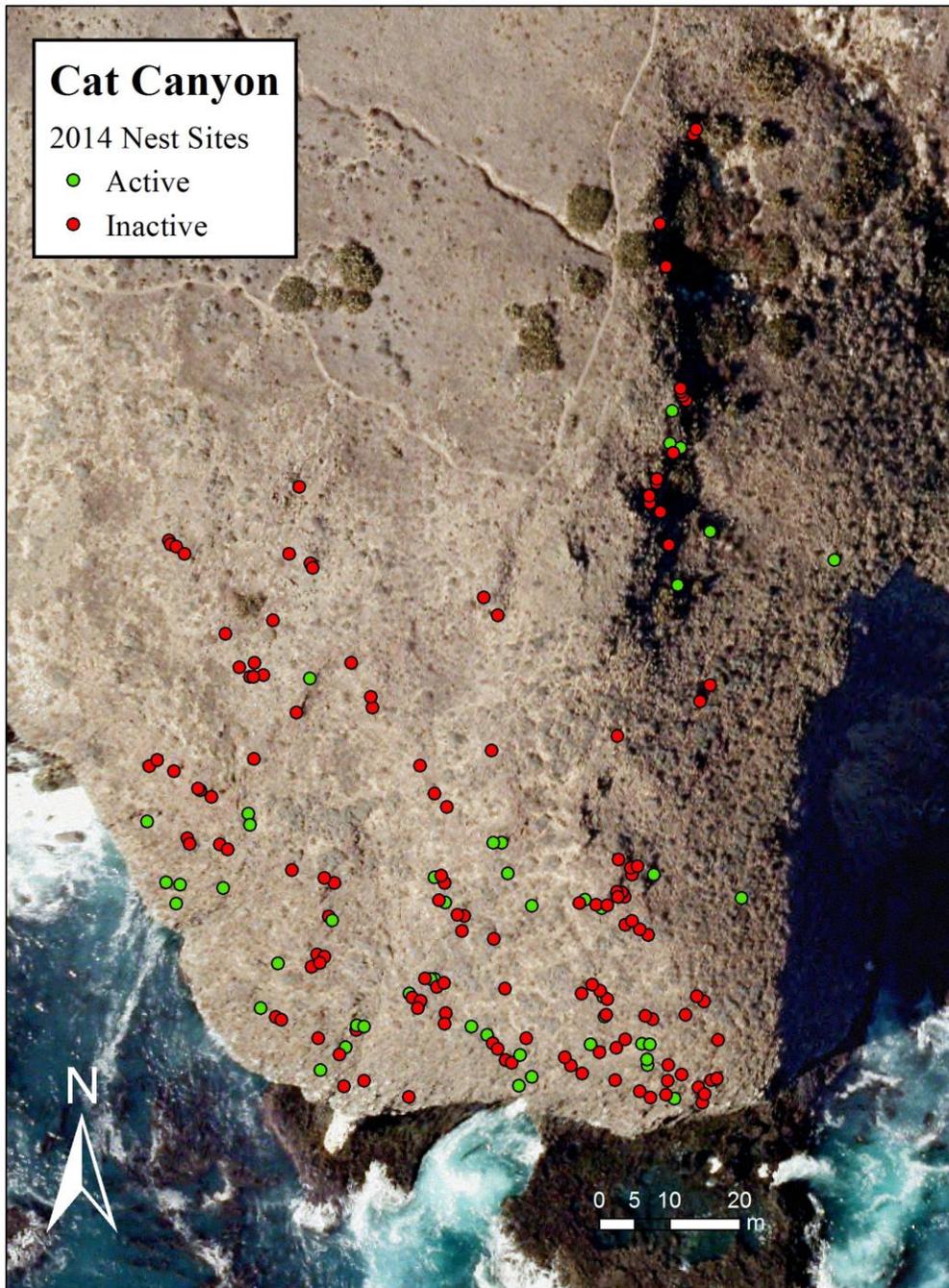


Figure 3. Overview map of Cat Canyon depicting activity status of all monitored sites.

