Scripps's Murrelet, Cassin's Auklet, and Ashy Storm-Petrel Reproductive Monitoring and Restoration Activities on Santa Barbara Island, California in 2012

A. Laurie Harvey[1,2], James A. Howard[1], David M. Mazurkiewicz[2], Marie-Eve Jacques[3], Sasha A. Auer[2,4], Catherine A. Carter[1], Kevin W. Barnes[2,4], Andrew A. Yamagiwa[1], and Sue J. Kim[1]

[1] Current Address: California Institute of Environmental Studies
3408 Whaler Avenue
Davis, CA 95616
laurie_harvey@seabirds.org.in

[2] Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

[3] Current Address: Oklahoma State University
008C AgHall
Stillwater, OK 74078

[4]Current Address: Ball State University
2000 West University Avenue
Muncie, IN 47306

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EXECUTIVE SUMMARY

- The Santa Barbara Island alcid habitat restoration project, which includes plot-based reproductive monitoring for Scripps's Murrelet (*Synthliboramphus scrippsi*; SCMU), social attraction for Cassin's Auklets (*Ptychoramphus aleuticus*; CAAU), and on-island native plant propagation and restoration work to benefit these species, has been ongoing since 2007.

- We monitored a total of 160 SCMU clutches in 120 active nest sites in the four baseline monitoring plots in 2012.

- The SCMU breeding season spanned approximately 4.5 months from the first clutch initiation (21 February) to the latest hatching date (10 July).

- SCMU clutch success (CS) in the four plots ranged from 33% to 70% for an overall estimated 62% of clutches hatching at least one egg (n=157 clutches). The Clutch per Site (CPS) statistic was similar among plots, ranging from 1.20 to 1.50 clutches per site. First clutches were much more successful than second attempts (CS=70% vs. 43%, respectively).

- The island-wide SCMU egg productivity and depredation rates were 54% and 20%, respectively (n=279 eggs). Contrary to results in most prior years, depredation rates calculated for those eggs where lay order was known were similar for first eggs (n= 106) versus second eggs (n=103) at 21% and 19%, respectively.

- SCMU egg abandonment rates were highest in the Bunkhouse and Landing Cove plots (55%; n=11 and 13%; n=110, respectively) and very low in all other plots.

- Following recommendations generated in the previous breeding season, social attraction for CAAU was not implemented in 2012. However, this species attempted to nest in the new colony area established in 2010-2011 by the social attraction system in Landing Cove; nest prospecting activities began by 4 January.

- We confirmed CAAU egg-laying in five artificial burrows in Landing Cove; an additional six natural burrows and six artificial burrows were potentially active, but egg-laying was not confirmed in these twelve sites.

- This report provides results of baseline monitoring efforts conducted for SCMU and CAAU in 2012 as well as recommendations for future colony assessment and protection strategies for use in assessing the long-term outcome of the native plant restoration work.

INTRODUCTION

The five islands that comprise the Channel Islands National Park (CINP) host 12 breeding seabird species (Carter et al. 1992, Harvey et al. 2013a). On Santa Barbara Island (SBI), a native plant restoration project to improve reproductive success for Scripps's Murrelets (*Synthliboramphus scrippsi*; SCMU) and Cassin's Auklets (*Ptychoramphus aleuticus*; CAAU) was initiated in 2007 (MSRP 2005, 2012, Harvey and Barnes 2009, Harvey et al. 2012, 2013b). While the historically large CAAU colony on SBI was nearly extirpated by the turn of the 19th century, SBI remains the largest SCMU colony in its range (Cooper 1873, Willet 1912, Grinnell 1897, Wright and Snyder 1913, Cooper *in* Howell 1917, Burkett et al. 2003, Carter et al. 2005, Whitworth et al. 2009, 2011). SCMU nesting on SBI occurs in rocky crevices, artificial habitats, and under native shrubs (Burkett et al. 2003, Schwemm et al. 2005, Harvey and Barnes 2009, Harvey et al. 2012, 2013b).

Implementation of the SBI habitat restoration project began in 2007 with pilot native plant restoration work, construction of an on-island temporary nursery facility, and baseline reproductive monitoring for SCMU (Harvey and Barnes 2009). In 2007, reference site monitoring for SCMU provided an egg productivity estimate of 42% and egg depredation rate of 45% (n=130 eggs; Harvey and Barnes 2009; see methods, below, for reproductive parameter definitions). No CAAU or Ashy Storm-Petrel (*Oceanodroma homochroa;* ASSP) nests were found during land-based habitat searches in that year. The Prohibition Point, Northeast Flats, and Landing Cove plant restoration plots were established in 2007.

In 2008, SCMU egg productivity at SBI increased slightly from the previous year (to 50%), reflected by a similar decrease in the egg depredation rate (38%; n=89; Harvey et al. 2012). Land-based searches for CAAU nests in 2008 again failed to find active nests, but a small sample of ASSP nests (n=7) were discovered (Whitworth et al. 2009). Limited spotlight and sea cave surveys to assess the SCMU population status at SBI, as well as an extensive review of published and unpublished data to compile information describing CAAU historical breeding locales, were also conducted in 2008 (Whitworth et al. 2009). The three native plant restoration plots established in 2007 (see above) were expanded annually, and preliminary work at the Elephant Seal Cove Cliffs restoration area was initiated.

In 2009, a collaborative study was designed to determine whether CAAU nesting still occurred on the main island, assess the island wide distribution of SCMU nesting, update the SCMU population estimate, and identify at-sea distribution of both species relative to ocean and prey conditions (Whitworth et al. 2009, 2011, in prep.). This study resulted in confirmation of CAAU breeding on SBI for the first time since 1994. A small sample of CAAU found nesting below Elephant Seal Point was also banded during mist-net captures. Results from the SCMU plot-based nest monitoring that year indicated decreased island-wide egg productivity (to 37%) and associated increase in egg depredation rate (51%; n=182 eggs; Whitworth et al. 2011, Harvey et al. 2012). Significant adult SCMU mortality attributed primarily to Barn Owl (*Tyto alba*, BNOW) predation was also documented in 2009, resulting in a strong recommendation to undertake an updated assessment of mortality on SBI. In 2009, nocturnal mist-net captures to initiate mark-recapture efforts for ASSP were also conducted (L. Harvey and H. Carter unpubl. data). Limited at-sea captures for SCMU were also conducted in 2009 to increase the sample of banded individuals captured at SBI for future demographic studies (Whitworth et al. 2010).

In 2010, an updated population assessment for SCMU was derived from spotlight surveys and nest monitoring in 2009-2010, indicating that SBI remained the largest colony in California (321-638 pairs; Whitworth et al. 2011). Plot-based monitoring, including a much expanded sample size, showed that SCMU reproductive success improved in 2010, with an estimated 66% egg productivity and 16% egg depredation rate (n=442 eggs; Harvey et al. 2013b). Prey sampling and diurnal at-sea surveys to assess SCMU and CAAU relative to foraging conditions were also conducted (Whitworth et al. in prep). A pilot study to assess BNOW distribution, abundance, and impacts to nesting seabirds was initiated in 2010 (Thomsen and Harvey 2012). An updated vegetation map for SBI was also completed (Rodriguez et al. in prep). Limited at-sea captures for SCMU were conducted as in the previous year to increase the sample of banded individuals captured at SBI (Whitworth et al. 2011). Small numbers of ASSP nests were monitored in 2010, and nocturnal mist-net surveys were conducted (20 individual ASSP banded; Harvey et al. 2012). Social attraction (nocturnal vocal broadcast) to attempt to recruit CAAU to restoration areas was also initiated in 2010, coupled with artificial burrows modeled after those used for the CAAU colony at Scorpion Rock offshore Santa Cruz Island (Adams et al. 2009, Harvey et al. 2013b). In 2010, small numbers of new SCMU and CAAU nests were documented in restoration plots for the first time since plant restoration was initiated (Harvey et al. 2013b).