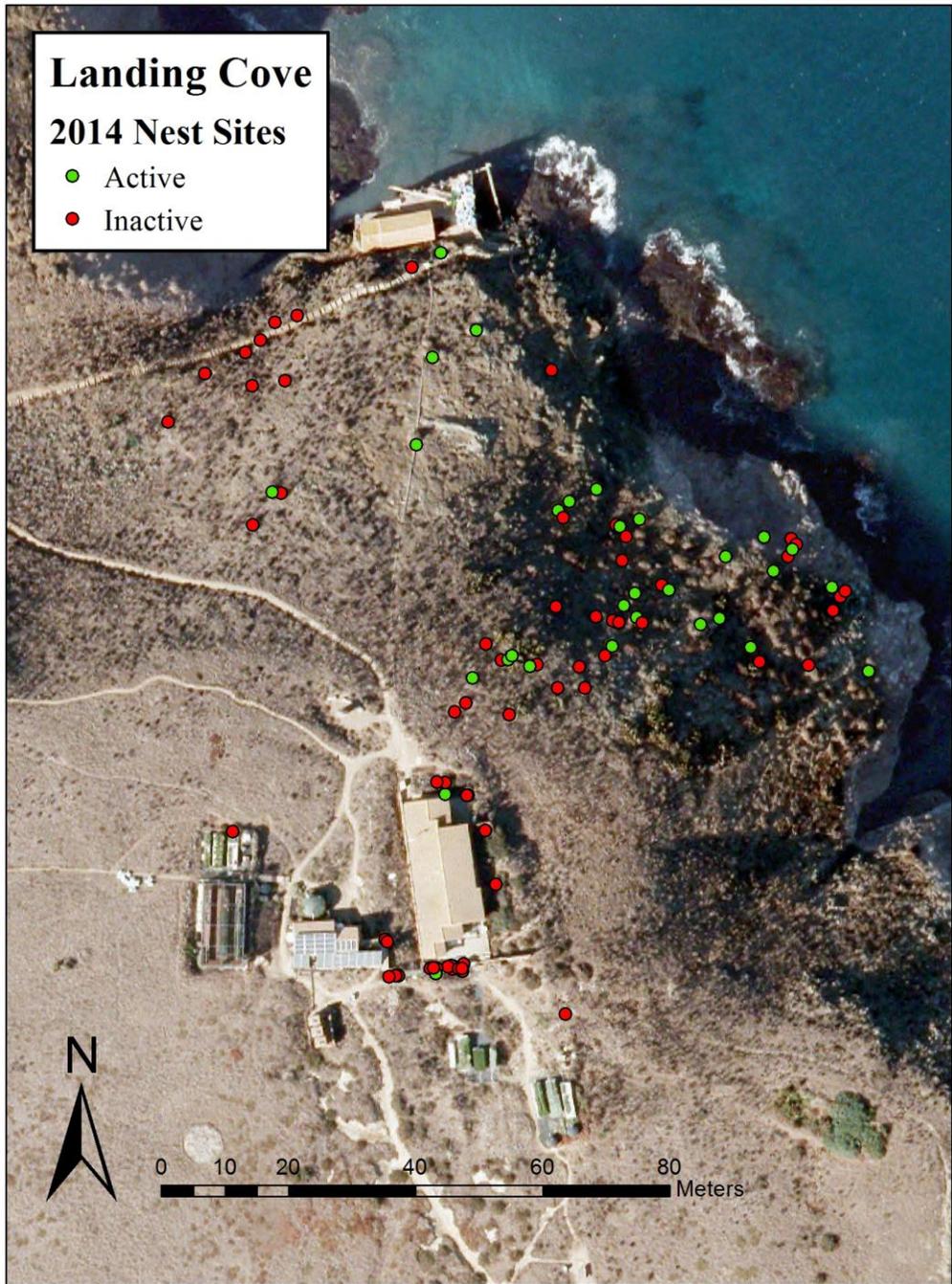


Figure 4. Overview map of Landing Cove depicting activity status of all monitored sites. Also shown are Bunkhouse monitoring sites.



Figure 5. Artificial habitat under the Dock.

***The Dock.*** The Dock plot, located at the bottom of Landing Cove, is mostly made up of artificial habitat in the form of nest boxes (Figure 5), unintended habitat under the dock pilings, and one small cave above the deck.

This plot was surveyed 17 times between 19 February and 11 June 2014, at an interval of 6-8 days (Table 1). There are a total of 24 marked sites at the Dock; 9% of nests were in crevice habitat, 56% in artificial nest boxes, and 34% under the structure of the dock itself (Table 9). Researchers found 23 active sites at the Dock, resulting in 31 Scripps's Murrelet clutches (Table 5). Of these sites, 7 were reused at least once during the season for a 30% rate of reuse (Table 6). Clutch Success at the Dock was 74% (n=31 clutches, Table 5). Clutch success of first clutches was higher than second clutches (Table 6). Hatch success and depredation rates were 61% and 27%, respectively (n=56 eggs, Table 5). First eggs were depredated more often than second eggs (Table 8).

Attendance at the Dock was slightly higher in 2014 than in 2013, with 4 more active sites and almost a 50% increase in clutch success from 2013. Egg depredation decreased slightly, and as a result, 20% more eggs hatched at the Dock. Approximately 34 chicks successfully fledged from the Dock monitoring plot.



Figure 6. Representative habitat surrounding the Bunkhouse

***Bunkhouse Area.*** The Bunkhouse area is located above Landing Cove, around the National Park Service housing area. The sites are located in artificial nest boxes, unintentional habitat under housing structures, and shrub habitat. Restoration activities have planted shrubs within this area, and native landscaping around the housing is large enough to provide habitat.

The Bunkhouse area was surveyed 19 times between 19 February and 19 June 2014, at an interval of 6-8 days (Table 1). A total of 33 marked sites were monitored in the Bunkhouse area, including one new site H18. The 4 active sites in the Bunkhouse area housed 6 Scripps's Murrelet clutches (Table 5), and 66% of these nests were under structures associated with housing, with 33% in shrub habitat. Only 1 of the 4 active sites was reused at least once during the season for a 25% rate of reuse (Table 6). Clutch success at the Bunkhouse area was 60% (n=5 clutches, Table 5). Clutch success of first clutches was higher than second clutches (Table 6). Hatch success and depredation rates were 50% and 0%, respectively (n=10 eggs, Table 5).

Attendance at the Bunkhouse plot was on par with 2013, with 4 active sites both years. No depredation was observed in 2014, and much higher clutch success and hatch success rates were seen as a result. 60% of clutches hatched at least one egg in 2014, as compared to the 20% clutch success in 2013.

## ISLAND-WIDE MONITORING STATUS

Monitoring of the Santa Barbara Island Scripps's Murrelet population began on 19 February 2014, with the first eggs found on 27 February at Arch Point - North Cliffs. The nesting season lasted 131 days, through 4 July 2014, when the last hatched egg was found at Landing Cove (Table 2, 3). The last day of monitoring was 8 July 2014.

**Egg laying.** The earliest date of clutch initiation (first egg laid) was calculated to be 23 February, and occurred at Arch Point North Cliffs 1316. The latest date of clutch initiation was 23 May, and occurred at Landing Cove 226. The median clutch initiation date, or the date at which 50% of all nests had been laid, was 15 March. This means that 50% of all nests that would be occupied in the season were occupied in the first three weeks of the season (20 days).

**Table 2. Scripps's Murrelet clutch initiation dates from all monitoring locations in 2014.**

Statistic	Clutch Initiation Date (all clutches combined)	Clutch Initiation Date (first clutches only)
N	166	128
Earliest Day	2/23	2/23
Latest Day	5/23	4/28
Mean Day	3/23	3/16
SD (days)	21	15
Median Day	3/15	3/12

N=number of clutches for which a reliable clutch initiation date could be determined

**Hatching.** The first hatching occurred on 7 April at Arch Point North Cliffs 1316. The latest hatch date observed was 4 July at Landing Cove 226. Median hatch date occurred on 27 April 2014. This means that 50% of all eggs that would hatch during the season had hatched by that date.

**Table 3. Scripps's Murrelet hatching dates of first eggs at all monitoring locations in 2014.**

Statistic	Hatch Date (all clutches combined)	Hatch Date (first clutches only)
N	85	66
Earliest Day	4/7	4/7
Latest Day	7/4	6/6
Mean Day	5/3	4/27
SD (days)	18d	14d
Median Day	4/27	4/24

N=number of first eggs for which a reliable hatch date could be determined

**Reproductive success.** We monitored 186 SCMU clutches in 141 active nest sites on Santa Barbara Island in 2014 (Table 4). Island wide clutch success was approximately 70% (n=182 clutches). 310 individual eggs were observed and tracked through the season (Table 4). 60% of all observed eggs laid in 2014 hatched, though approximately 2% failed after hatch (chick was found dead in nest) (Table 7). Hatch success was highest at Landing Cove, and lowest at Arch Point North Cliffs (Table 4)

**Table 4. Scripps’s Murrelet reproductive success at Santa Barbara Island in 2014.**

Reproductive metric	APNC	BH	CC	DO	LACO	All
Active Sites	25	4	49	23	40	141
Total Clutches	35	6	62	31	52	186
% Clutch Success <sup>1</sup>	59%	60%	70%	74%	75%	70%
Clutch Success (n) <sup>2</sup>	34	5	61	31	51	182
Hatch Success <sup>3</sup>	46%	50%	60%	61%	69%	60%
Egg Depredation <sup>4</sup>	42%	0%	33%	27%	14%	27%
Egg Metrics (n)	52	10	108	56	84	310
Clutches per site	1.4	1.5	1.3	1.3	1.3	1.3

1 percentage of clutches hatching at least one egg

2 number of clutches monitored for which a reliable fate could be determined for both eggs

3 percentages of eggs reliably observed to have hatched

4 percentages of eggs reliably observed to have been depredated

Individual nest sites were used up to three times during the season. The number of clutches per site varied from 1.30 to 1.50, and 38 of the 141 active sites were reused at least once during the season, for a 26% rate of reuse. Clutch success of first clutches was lower than second clutches, 70% vs. 74%. Only 1 of the 3 third clutches (33%) hatched an egg (Table 5).

**Table 5. Clutch success of subsequent nesting attempts within discrete nest sites in 2014.**

Clutch	APNC	n	BH	n	CC	n	DO	n	LC	n	ALL	n
1	52%	25	75%	4	67%	49	78%	23	78%	40	70%	141
2	88%	8	0%	1	83%	12	57%	7	70%	10	74%	38
3	0%	1	-	-	-	-	100%	1	0%	1	33%	3
Total	59%	34	60%	5	70%	61	74%	31	75%	51	70%	182

n= number of individual nesting attempts within each clutch category

Of all observed eggs laid in 2014, 27% were recorded as depredated by mice. This was the single most significant source of failure, followed by abandonment (5%, Table 6). Where fate and egg order was known, depredation rates were higher for first eggs (33%, n= 120) than second eggs (18%, n=120, Table 7). Where fate and egg order was known, hatch success was higher for second eggs (69% n=120) than first eggs (50%, n=120, Table 7)

**Table 6. Scripps's Murrelet egg fates at Santa Barbara Island in 2014 from the five monitoring plots. Fates in italics are primary causes of failure of unhatched eggs.**

Fate	APNC	BH	CC	DO	LC	All	% of total
Hatched*	23	5	65	32	55	180	58%
Failed	29	5	43	24	29	130	42%
Abandoned	1	2	1	3	8	15	5%
Addled	0	0	0	2	2	4	1%
Broken Egg	1	1	1	2	2	7	2%
Depredated	22	0	36	15	12	85	27%
Disappeared	4	1	4	0	1	10	3%
Chick died in nest	1	0	0	2	3	6	2%
Kicked out of nest	0	1	1	0	1	3	1%
<b>Total</b>	<b>52</b>	<b>10</b>	<b>108</b>	<b>56</b>	<b>84</b>	<b>310</b>	

\*Chick not found dead, likely successfully made it to ocean

**Table 7. Percentages of Scripps's Murrelet eggs (with known lay order) hatched or depredated by mice on Santa Barbara Island in 2014. See text for details.**

Depredation	APNC	BH	CC	DO	LC	All
Egg 1	56%	0%	43%	31%	10%	33%
Egg 2	31%	0%	20%	15%	13%	18%
Hatch	APNC	BH	CC	DO	LC	All
Egg 1	25%	50%	50%	50%	63%	50%
Egg 2	44%	75%	75%	69%	73%	69%

**Clutch success relative to nest site description.** Of the 186 nests observed in 2014, 89 were located in natural rock crevices, 65 in native shrub sites, 17 in artificial nest boxes, and 15 were located under manmade structures such as the Landing Cove Dock (Table 8).

**Table 8. Scripps's Murrelet nest site types at Santa Barbara Island in 2014.**

Site Type	APNC	BH	CC	DO	LC	Total
Crevice	35	-	48	3	3	89
Nest Box	-	-	-	17	-	17
Shrub	-	2	14	-	49	65
Under Structure	-	4	-	11	-	15
<b>Grand Total</b>	<b>35</b>	<b>6</b>	<b>62</b>	<b>31</b>	<b>52</b>	<b>186</b>

Where fates could be determined, clutch success was highest within the habitat provided by native shrub cover (77%, n=62). The least successful nest sites were actually found in natural crevice sites (64%, n=88, Table 9), where depredation rates were highest (39%, n=148).

**Table 9. Scripps’s Murrelet clutch success (CS) and egg depredation rates by site type and plot at Santa Barbara Island in 2014.**

Site Type	Depredation Rates	CS per Monitoring Plot					
		APNC	BH	CC	DO	LC	Total
Crevice	39%	59%	-	67%	67%	67%	64%
Nest box	28%	-	-	-	76%	-	76%
Shrub	13%	-	100%	85%	-	75%	77%
Under Structure	17%	-	50%	-	73%	-	67%
Total	27%	59%	60%	70%	74%	75%	70%

**CASSIN’S AUKLET.**

Cassin’s Auklet monitoring on Santa Barbara Island in 2014 was restricted to incidental observation of auklets within the scope of Scripps’s Murrelet monitoring efforts, and surveys of 100 artificial burrows installed at three restoration plots: Landing Cove, Northeast Flats, and Elephant Seal Cove.

**Arch Point North Cliffs.** Several likely active sites were located in 2014, though most could not be confirmed. Only APNC 1303, active since 2009, contained a visible egg. This egg was not seen after it was initially discovered, and no chicks were seen in the burrow, so it is assumed the nest was unsuccessful. At 1317 an adult Cassin’s Auklet was seen for three checks between 25 April and 9 May, but no egg or chick was observed in that site.

**Artificial Habitat.** No nesting activity by Cassin’s Auklets was observed in any artificial burrow on Santa Barbara Island in 2014. The artificial burrows were checked and cleaned before the season, and any mouse nests, clogged entrances, or seed caches were removed to make the unit available for prospecting auklets.

**ASHY STORM-PETREL.**

Nest searches and monitoring for Storm-Petrels was also restricted to incidental observation within Scripps’s Murrelet Monitoring protocols. No additional effort was attempted to assess Storm-Petrel nesting at Santa Barbara Island in 2014.

**Arch Point - North Cliffs.** Ashy Storm-Petrels were observed in 5 locations in the APNC plot, most often as a single bird in a nest site. APNC 1330 was the only nest site with a confirmed ASSP egg (hatched eggshells on 4 July, 2014).

## **CALIFORNIA BROWN PELICAN.**

Monitoring for California Brown Pelicans was performed 6 times between 1 March 2014 and 1 June 2014. Boat based surveys of the island on 23 February 2014 recorded 549 individuals, 326 nesting pelicans across the entire island. Approximately 150 additional individuals were counted at colonies above Middle and Graveyard Canyon, but nesting status could not be determined due to visibility constraints. Focused surveys at Cat Canyon, Graveyard Canyon, and the Landing Cove Boxthorn Patch indicated a low productivity season for the Brown Pelican population of Santa Barbara Island.

While initial attendance appeared promising, a large mortality event between 16 March and 13 April resulted in a significant number of dead chicks and nest abandonment. Attendance at Cat Canyon on 16 March counted 125 adults and 89 occupied nests, while the same location on 13 April saw 16 occupied nests and 17 adults, with many dead chicks within the nesting area. Approximately 37 chicks eventually fledged from the 235 nests identified on 1 March. Applying that success rate to the approximately 500 nests identified in the beginning of the season, about 78 Brown Pelicans survived to fledge on Santa Barbara Island in 2014.