In 2011, CAAU responded to the social attraction system installed in the previous year, initiating seven nests during the breeding season; this represented the first known successful use of social attraction for the species (Harvey et al. 2013b). Additional remote cameras were installed to assess nesting activity in the restoration areas. SCMU egg productivity remained high at 61% (n=214 eggs; Harvey et al. 2013). A larger effort for ASSP mark-recapture studies resulted in 85 captures, just two of which had been previously banded (in the prior year; Harvey et al. 2013b). Limited at-sea capture and banding efforts for SCMU were conducted as in previous years, and a larger native plant nursery facility was completed in 2011.

The 2012 work plan included continued native plant restoration, land-based SCMU reproductive monitoring and at-sea banding efforts, and nest monitoring for CAAU. This report provides summary reproductive data for SCMU and CAAU as well as incidental data for ASSP from land-based monitoring plots. These data will be used to assess the eventual outcome of the restoration project on SBI.

METHODS

Field Crew Logistics. Monitoring schedules generally were coordinated around CINP weekly transportation (typically Wednesday boats). Helicopters (Aspen Helicopters, Inc.) were contracted to access the island if boats were not available. Seabird monitoring and restoration staff were housed in the CINP residence on SBI. In 2012, we maintained blackout curtains installed in 2008 in the CINP residences to curtail light emission (Harvey et al. 2012) and implemented other disturbance reduction efforts as needed (discussed below).

Reproductive Monitoring. Detailed monitoring methodology for the SBI SCMU colony was provided in Harvey et al. (2013b) and references therein. Briefly, nest contents were examined using a handheld flashlight; adults were not handled. Accessible, unattended eggs were individually labeled for clutch order determinations, photographed, measured, and assigned a color identifier to assist with clutch fate determinations, as murrelet egg colors often vary markedly within clutches (see Murray et al. 1983 for description of egg neglect and other breeding characteristics of the SCMU). Egg measurements are not reported herein but are archived at CINP for long-term reference. Eggshell fragments were removed from nest sites to assist with ultimate egg fate determinations. Beginning in 2009, and continuing through the present study, nest monitoring data were recorded in the field using a Personal Data Assistant rather than in paper notebooks; data entry fields are itemized in Appendix 1. In 2010-2012, eggshells were removed and stored (frozen) on the mainland CINP office for possible future genetic studies. Plot boundaries and individual nest site locations were mapped using handheld Garmin GPS units. Aerial photographs used for GIS graphics were taken in 2009 (R. Rudolph pers. comm.).

In 2012, we routinely monitored four baseline plots: Bunkhouse (BH), Cat Canyon (CC), Dock (DO), and Landing Cove (LC; Figure 1). Reduced monitoring was also conducted at Arch Point North Cliffs (APNC). In total, we conducted surveys on 85 individual days between 1 March and 3 August; all potential habitat within plots was checked during the final survey to ensure that late nesting had not occurred (Table 1, Appendix 2). We also continued to routinely monitor the restoration plots: Northeast Flats (NEF), Landing Cove, Elephant Seal Cove Cliffs (ESC), and Beacon Hill Plot (BHP), as well as the restored portions of LC and House (formerly "Prohibition Point"; see Harvey and Barnes 2009). In addition to monitoring habitat restoration areas for new nesting, we regularly monitored a total of 362 tagged nest sites, including 31 artificial nest boxes for SCMU and 100 artificial nest burrows installed for CAAU (in which SCMU nest from time to time; see Harvey et al. 2012, 2013b for discussion of artificial habitat). New nesting sites discovered within search plots were assigned a nest number, tagged, and checked routinely with the other nests. Artificial burrows installed for CAAU recruitment (in 2009-2011; Harvey et al. 2013b) were checked on 32 individual days between 4 January and 3 August (Appendix 2). Raw data from monitoring and restoration activities were archived at CINP. We reported the following parameters to describe SCMU reproduction on SBI: 1) Egg Productivity (EP) as the number of eggs hatched per total eggs laid; 2) Egg Depredation (ED) as the proportion of eggs that failed due to mouse depredation prior to potential hatching; 3) Clutch Success (CS) as the proportion of all clutches from which at least one egg hatched. Eggs and clutches where fates could not be reliably determined were excluded from analyses.

Cassin's Auklet Social Attraction and Captures. Per recommendations in Harvey et al. (2013), we did not implement social attraction for Cassin's Auklets in 2012. However, we continued to maintain and monitor artificial habitat, discussed below.

Scripps's Murrelet at-sea Captures. We conducted mark-recapture efforts in the Landing Cove area using methods described in Whitworth et al (1997) and Harvey et al. (2013a, b) on 5 survey nights in 2012: 11-12 April, 15-16 April, 16-17 April, 20-21 May, and 21-22 May (Table 2). A support vessel was not available for captures in 2012; all banding was conducted in the capture boat.

Table 1. Basic survey intervals for Scripps's Murrelet reproductive monitoring plots in 2012. See text for details and Appendix 2 for all survey dates.

Monitoring Plot	Survey Date Range	Survey Interval (days)	Final Survey	Total Surveys
APNC	3-16 March	5 to 7	23 April	4
BH	1 March–27 June	6 to7	01 August	19
CC	6 March-14 July	4 to 6	02 August	30
DO	1 March - 4 July	6 to 7	01 August	20
ESC	4 March–29 May	5 to18	03 June	9
LC	2 March-13 July	5 to 8	03 August	21

Table 2. Scripps's Murrelet dip-net capture effort dates at SBI in 2012.

Survey Night			Start Time	End Time
4/11/2012	To	4/12/2012	21:55	1:00
4/15/2012	To	4/16/2012	21:17	3:15
4/16/2012	To	4/17/2012	20:55	0:20
5/20/2012	To	5/21/2012	22:00	2:01
5/21/2012	To	5/22/2012	22:38	2:22

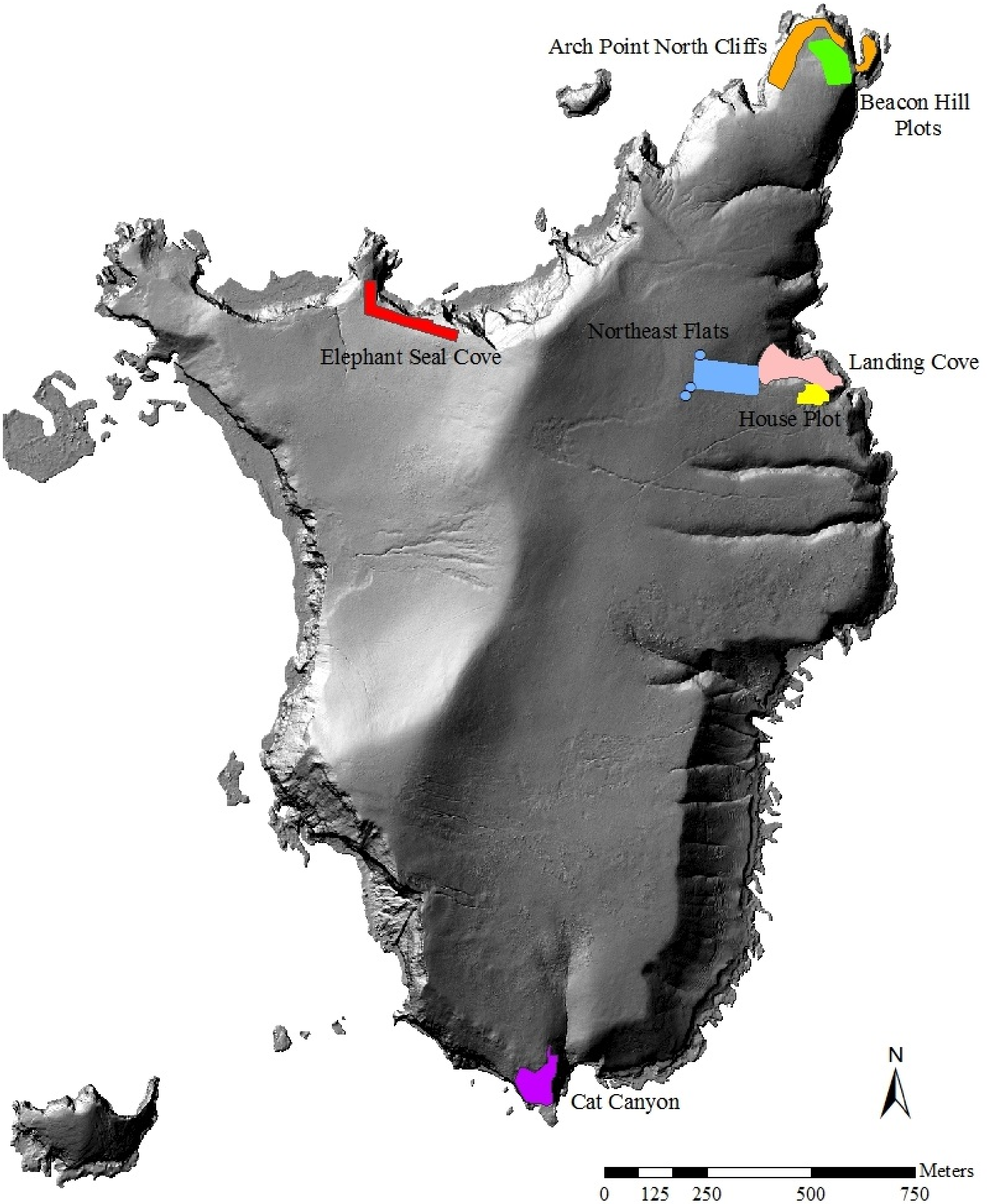

Figure 1. Overview map of monitoring and restoration plots on Santa Barbara Island in 2012.

Other Seabird Species. Mark-recapture surveys for ASSP were not included in the 2012 monitoring schedule; we did not attempt to mist-net for storm-petrels in 2012. See below for ASSP encountered in SCMU monitoring plots. We conducted reproductive monitoring for the following additional seabird species as time allowed: California Brown Pelican (*Pelecanus occidentalis californicus*; BRPE), Pigeon Guillemot (*Cepphus Columba*; PIGU), Brandt's Cormorant (*Phalacrocorax penicillatus*), Double-crested Cormorant (*Phalacrocorax auritus*), Pelagic Cormorant (*Phalacrocorax pelagicus*, PECO), and Black Oystercatcher (*Haematopus bachmani*). Data were archived at CINP and, except where nesting overlapped with restoration-associated monitoring plots, are not reported here.

RESULTS

SCMU Breeding Phenology. The 2012 SCMU breeding season was relatively prolonged, spanning 139 days (approximately 4.5 months) from the first observed clutch initiation to the last hatching date (Tables 3, 4). For first clutches only, the earliest, median, and latest clutch initiations (first eggs laid) occurred on 21 February, 24 March, and 22 May, respectively. Median and latest initiations for all clutches occurred on 28 March and 16 June, respectively. The first hatching occurred on approximately 4 April at APNC, the last hatch date occurred on 10 July at LC, and the median hatch date fell on 8 May 2012.

Table 3. Summary statistics for Scripps's Murrelet clutch initiation dates from all monitoring locations in 2012.

Statistic	Clutch Initiation Date (all clutches combined)	Clutch Initiation Date (first clutches only)
N	149	114
Earliest Day	21 February	21 February
Latest Day	16 June	21 May
Mean Day	8 April	28 March
SD (days)	*25*	*17*
Median Day	28 March	24 March

Table 4. Summary statistics for Scripps's Murrelet hatching dates at all Santa Barbara Island monitoring locations in 2012.

Statistic	Hatch Date (all clutches combined)	Hatch Date (first clutches only)
N	99	83
Earliest Day	4 April	4 April
Latest Day	9 July	23 June
Mean Day	2 May	21 April
SD (days)	*21*	*14*
Median Day	7 May	4 May

Island-wide Reproductive Success. We monitored a total of 160 SCMU clutches in 120 active nest sites in the four baseline monitoring plots in 2012 (Table 5). Clutch success (CS) in the four plots ranged from 33% to 70% for an overall estimated 62% of clutches hatching at least one egg (n=157 clutches). The Clutch per Site (CPS) statistic was similar among plots, ranging from 1.20 to 1.50 clutches per site (Table 5). The percentage of sites with multiple attempts in the Northeastern areas was a combined 28%; seven nest sites at the DO produced more than one clutch, and 13 sites in LC produced multiple clutches (Table 6). First clutches were much more successful than second attempts (CS=70% vs. 43%, respectively); none of the third (n=3) and fourth (n=1) attempts in discrete sites successfully hatched (Table 6).

In 2012, we determined fates for a total of 279 eggs from the 120 active nest sites in the baseline monitoring plots (Table 7). The island-wide egg productivity and depredation rates were 54% and 20%, respectively (n=279 eggs). Of the 129 eggs that failed to hatch, most were either depredated by mice (57), abandoned (23), addled (20), or broken in the nest (10). Egg productivity was highest at LC and lowest at BH; depredation rates were highest at CC, as observed in previous years (Schwemm et al. 2005, Harvey and Barnes 2009, Harvey et al. 2012, 2013b). Contrary to results in most prior years, depredation rates calculated for those eggs where lay order was known (i.e. a sample of total eggs) were similar for first eggs (n= 106) versus second eggs (n=103) at 21% and 15%, respectively (Table 8). Egg abandonment rates were highest in the BH and LC plots (55%; n=11eggs and 13%; n=110 eggs, respectively) and very low in the other plots (4% maximum; Table 7).

Table 5. Scripps's Murrelet reproductive success at Santa Barbara Island in 2012.

Reproductive metric	CC	DO	BH	LC	All
Active Sites	45	18	5	52	120
Total Clutches	62	27	6	65	160
% Clutch Success[1]	59%	59%	33%	70%	62%
Clutch Success (n)	61	27	6	63	157
Egg Productivity[2]	55%	50%	27%	57%	54%
Egg Depredation[3]	36%	16%	0%	9%	20%
Egg Metrics (n)	108	50	11	110	279
CPS[4]	1.38	1.50	1.20	1.25	1.33

[1] Clutch Success as percentage of known fate clutches that hatch at least one chick (n=number of clutches from which ≥1 egg hatched).
[2] Egg Productivity as number of eggs hatched per egg laid (n=hatched eggs).
[3] Depredation Rate as number of eggs depredated per eggs laid (n=depredated eggs).
[4] CPS= total clutches laid per unique site.