## **SEABIRD MISTNETTING AND AT-SEA CAPTURES**

**Scripps's Murrelet.** In 2014, spotlight captures were attempted on 6 nights in late May and early June. From 22 May through 2 June, 69 individual captures were made, 59 of which resulted in a new band deployed. 10 murrelets were recaptured, 5 of which were from previous years banding attempts. Murrelets with bands 1262-03216 and 1262-03214 were banded in 2009, 1262-03145 in 2010, 1262-03281 in 2011, and 1262-03414 was banded in 2012; all were initially captured and recaptured in the Landing Cove area. One hatch year chick was banded on 30 May, 1322-22091, and will provide known age survivorship upon recapture. See Appendix 2 for Scripps's Murrelet bands deployed in 2014.

**Table 10. Survey details for Scripps's Murrelet dip-net capture effort at Santa Barbara Island in 2014.**

Survey Night	Start Time	End Time
5/22 to 5/23	23:11	03:55
5/24 to 5/25	23:06	01:20
5/25 to 5/26	23:10	03:39
5/29 to 5/30	23:23	04:25
5/31 to 5/31	00:08	04:00
6/2 to 6/2	00:18	03:46

**Table 11. Scripps's Murrelets captured during at-sea banding efforts at Santa Barbara Island in 2014.**

Survey Night	New	Recapture	Total	# Brood Patch Present
5/22-23/2014	17	1	18	0
5/24-25/2014	5	1	6	0
5/25-26/2014	11	-	11	0
5/29-30/2014	15	3	18	2
5/31/2014	4	3	7	2
6/2/2014	7	2	9	6
Total	59	10	69	10

**Storm-Petrel species.** Mist net capture efforts for Ashy Storm-Petrel were attempted on 10 nights in 2014. Starting 2 July through 22 August, 177 new bands were deployed on Ashy Storm-Petrels. In addition to these captures, 10 new Black Storm-Petrels were also banded in 2014. Capture locations were at Elephant Seal Point, Arch Point, and the Shag Rock Overlook Bench. One net night was also conducted at the Nature Trail Restoration Plot near the Santa Barbara Island Campground.

Please see Appendix 3 for Storm-Petrel bands deployed in 2014.

## DISCUSSION

Seabird monitoring on Santa Barbara Island has been regularly conducted since the mid 1970's, and the island was known to be important to nesting seabirds as early as the 1860's. Monitoring in conjunction with habitat restoration by California Institute of Environmental Studies staff entered its eighth year on Santa Barbara Island in 2014. This monitoring is primarily focused on Scripps's Murrelet reproductive performance, though other species are recorded incidentally when encountered within the murrelet monitoring plots.

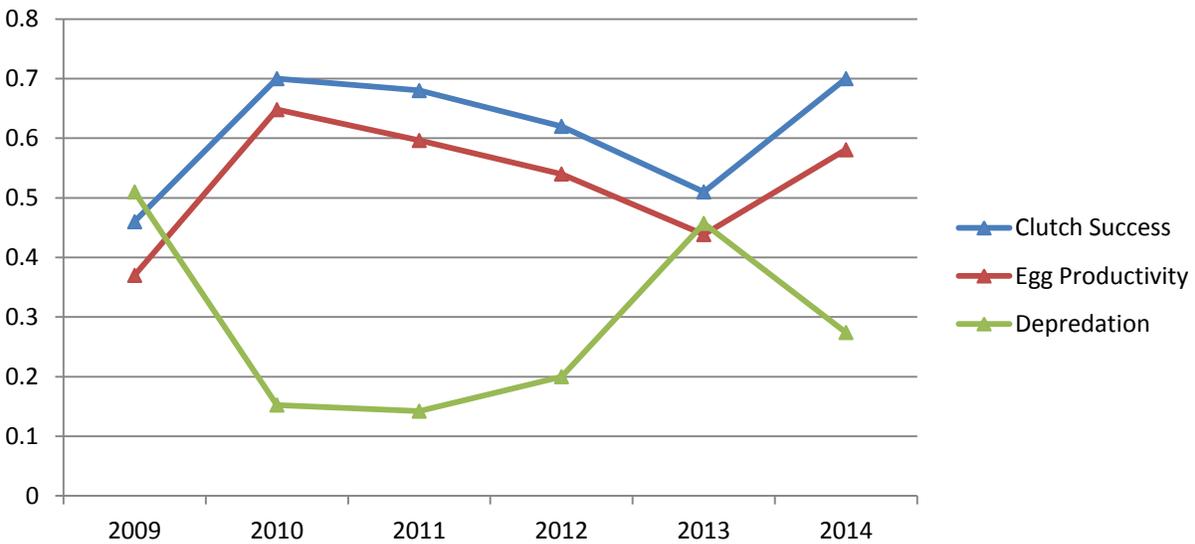


Figure 7. Scripps's Murrelet reproductive success 2009 to 2014. Data from CIES/MSRP Annual reports.

**Scripps's Murrelet Reproductive Success.** The 2014 nesting season for Scripps's Murrelet was a welcome reprieve from the past few years' decreasing reproductive success rates. Lower depredation pressure allowed more eggs to survive to hatching, and clutch success returned to around 70%, similar to 2010. This amounted to a large increase from 2013, when only 51% of observed clutches hatched any eggs.

The plot with the highest hatch success rates in 2014 was Landing Cove. Landing Cove was also one of the more successful plots in 2013 at 57%, and hatch success increased in 2014 to 69%. The lowest hatch success rates were observed in the Arch Point – North Cliffs plot. One of the most successful plots in 2013 at 53%, this plot experienced higher predation than the other plots, and hatch success dropped to 46% in 2014.

To put this in historical context, in 2007 approximately 42% of all eggs hatched and 45% of eggs were depredated (n=130 eggs, Harvey and Barnes 2009). Murray et al. 1983 found that between

1975 and 1979, hatching success was 39%, and 44% of all eggs were depredated. The 1975-79 surveys identified depredation by native deer mice to be the greatest contributor to hatching failure for murrelets on Santa Barbara Island.

**Egg Failure.** Depredation by native deer mouse populations continues to be the largest observable source of failure in Scripps’s Murrelet nests. Data collected in 2014 identified only 27% of the 310 eggs observed this year as depredated, a much lower percentage than 2013 when 46% were found eaten (Figure 7). The only location that did not see a decrease in depredation was the Arch Point – North Cliffs plot, which increased to 42% from 33% in 2013. The Arch Point – North Cliffs plot was the highest depredation rate on the island, nearly 10 percentage points above Cat Canyon, which has consistently hosted the highest depredation rate in past years.

Surveys for Island Deer Mouse during the murrelet nesting season (spring) on Santa Barbara Island recorded very low numbers in 2014 (JAH *pers. obs.*). Specifically, only one mouse was caught twice during the mid-March survey, and no other captures made. While the mouse grids are not located within murrelet nesting territory, the dearth of mice recorded on the survey does give an idea that the island-wide population was likely low during the 2014 seabird nesting season.