Table 6. Scripps's Murrelet clutch success (CS) of multiple clutches laid sequentially in discrete nest sites in 2012.

Clutch Number	BH	*(n)*	CC	*(n)*	DO	*(n)*	LC	*(n)*	Total	*(n)*
1	40%	*5*	68%	*44*	72%	*18*	75%	*51*	**70%**	*118*
2	0%	*1*	40%	*15*	43%	*7*	50%	*12*	**43%**	*35*
3	*nl*[1]	*0*	0%	*2*	0%	*1*	*nl*	*0*	**0%**	*3*
4	*nl*	*0*	nl	*0*	0%	*1*	*nl*	*0*	**0%**	*1*
Overall CS	**33%**	*6*	**59%**	*61*	**59%**	*27*	**70%**	*63*	**62%**	*157*

[1] nl= none laid.

Table 7. Scripps's Murrelet egg fates at Santa Barbara Island in 2012 from the four baseline monitoring plots. Categories in italics represent the cause of egg failure prior to successful hatch.

Egg Fate	BH	CC	DO	LC	Total
Hatched	3	59	25	63	150
Failed	8	49	25	47	129
Depredated (mouse)	*0*	*39*	*8*	*10*	*57*
Abandoned	*6*	*0*	*2*	*15*	*23*
Addled	*0*	*3*	*6*	*11*	*20*
Broken	*0*	*2*	*6*	*2*	*10*
Chick died in nest	*0*	*2*	*0*	*0*	*2*
Kicked Out	*2*	*0*	*2*	*4*	*8*
Disappeared	*0*	*3*	*0*	*5*	*8*
Usurped	*0*	*0*	*1*	*0*	*1*
n	**11**	**108**	**50**	**110**	**279**

Table 8. Percentages of first versus second Scripps's Murrelet eggs depredated by mice on Santa Barbara Island in 2012. See text for details.

Egg Order	BH	CC	DO	LC	Total
First Egg	0%	33%	17%	8%	21%
N	*2*	*45*	*23*	*36*	*106*
Second Egg	0%	24%	14%	3%	15%
N	*2*	*45*	*22*	*36*	*103*
All Eggs	0%	29%	16%	6%	18%

Cat Canyon. The CC plot is located at the extreme southern end of the island (Figures 1, 2). Active nests in this plot are primarily located in natural rocky crevice habitat (see below). The majority of the plot has a southerly aspect; the perennial plant community is characterized by dense cholla (*Cylindropuntia prolifera*), abundant crystalline iceplant (*Mesembryanthemum crystallinum)*, patchy boxthorn *(Lycium californicum*), and sparse SBI liveforever (*Dudleya traskiae*). The plot area with a more easterly aspect (above Cat Canyon proper) has a much greater abundance of native shrub habitat; prickly pear (*Opuntia littoralis*) and SBI Buckwheat (*Eriogonum giganteum var. compactum*) are the dominant shrub species.

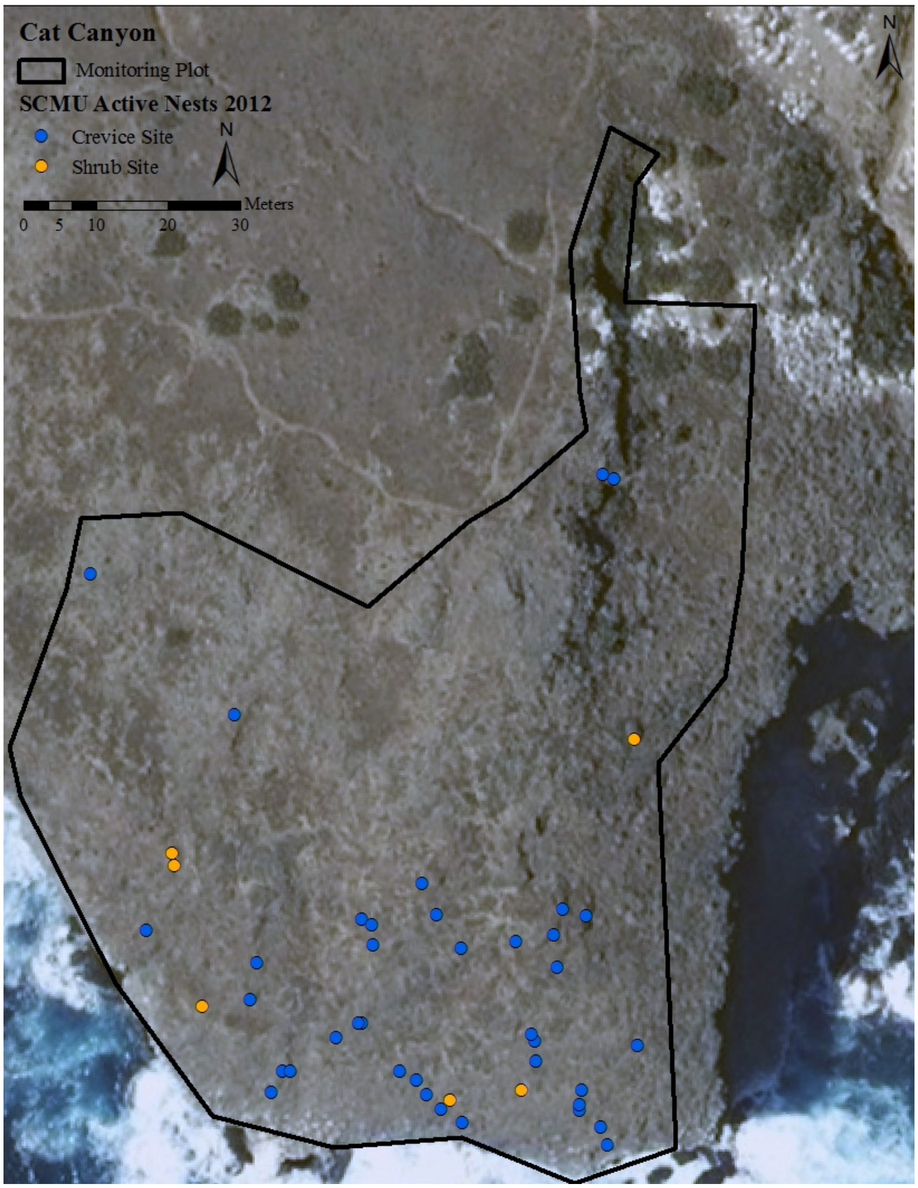

Figure 2. Scripps's Murrelet active nest locations in the Cat Canyon plot in 2012.

While a portion of the CC plot cannot be accessed in some years due to BRPE nesting (see Harvey and Barnes 2009, Harvey et al. 2012, Harvey et al. 2013b), we were able to access the entirety of the CC plot in 2012. We conducted surveys at CC on 30 days between 6 March and 2 August 2012 with nests checked every 4-6 days (Appendix 2). Nest monitoring encompassed all accessible nesting habitat and 172 marked sites, 71 of which were recorded separately as historic sites (Roth et al. 1999, Schwemm and Martin 2005, Harvey and Barnes 2009, Harvey et al. 2012, 2013a).

A total of 62 clutches were laid in the 45 active sites at CC in 2012 (Table 5). Overall clutch success at CC was 59% (n=61), a decrease from the two previous years' clutch success of 68% in 2010 and 62% in 2011 (Harvey et al. 2013b). Egg productivity and depredation rates were 55% and 36%, respectively (n=108).

Landing Cove. The LC SCMU monitoring plot was established in 2008 to provide an alternative to the previously monitored Nature Trail plot. In contrast to the CC plot, the LC SCMU monitoring plot is comprised almost entirely of native shrub habitat (Figures 3, 4, 5; Schwemm et al. 2005, Harvey et al. 2012, 2013b). Plant restoration and artificial habitat have been ongoing in this area since 2007 (see below).

While a portion of the LC plot cannot be accessed in some years due to BRPE nesting (see references above), we were able to access the entirety of the LC plot in 2012 due to very low numbers of nesting BRPE in that year. All potential habitat was surveyed at approximately 5-8 day intervals from 2 March through 3 August. A total of 21 surveys of 79 previously tagged sites as well as available habitat were made during that time, not including limited supplemental checks of video monitored nests (Appendix 2). The LC restoration plot overlaps the murrelet monitoring plot; to date, murrelets have not expanded into the additional shrub habitat installed. However, most shrubs planted in 2007-2011 were not yet large enough by the 2012 murrelet nesting season to support new nests.

The LC SCMU nesting sample size increased from just 12 sites in 2011 to 52 in 2012. This increased sample size reflected an expanded search area allowed by the lack of BRPE nesting in the plot rather than a change in density. A total of 65 clutches were laid in the 52 active sites; CS was 70% (n=63). Egg productivity and depredation rates were 57% and 9%, respectively (n=110 eggs).

Figure 3. Overview photograph of the North side of the Landing Cove plot prior to restoration (March 2007). Photo A.L. Harvey.

Figure 4. The North portion of the Landing Cove plot prior to restoration (Left panel; in February 2009, photo by A.L. Harvey) and in February 2013 after three years of native plant restoration (right panel; photo by C.A. Carter).

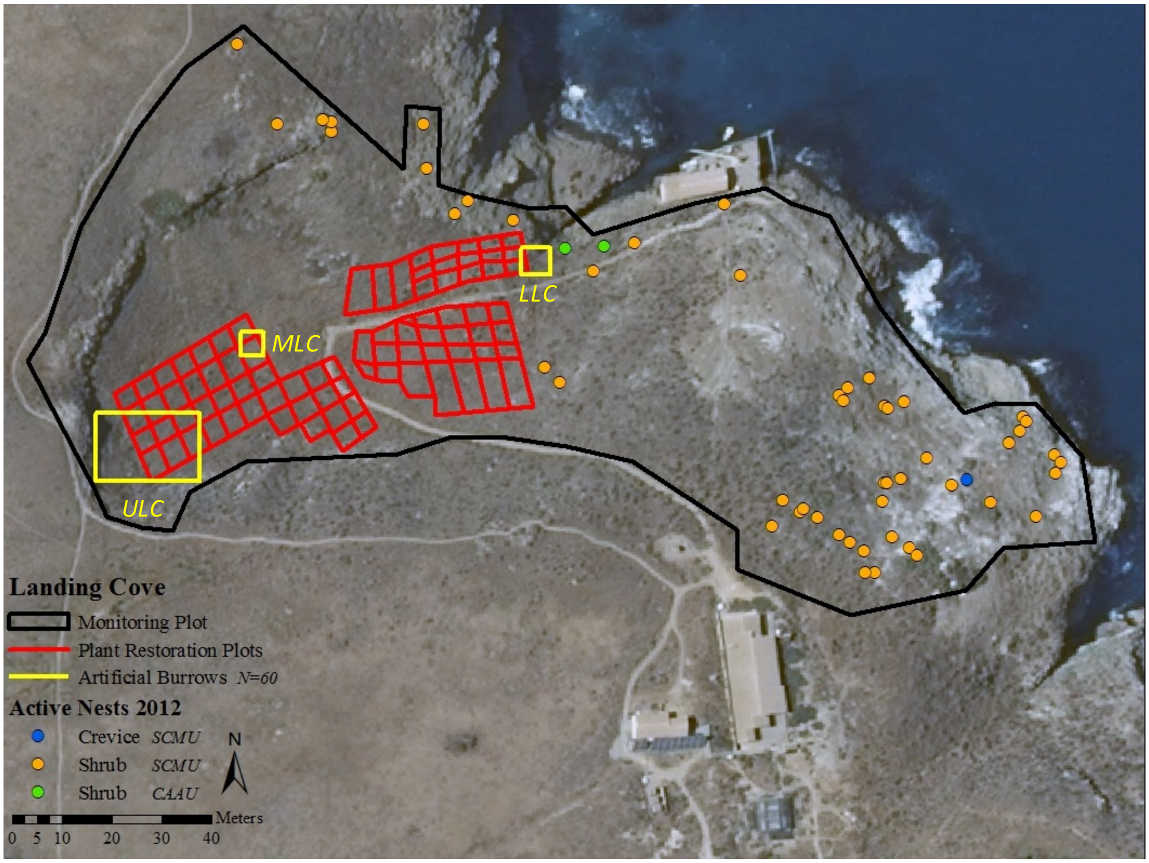

Figure 5. The Landing Cove Scripps's Murrelet monitoring plot area, active nests monitored in 2012, plant restoration subplots, and artificial habitat locations. See text for details.

Landing Cove artificial burrows and social attraction. Sixty **(**60) artificial nest burrows (ABs) were installed in the LC drainage in 2009 and 2011 in three clusters of 20 burrows each: Upper Landing Cove ("ULC"), Middle Landing Cove ("MLC"), and Lower Landing Cove ("LLC"; Figure 5). Artificial burrows were supplemented with coverboards, erosion control fabric, and native shrubs (see Harvey et al. 2013b for design and installation details). Social attraction was not implemented in 2012 at LC as a response to the mortality observed there (attributed to BNOW predation) in previous years (Harvey et al. 2012, 2013b; Thomsen and Harvey 2012, Thomsen et al. 2013).

We deployed remote monitoring cameras at LLC and MLC as in 2011 (see Harvey et al. 2013a for description of artificial habitat installations). We checked artificial habitat approximately every 2 weeks between 4 January and 4 July. Although we procured a burrow scope

(“Pukumanu”) prior to the 2012 nesting season to aid in assessing reproductive outcomes, most natural sites established near the ABs, as well as tunnels excavated out of the ABs, were too deep to reliably monitor. Site outcomes reported here therefore represent our best estimates of the fate of each clutch.

We confirmed CAAU egg-laying in five ABs and two natural burrows. An additional six natural burrows were potentially active and birds also visited an additional six ABs, but egg-laying was not confirmed in these twelve sites. Of the seven occupied nest burrows, six contained a single clutch only and one likely held two clutches over the course of the season (evidence of site use subsequent to the failure of the first clutch was restricted to one observation of an adult in the nest; see below).

Prospecting or visiting activity by CAAU (evidenced by fresh digging and/or fresh guano at burrow entrances) was first observed on 4 January; the earliest eggs were observed on 5 February; and the latest activity (an adult inside the burrow) was observed on 1 May. Only one of the active sites may have fledged a chick; the last observation of the chick was on 1 May (a medium downy chick). Inspection of this nest was erroneously omitted from the 13 May nest check and so was not examined until 27 May, at which time the site was empty; therefore fledging could not be confirmed. All other clutches failed as follows: egg depredated (two clutches), chick died in nest (small downy chick, one clutch); abandoned or not hatched (three clutches; chick never observed); unknown (one clutch). CAAU and SCMU carcasses and owl pellets (BNOW and Burrowing Owl [*Athene cunicularia*]) were frequently encountered and will be reported separately.