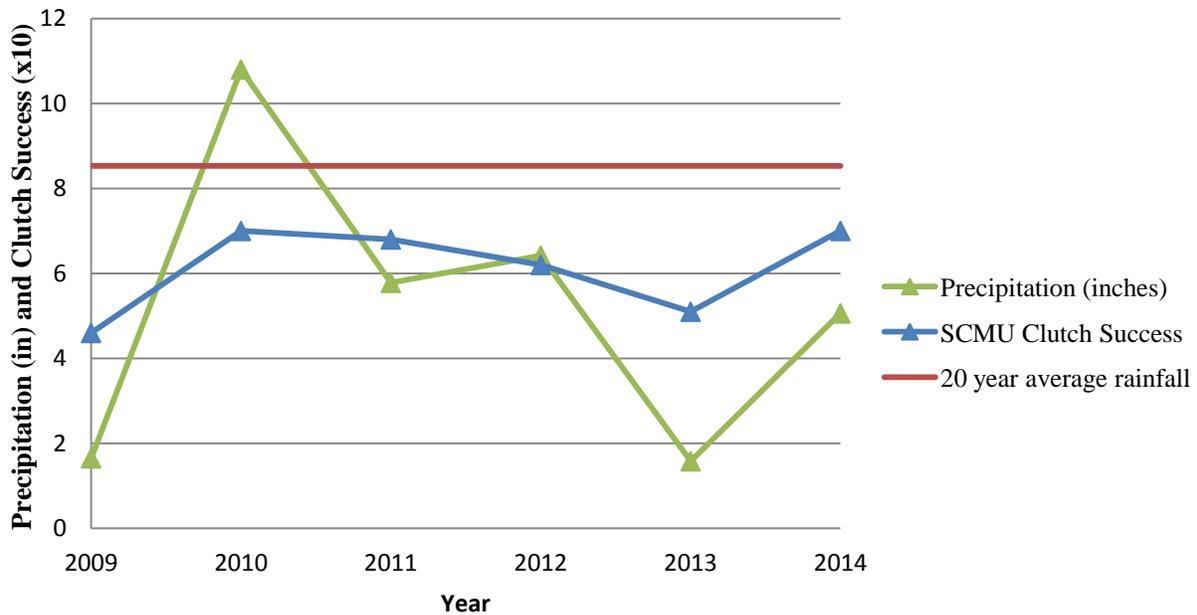


Figure 8. Clutch Success and Annual recorded rainfall 2009 to 2014. Rainfall data from RAWS weather station Santa Barbara Island (Handley et al. 2013 and Jacques et al. *in review*).

The Island Deer Mouse population is known to be associated with the seasonal fluctuations in rainfall and island seed production. 2010 was a high rainfall year, with low depredation rates. 2011, 2012, and 2013 saw decreasing annual rainfall and increasing depredation of seabird eggs by mice. 2014 was an increased rainfall year, though still well below the twenty year average, and saw a decrease in depredation pressure for the Scripps's Murrelet eggs on Santa Barbara Island. It appears that while there were fewer mice on the island, their appetite for seabird eggs increased. It is possible the low numbers of mice reflected a low seed availability, which the survivors augmented opportunistically with murrelet eggs, especially in 2013. The improvement of this situation in 2014, might point to the (slightly) increased rainfall on Santa Barbara Island producing more seed to support the mouse population, which responded with increasing numbers after the murrelet nesting season.

**Cassin's Auklet.** Artificial habitat for Cassin's Auklet nesting is located in three main locations on Santa Barbara Island. Again in 2014, no nesting was observed in these locations, and no visitation was evident in the chambers. Nesting was observed in artificial habitat when audio attraction was implemented in 2010-2011. This method, while successful in drawing in nesting Cassin's Auklets, also attracted Barn Owls to the sound and presence of auklets, and was discontinued in 2011. Nesting attempts dropped quickly to zero in the artificial habitat after the project was abandoned. Other locations such as the Farallon Islands utilize similar artificial habitat without audio attraction with much higher success rates than has been seen on Santa Barbara Island.

**Brown Pelican.** The 2014 season for Brown Pelican was short lived and unsuccessful. Beginning in February, relatively good numbers were seen building nests and pairing up at several sites across the island. As stated above, approximately 500 nests were identified early in the season. An unknown cause resulted in nest abandonment and high chick mortality between 16 March and 13 April. During the 2014 season, the west coast sardine fishery was restricted due to low stock numbers, which may be the root cause of this event. One major wind event occurred during this timeframe, perhaps requiring adults to forgo eating to incubate brooding chicks. Once the winds lessened, it is possible the adults could not locate enough bait fish to sustain both themselves and their chicks, and abandoned. Whatever the reason, the very few chicks that survived through this period appeared to remain alive through fledging.

## **RECOMMENDATIONS FOR FUTURE MONITORING EFFORT**

**Scripps's Murrelet.** Continued monitoring and timely annual reports should remain a priority for this species. Monitoring and reporting should continue to be as comparable to the existing data set as possible, following the protocols currently in place. Reporting the seasonal phenology, and basic metrics of clutch success, hatch success, and depredation rate for individual plots and the island as a whole will allow for better tracking of the Santa Barbara Island population, and allow comparisons to other nesting populations.

The currently monitored plots should be regarded as the minimum necessary effort, and should be monitored consistently through the breeding season. If and when a larger staff presence and funding would allow the increase in monitoring effort, Elephant Seal Cove, West Cliffs, Webster Point, The Arch Point Rock fall and the sea caves around Santa Barbara Island should be checked for nesting effort.

Spotlight surveys conducted in 2009-2010 at Santa Barbara Island combined with an increased monitoring effort gave a more robust population estimate of the attendant murrelets during the breeding season than land based monitoring alone. The populations nesting on the Mexican Pacific Islands are surveyed in this manner yearly, and it would be good to coordinate and compare the populations across the breeding range. Santa Barbara Island is still considered the largest breeding colony of the species, and it would not pose an insurmountable logistic obstacle and would benefit the long term restoration and management plans to conduct 3-4 spotlight surveys during the seasonal peak of nesting (mid-March through early May).

Mark-recapture efforts of Scripps's Murrelets have been conducted at Santa Barbara since the 1970's. The numbers of banded individuals varies from year to year as do the numbers of recaptures. Capture timing should be focused on the point in the season when the highest nocturnal attendance is occurring, which appears to be mid-April – mid May. Within that timeframe, capture efforts should be mindful of the timing of peak egg laying, and attempt to begin soon after the peak to lower the likelihood possible capture of gravid birds. Since the captures have been focused on the east side of the island, specifically in and around Landing Cove, maintaining the effort locality might be a better choice than expanding the capture area.

Nest cameras have been seasonally installed at up to 12 sites in the Landing Cove/Dock plot vicinity. Many hours of video are being watched and analyzed by students of Dr. Nina Karnovsky at Pomona College, California. Many interesting opportunities to uncover previously unknown behaviors and interactions in the nest exist on these videos. This program should continue to be supported and future analysis funded.

Eggshells have been collected at nest sites around the island as part of the monitoring protocol since 2010. These eggshells could be analyzed for eggshell thickness variation, presence of marine contaminants, stable isotopes for adult diet during egg development, and eggshell color as related to diet. The genetic material in these eggshells could also be analyzed to look at the role of genetics and what role relatedness has in site selection, why some nests are reutilized in consecutive nesting attempts versus creating a new nest bowl in a different location, or if the same pair is relaying a second brood. These are all questions that may be valuable to the restoration effort and understanding of the murrelet population. A sample of eggshells collected during this monitoring program will be analyzed for thickness at the Western Foundation of Vertebrate Zoology in Camarillo, CA.

The biggest obstacle to hatching success of murrelets (and likely other seabirds on Santa Barbara Island) continues to be the native island deer mouse population. We recommend that this relationship and the deer mouse population should continue to be studied to watch for trends detrimental to the future survival of seabird species. Additionally, barn owl surveys should be continued throughout the year to assess avian predator abundance. Nest content analysis of Peregrine Falcon nests on the island should be continue to be monitored for seabird remains to allow better understanding of that dynamic.

**Cassin's Auklet.** One of the major goals of the habitat restoration project on Santa Barbara Island is to restore an historic colony of Cassin's Auklets. Continued restoration and the planting of ground stabilizing plants in appropriate locations for auklet utilization should continue to be a priority. Additional artificial habitat in restoration locations might encourage pioneering auklets to colonize recently restored areas they may not otherwise initially be attracted to.

A directed effort to locate and monitor Cassin's Auklet burrows with the consistency of the Scripps's Murrelet monitoring protocol would help to better assess the population size and health of the small colony on Santa Barbara Island. Audio Recording Units and motion cameras would be a low impact and low effort way to assess colony attendance in locations that could not be monitored effectively on a weekly or biweekly basis.

Audio social attraction proved to be very successful in 2011 in bringing auklets to the restoration plot in Landing Cove. Several occupied artificial and natural burrows were used in the first year of the social attraction program, and continued to be used at least one year after the program was terminated. If the increased barn owl predation can be avoided or mitigated, social attraction should remain an option to increase the effectiveness of the restoration effort.

**Storm-Petrel species.** Three species of Storm-Petrel have been recorded on Santa Barbara Island, and there is currently no monitoring effort aimed at the nesting locations or assessment of these breeding seabirds. Mist netting efforts in 2014 banded 177 new Ashy Storm-Petrels and 10

Black Storm-Petrels between Elephant Seal Point and the Nature Trail restoration Plot near NPS Housing.

A dedicated breeding season survey or mist netting effort through the breeding season would help to at least minimally assess the breeding population of Ashy, Black, and possibly Leach's Storm-Petrels of Santa Barbara Island.

Audio recording units placed in likely Storm-Petrel nesting locations might aid in locating small colonies in hard to monitor locations, such as in sea caves and on sea cliffs.

Nocturnal spotlight surveys as done in 2009-2010 might help to assess numbers of Storm-Petrel species feeding in the vicinity of Santa Barbara Island and adjacent off shore rocks.

**General recommendations for actions to benefit the SBI seabird colony.** As much as can be accomplished, disturbance to nesting seabirds should be avoided especially during the onset of breeding/nesting season. Light pollution from housing, noise and air pollution from dock activities, and visitor disturbance should continue to be kept to a minimum. The following recommendations should be implemented as suggested by past annual reports:

Island visitors should be well educated about the need to keep non-native plants and animals off the island. Additionally, they should be made aware of trail closures during nesting season and the need to stay on trail. They should not be allowed to investigate the cliffs or other nesting locations of seabirds. Island Naturalist Volunteers with the Park Service should likewise be informed of any closures and the need to enforce them. Island closures should be well marked, with explanatory signs placed in the center of the trail, and updated maps at the visitor center and kiosk. Temporary trail closures in 2014 included sections of the trail from Landing Cove to Arch Point, through the gull colony between Graveyard Canyon and Cat Canyon, and along the trail to Webster Point and back to the Saddle Bench. These trails were closed from Early May through Late July, and protected nesting Brown Pelicans, Western Gulls, Cormorants and other surface nesting birds. These were well marked on visitor maps, incorporated into the Visitor Information Kiosk, and explained to Island Visitors during orientation and outreach conversations.