The eight CAAU natural burrows that were active or visited in 2012 (see above) were associated with native vegetation or artificial structures as follows: cucamonga manroot (*Marah macrocarpa*, three sites); giant coreopsis (*Leptosyne gigantea*, one site); Catalina tarweed (*Deinandra clementina*, two sites); under an old BRPE nest (one site); and associated with artificial habitat system (one site).

One SCMU clutch was laid in the LLC ABs; one egg did not hatch (addled) and the second egg hatched in early May (EP=0.5 and CS=1).

Other Species in Artificial Burrows. As noted for the NEF burrows (below), island night lizards (*Xantusia riversiana*; XARI) were regularly observed in the ABs (maximum count of seven individuals in the LACO ABs on 27 May); data are archived with CINP for future use if needed. Santa Barbara Island deer mouse (*Peromyscus maniculatus elusus*) individuals and nests were regularly observed in the artificial burrows.

Dock Area. SCMU nesting habitat at the Dock is comprised of 15 artificial nest boxes, the area under the dock, and one small natural pocket cave by the dock house. Nesting surveys were conducted at 6-7 day intervals (Figures 6, 7, Appendix 2). In total, 20 surveys were conducted from 1 March through 1 August, not including limited checks (5) of nest sites with video monitoring equipment. Of the artificial habitat at the DO, 10 of 15 nest boxes were active in 2012. A total of 27 SCMU clutches were laid in the 18 active sites in 2012. Clutch success was 59% (n=27 clutches); egg productivity and depredation rates were 50% and 16%, respectively (n=50 eggs).

Figure 6. Scripps's Murrelet nesting adjacent to an artificial nest box under the dock. Photo: A.L. Harvey.

Bunkhouse Area. Surveys of all available BH nesting habitat were conducted approximately once per week (every 6-7 days) from 1 March through 27 June, for a total of 19 surveys. 37 previously marked sites, including 16 artificial nest boxes and potential habitat (shrub, crevices, and other nest sites associated with housing and nursery structures) around the house were checked (Figure 8). Occasional additional checks were done on sites equipped with video surveillance (Appendix 2). Active SCMU nests in the BH area were limited to just five nest sites in 2012. CS was 33% (n=6 clutches); egg productivity and depredation rates were 27% and 0%, respectively (n=11 eggs).

Figure 7. Overview of the Santa Barbara Island dock and Landing Cove drainage on 7 April 2009 (upper panel) and 16 April 2012 (lower panel). Photos by A.L. Harvey.

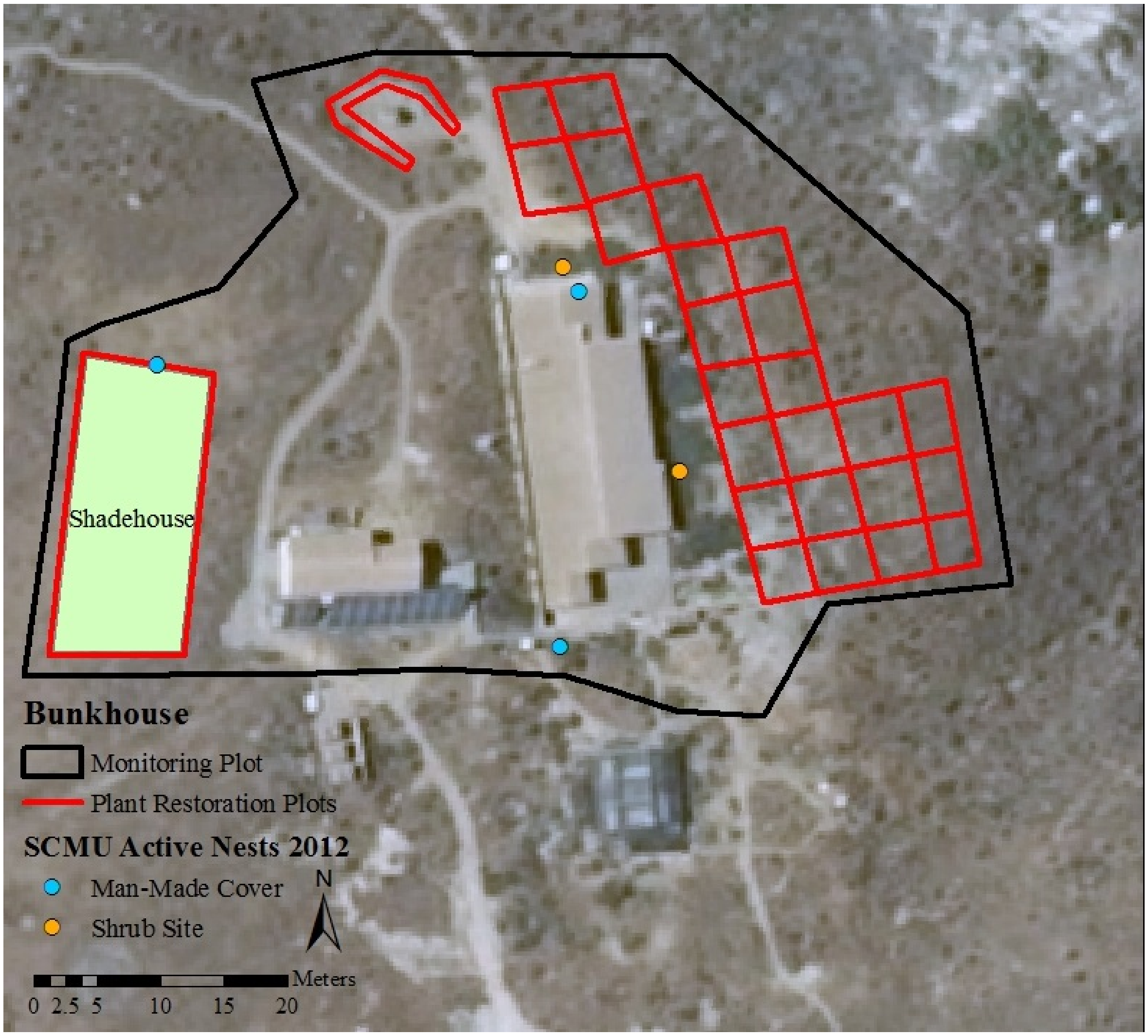

Figure 8. Restoration and monitoring areas surrounding the housing and nursery facilities on Santa Barbara Island.

Northeast Flats Restoration Plot. The NEF plot, located above the LC drainage, was established in fall 2007; plant restoration has occurred annually since that time (Figure 9). Three small additional "Sage Plots" are located adjacent to the main NEF plot. In 2012, we continued to survey the 20 ABs in NEF every two weeks (interval 12-16 days) between 3 March and 27 May (see Harvey et al. 2012, 2013b for ABs descriptions). There was no seabird nesting activity observed in or around these artificial sites in 2012, but many of the burrows were occupied by

XARI and SBI deer mice as in previous years (see Harvey et al. 2013b for discussion); data are archived for future use if desired. Native outplantings within the restoration plot had not yet reached sufficient size to provide cover for natural SCMU nests.