# Santa Barbara Island

## May 2014 Seabird Closure Zones

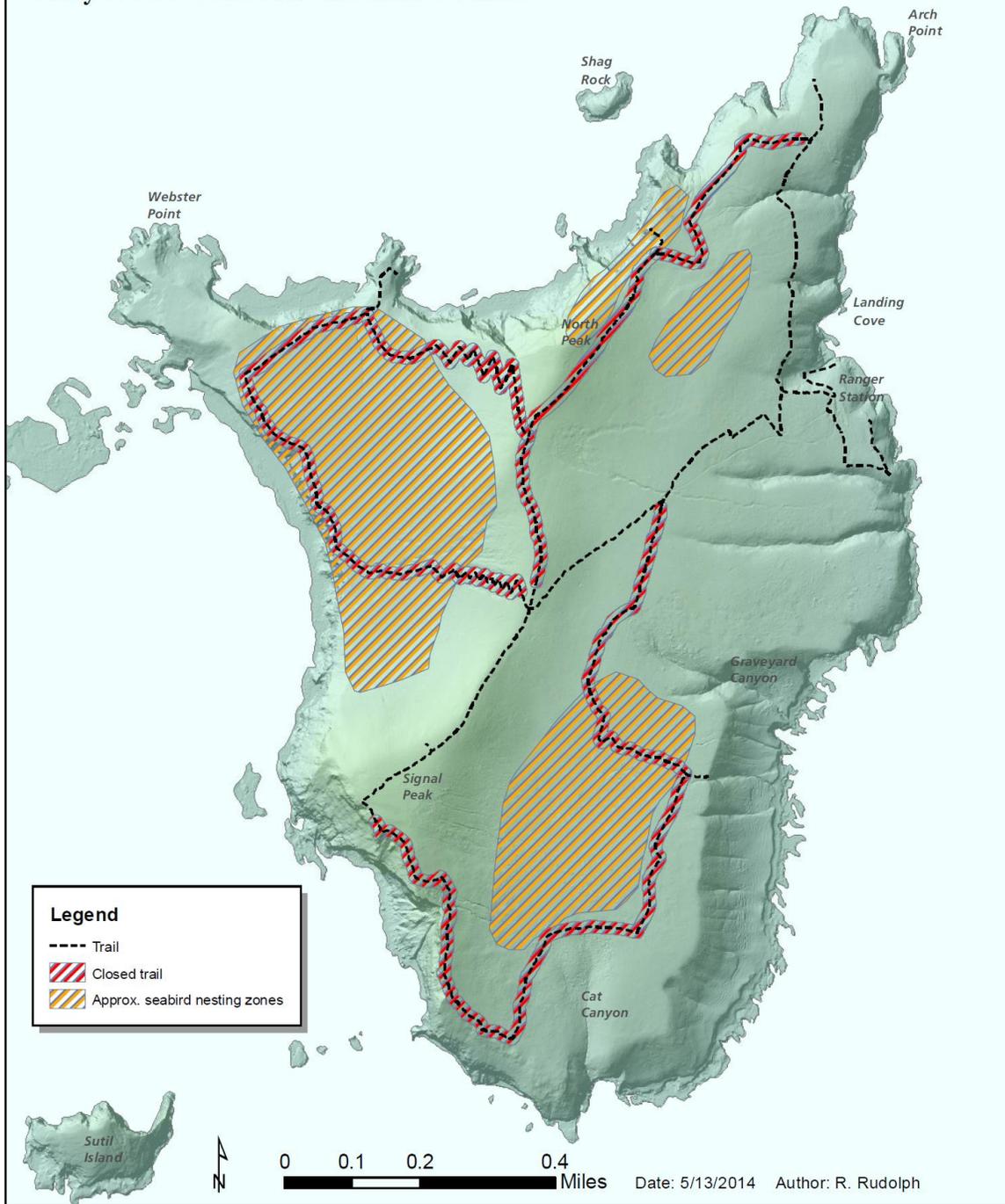


Figure 9. Map of temporary trail closures on Santa Barbara Island in 2014. Credit R. Rudolph, Channel Islands National Park GIS Specialist

Black-out curtains should be well maintained and used throughout the seabird presence on Santa Barbara Island. This usually begins in late November with calling Scripps's Murrelets below nesting locations, and extends through August, possibly longer for Storm-Petrel species. Lights at the Dock and Bunkhouse hallways should be turned off at night. Harvey et al (2014) suggested a boater outreach program to inform private boaters of the seabird hazards associated with lights at sea.

Maintenance activities involving power tools or loud engines should be planned accordingly and completed outside of the seabird nesting season. Unless required by emergency or public safety, tools such as impact drivers, circular saws, septic mixers and pumps, weed whackers and lawnmowers should only be used far away from nesting birds to reduce the disturbance caused by the loud and abrupt noises.

Loose building materials can be used by crevice and burrow nesters, which may go undetected until it is too late. Preemptive organization of materials around housing and the dock will help minimize the possibility of seabird death by accidentally crushing the nest site when moving material.

In summary, we recommend that nest monitoring and disturbance reduction activities, and where possible the expanded studies described above, should be conducted annually to ensure adequate information is collected with which to assess the status of this important seabird breeding location.

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Appendix 1. Survey dates for Scripps's Murrelet monitoring in 2014.

Date	APNC	BH	CC	DOCK	LACO	Date	APNC	BH	CC	DOCK	LACO
2/19/2014		X		X		4/28/2014			X		
2/21/2014	X					4/29/2014					X
2/23/2014			X			4/30/2014		X		X	
2/25/2014					X	5/2/2014	X				
2/26/2014		X		X		5/4/2014			X		
2/27/2014	X					5/6/2014					X
3/2/2014			X			5/7/2014		X		X	
3/4/2014					X	5/9/2014	X				
3/5/2014		X		X		5/11/2014			X		
3/7/2014	X					5/13/2014					X
3/9/2014			X			5/14/2014		X		X	
3/11/2014					X	5/16/2014	X				
3/12/2014				X		5/18/2014			X		
3/14/2014	X	X				5/20/2014					X
3/16/2014			X			5/21/2014		X		X	
3/17-18/2014					X	5/23/2014	X				
3/19/2014				X		5/25/2014			X		
3/20/2014		X				5/27/2014					X
3/21/2014	X					5/28/2014		X		X	
3/23/2014			X			5/30/2014	X				
3/24/2014					X	6/1/2014			X		
3/26/2014		X		X		6/3/2014					X
3/28/2014	X					6/5/2014		X		X	
3/31/2014			X			6/6/2014	X				
4/1/2014					X	6/8/2014			X		
4/2/2014		X		X		6/10/2014					X
4/4/2014	X					6/11/2014		X		X	
4/6/2014			X			6/13/2014	X				
4/8/2014					X	6/15/2014			X		
4/9/2014		X		X		6/17/2014					X
4/11/2014	X					6/19/2014		X			
4/13/2014			X			6/20/2014	X				
4/15/2014					X	6/23/2014			X		
4/16/2014		X		X		6/24/2014					X
4/18/2014	X					7/1/2014					X
4/20/2014			X			7/4/2014	X				
4/22/2014					X	7/5/2014		X			
4/23/2014		X		X		7/6/2014			X		
4/25/2014	X					7/8/2014					X

Appendix 2. Scripps's Murrelet bands deployed/recaptured in 2014 at Santa Barbara Island.

Band	Date	Band	Date	Recaptures	
1322-22051	5/22/2014	1322-22082	5/26/2014		
1322-22052	5/22/2014	1322-22083	5/26/2014	Band	Date
1322-22053	5/22/2014	1322-22084	5/26/2014	1262-03216	5/23/2014
1322-22054	5/22/2014	1322-22085	5/29/2014	1262-03414	5/24/2014
1322-22055	5/23/2014	1322-22086	5/29/2014	1262-03214	5/30/2014
1322-22056	5/23/2014	1322-22087	5/29/2014	1322-22064	5/30/2014
1322-22057	5/23/2014	1322-22088	5/30/2014	1322-22091*	5/30/2014
1322-22058	5/23/2014	1322-22089	5/30/2014	1322-22083	5/31/2014
1322-22059	5/23/2014	1322-22090	5/30/2014	1322-22086	5/31/2014
1322-22060	5/23/2014	1322-22091*	5/30/2014	1322-22096	5/31/2014
1322-22061	5/23/2014	1322-22092	5/30/2014	1262-03145	6/2/2014
1322-22062	5/23/2014	1322-22093	5/30/2014	1262-03281	6/2/2014
1322-22064	5/23/2014	1322-22094	5/30/2014		
1322-22065	5/23/2014	1322-22095	5/30/2014	*Hatch Year Chick	
1322-22066	5/23/2014	1322-22096	5/30/2014		
1322-22067	5/23/2014	1322-22097	5/30/2014		
1322-22068	5/23/2014	1322-22098	5/30/2014		
1322-22069	5/24/2014	1322-22099	5/31/2014		
1322-22070	5/24/2014	1322-22100	5/30/2014		
1322-22071	5/25/2014	1262-03516	5/31/2014		
1322-22072	5/25/2014	1262-03517	5/31/2014		
1322-22073	5/25/2014	1262-03519	5/31/2014		
1322-22074	5/25/2014	1262-03521	6/2/2014		
1322-22075	5/25/2014	1262-03522	6/2/2014		
1322-22076	5/26/2014	1262-03523	6/2/2014		
1322-22077	5/26/2014	1262-03524	6/2/2014		
1322-22078	5/26/2014	1262-03525	6/2/2014		
1322-22079	5/26/2014	1262-03526	6/2/2014		
1322-22080	5/26/2014	1262-03527	6/2/2014		
1322-22081	5/26/2014				

Appendix 3. Ashy Storm-Petrel bands deployed in 2014 at Santa Barbara Island.

Band	Date	Band	Date	Band	Date
4501-41101	7/17/2014	4501-41161	7/21/2014	4501-41652	7/04/2014
4501-41102	7/17/2014	4501-41162	7/21/2014	4501-41653	7/04/2014
4501-41103	7/17/2014	4501-41163	7/21/2014	4501-41654	7/04/2014
4501-41104	7/18/2014	4501-41164	7/21/2014	4501-41655	7/04/2014
4501-41105	7/18/2014	4501-41165	7/21/2014	4501-41656	7/04/2014
4501-41106	7/18/2014	4501-41166	7/21/2014	4501-41657	7/04/2014
4501-41107	7/18/2014	4501-41167	7/21/2014	4501-41658	7/04/2014
4501-41108	7/18/2014	4501-41168	7/21/2014	4501-41659	7/04/2014
4501-41109	7/18/2014	4501-41169	7/21/2014	4501-41660	7/04/2014
4501-41110	7/18/2014	4501-41170	7/21/2014	4501-41661	7/04/2014
4501-41111	7/18/2014	4501-41478	7/16/2014	4501-41662	7/04/2014
4501-41112	7/18/2014	4501-41479	7/16/2014	4501-41663	7/05/2014
4501-41113	7/18/2014	4501-41480	7/16/2014	4501-41664	7/05/2014
4501-41114	7/18/2014	4501-41481	7/16/2014	4501-41665	7/05/2014
4501-41115	7/18/2014	4501-41482	7/16/2014	4501-41666	7/05/2014
4501-41116	7/18/2014	4501-41483	7/16/2014	4501-41667	7/05/2014
4501-41117	7/18/2014	4501-41484	7/16/2014	4501-41668	7/05/2014
4501-41118	7/18/2014	4501-41485	7/16/2014	4501-41669	7/05/2014
4501-41119	7/18/2014	4501-41486	7/16/2014	4501-41670	7/05/2014
4501-41120	7/19/2014	4501-41487	7/16/2014	4501-41671	7/05/2014
4501-41121	7/19/2014	4501-41488	7/16/2014	4501-41672	7/05/2014
4501-41122	7/19/2014	4501-41489	7/16/2014	4501-41673	7/05/2014
4501-41123	7/19/2014	4501-41490	7/17/2014	4501-41674	7/05/2014
4501-41124	7/19/2014	4501-41491	7/17/2014	4501-41675	7/05/2014
4501-41125	7/19/2014	4501-41492	7/17/2014	4501-41676	7/05/2014
4501-41126	7/20/2014	4501-41493	7/17/2014	4501-41677	7/05/2014
4501-41127	7/20/2014	4501-41494	7/17/2014	4501-41678	7/05/2014
4501-41128	7/20/2014	4501-41495	7/17/2014	4501-41679	7/05/2014
4501-41129	7/20/2014	4501-41496	7/17/2014	4501-41680	7/05/2014
4501-41130	7/20/2014	4501-41497	7/17/2014	4501-41681	7/05/2014
4501-41131	7/20/2014	4501-41498	7/17/2014	4501-41682	7/05/2014
4501-41132	7/20/2014	4501-41499	7/17/2014	4501-41683	7/05/2014
4501-41133	7/20/2014	4501-41500	7/17/2014	4501-41684	7/05/2014
4501-41134	7/20/2014	4501-41625	7/02/2014	4501-41685	7/05/2014
4501-41135	7/20/2014	4501-41626	7/02/2014	4501-41686	7/05/2014
4501-41136	7/21/2014	4501-41627	7/02/2014	4501-41687	7/05/2014
4501-41137	7/21/2014	4501-41628	7/02/2014	4501-41688	7/05/2014
4501-41138	7/21/2014	4501-41629	7/02/2014	4501-41689	7/06/2014
4501-41139	7/21/2014	4501-41630	7/02/2014	4501-41690	7/06/2014
4501-41140	7/21/2014	4501-41631	7/02/2014	4501-41691	7/06/2014
4501-41141	7/21/2014	4501-41632	7/02/2014	4501-41692	7/07/2014
4501-41142	7/21/2014	4501-41633	7/02/2014	4501-41693	7/07/2014

Appendix 3 Continued

Band	Date	Band	Date	Band	Date
4501-41143	7/21/2014	4501-41634	7/02/2014	4501-41696	7/07/2014
4501-41144	7/21/2014	4501-41635	7/03/2014	4501-37835	8/08/2014
4501-41145	7/21/2014	4501-41636	7/03/2014	4501-37836	8/08/2014
4501-41146	7/21/2014	4501-41637	7/03/2014	4501-37837	8/21/2014
4501-41147	7/21/2014	4501-41638	7/03/2014	4501-37838	8/21/2014
4501-41148	7/21/2014	4501-41639	7/03/2014	4501-37839	8/21/2014
4501-41149	7/21/2014	4501-41640	7/04/2014	4501-37841	8/21/2014
4501-41150	7/21/2014	4501-41641	7/04/2014	4501-37842	8/22/2014
4501-41151	7/21/2014	4501-41642	7/04/2014	4501-37843	8/22/2014
4501-41152	7/21/2014	4501-41643	7/04/2014	4501-37844	8/22/2014
4501-41153	7/21/2014	4501-41644	7/04/2014	4501-37845	8/22/2014
4501-41154	7/21/2014	4501-41645	7/04/2014	4501-37846	8/22/2014
4501-41155	7/21/2014	4501-41646	7/04/2014	4501-37847	8/22/2014
4501-41156	7/21/2014	4501-41647	7/04/2014	4501-37848	8/23/2014
4501-41157	7/21/2014	4501-41648	7/04/2014	4501-37849	8/23/2014
4501-41158	7/21/2014	4501-41649	7/04/2014		
4501-41159	7/21/2014	4501-41650	7/04/2014		
4501-41160	7/21/2014	4501-41651	7/04/2014		

Appendix 4. Black Storm-Petrel bands deployed in 2014 at Santa Barbara Island.

Band	Date
1001-21565	7/02/2014
1001-21566	7/02/2014
1001-21567	7/02/2014
1001-21568	7/03/2014
1001-21569	7/04/2014
1001-21570	7/05/2014
1001-21571	7/08/2014
1001-21572	7/16/2014
1001-21573	7/18/2014
1001-21589	8/22/2014