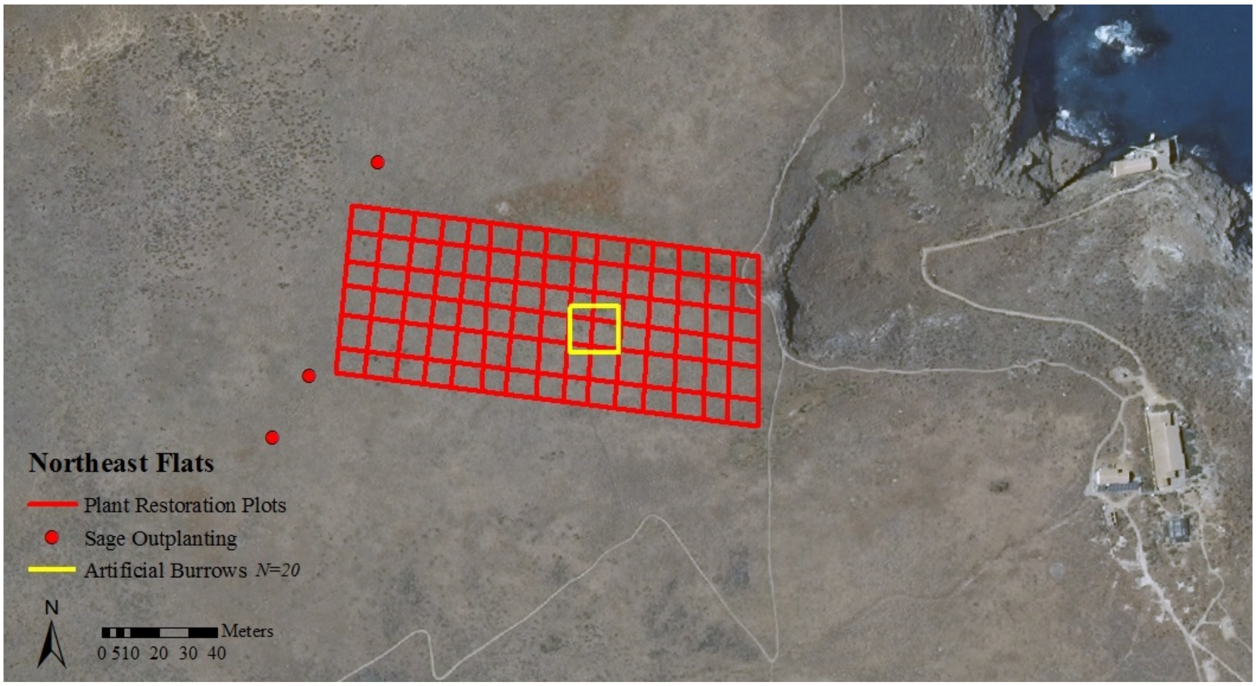

Figure 9. Northeast Flats restoration plot area and artificial habitat locations.

Arch Point/North Cliffs and Beacon Hill. The APNC monitoring plot is located at the north end of the island and is comprised entirely of rocky crevice habitat (Figure 10, 11). Accessible habitat at APNC was checked for nesting activity just four times during the 2012 season due to limited availability of experienced staff in that year. Beginning 03 March, 46 previously marked sites (see Whitworth et al. 2012, Harvey et al. 2013) and all potential sites were checked at 5 and 7 day intervals for the first three searches and then again five weeks later on 23 April. Because of this low monitoring effort, active nest numbers and clutch numbers are minimum estimates only, and are not included in island-wide estimates of reproductive success (discussed below).

APNC produced at least 19 clutches from 18 active SCMU sites; we could assign fates to just seven clutches (see methods), of which only one (14%) hatched at least one egg. This plot's survey effort was insufficient to assess comparable reproductive success estimates (see discussion). The Beacon Hill plant restoration plot was established on the slopes above the APNC plot in fall 2011; plants have not yet reached sufficient size to support nesting.

Figure 10. Overview photograph of the Arch Point North Cliffs monitoring plot, 16 April 2012. Photo: A.L. Harvey.

Cassin's Auklets at APNC. In 2012, one CAAU nest was active in the APNC plot. Site 1303 held an unattended egg on 3 March, an incubating adult on 10 March, and a small downy chick on 16 March. Either a fully feathered chick or adult was present for the final check on 23 April. Note that site APNC 1303, found on SBI in 2009, was the first confirmed CAAU nest since 1994 (Whitworth et al. 2011) and has been active in each year since then (Harvey et al. 2013).

Ashy Storm-Petrel at APNC. Just three potentially active ASSP nests were observed in the APNC plot in 2012; however, plot checks were not conducted late in the season and so we cannot compare to total nest numbers found in 2010-2011 (Harvey et al. 2013). APNC 1315 and 1338 were potentially active (petrel odor was detected). Adult ASSP were first observed in site 1332 on 3 March. Eggs were never observed in the site, and nest checks at APNC were discontinued before adequate reproductive success could be measured for this species.

Pigeon Guillemot. PIGU have been occasionally documented in the APNC plot in previous years, but in PIGU nesting did not occur in this or other monitoring or restoration plots in 2012.

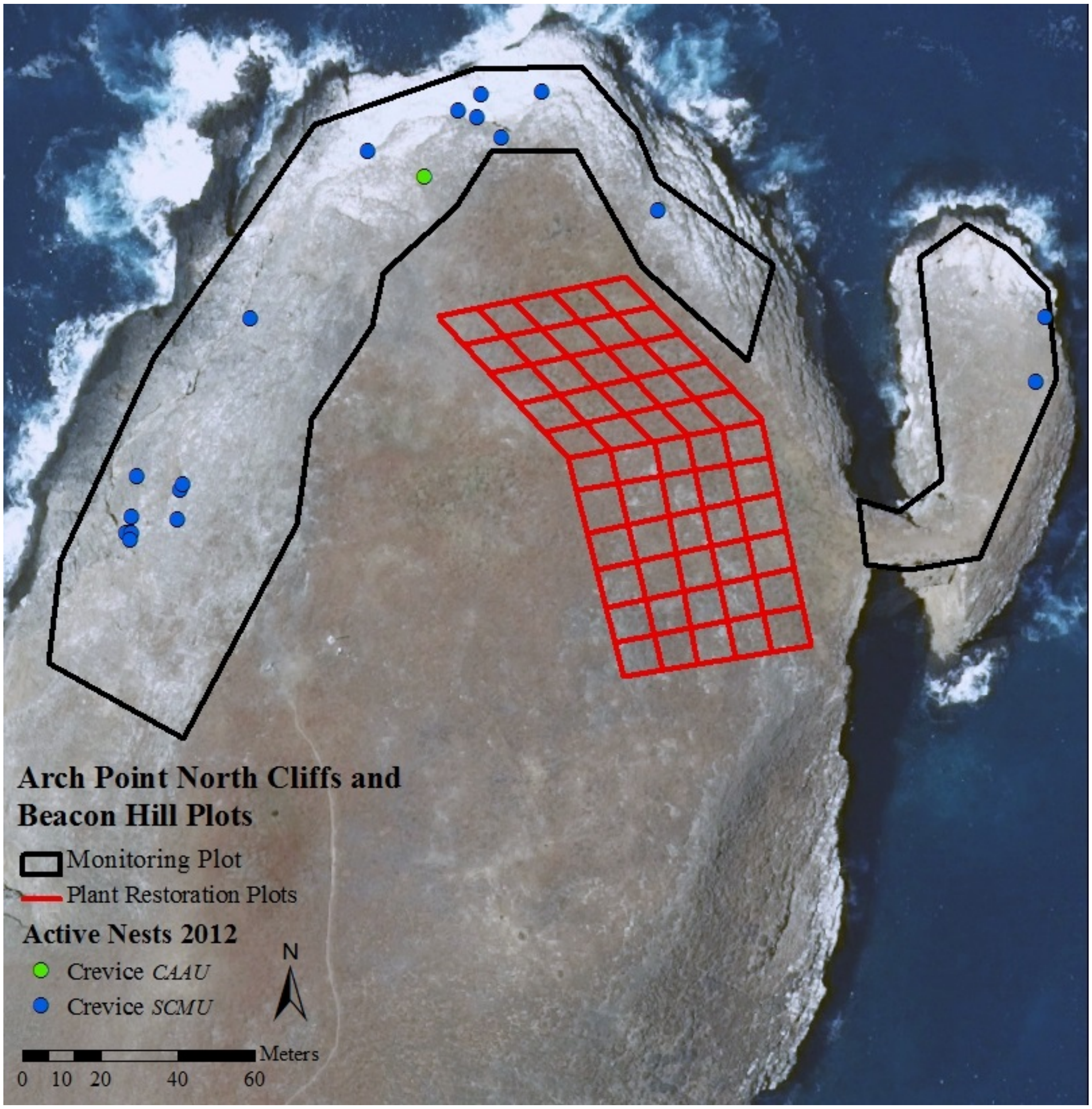

Figure 11. The Scripps's Murrelet Arch Point North Cliffs monitoring plot survey area and Beacon Hill plant restoration plot.

Elephant Seal Cove Cliffs Restoration Plot. Habitat in the ESC restoration plot, established in 2008 (with additional plantings annually thereafter), includes native shrub cover, an exposed rock band containing small caves, and 20 artificial burrows installed to encourage CAAU nesting (see Harvey et al. 2012, 2013b; Figure 12, 13). All potential habitat at ESC was checked at 5-18 day intervals from 4 March through 3 June (Appendix 2).

Figure 12. Overview photographs of the Elephant Seal Cove Cliffs plot: (a) plot preparation in November 2009 prior to plant restoration (upper; Photo D.M. Mazurkiewicz) and (b) the northeast corner of the plot in June 2012 during the third year of plant restoration (lower; photo A.L. Harvey).

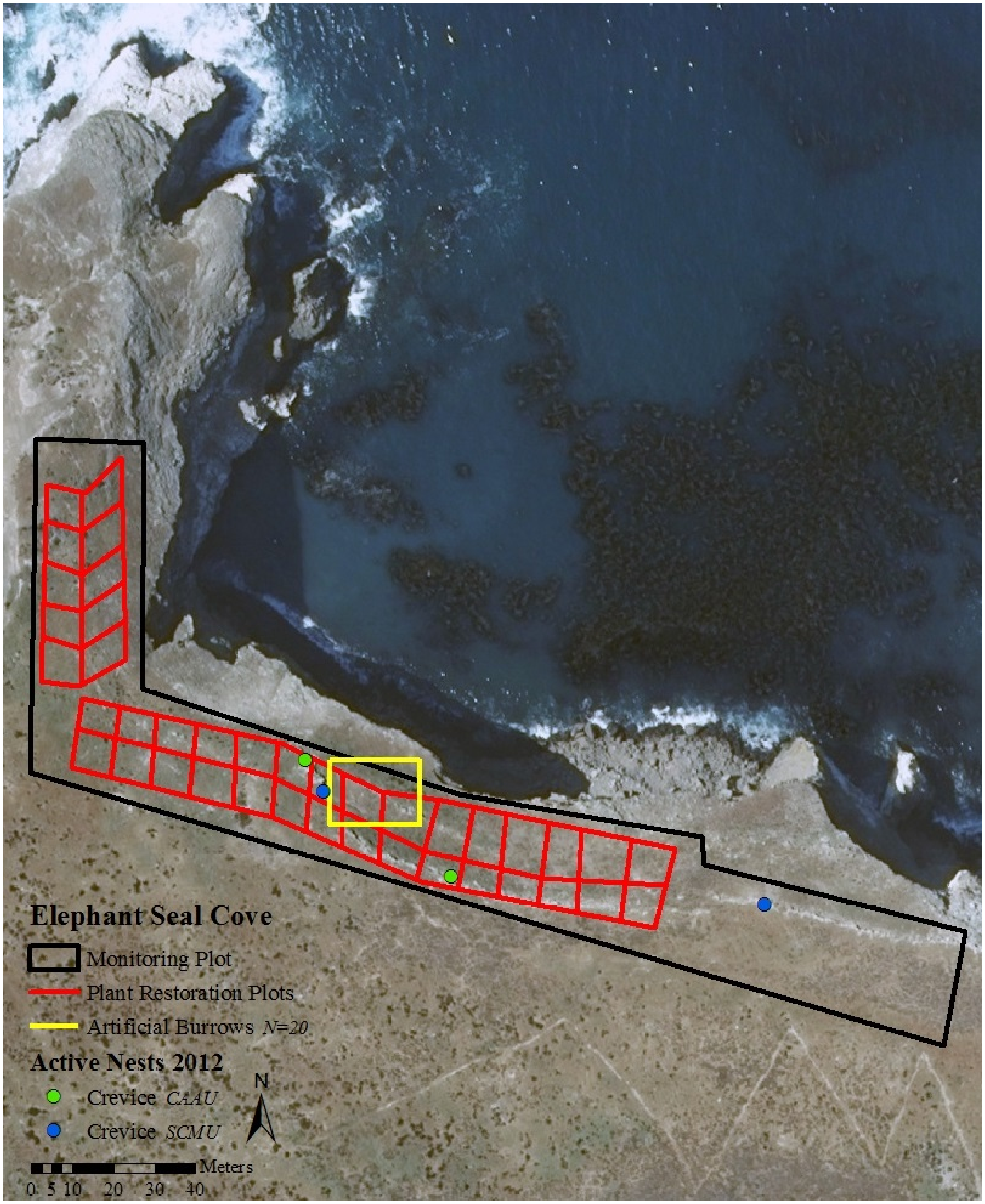

Figure 13. The Elephant Seal Cove Cliffs monitoring and restoration plot areas.

SCMU Nesting at ESC. In 2012, at the ESC restoration area, two murrelet nest sites were active (A2 and A4), with one clutch (1 egg observed) hatching at A2. A2 is located in a rock crevice sites in the exposed cliff band that contours the upper southeast boundary of the restoration site; A4 is located outside of the eastern plot boundary (Figure 13).

CAAU Nesting at ESC. In 2012, two CAAU nests (A1 and A3), were active at ESC. On 1 April, both sites contained a small downy chick, and both chicks were absent when checked approximately one month later, between 29 April and 7 May. The clutches in site A1 and A3 likely fledged around 4 May. A second clutch was subsequently laid in site A1 but fledging success could not be determined. In summary, 100% of known CAAU clutches (n=2) fledged a chick at ESC in 2012.

Reproductive Success Associated with Natural and Artificial Nest Site Types at Santa Barbara Island in 2012. Natural SCMU nesting habitat on SBI is comprised of rocky crevices and native perennial shrubs (Figure 14, Table 9). Of the 120 active nest sites monitored in the four core plot areas in 2012, 60 were located in native shrubs, 41 in natural rock crevices, 10 in artificial nest boxes, and the remainder (9) under various artificial structures associated with housing infrastructure (for example, under stairs and deck by housing). The largest nesting sample sizes were located in CC (45 active nests) and LC (51 active nests). As in previous years, the CC habitat was comprised primarily of natural rocky crevices, while the LC habitat consisted mainly of native shrubs.

Figure 14. Newly hatched Scripps's Murrelet chicks in a natural rocky crevice nest (left) and four unattended murrelet eggs from multiple clutches laid under a native Nevin's woolly sunflower *(Constancea nevinii)* shrub (right). Photos A.L. Harvey.

We calculated CS by site type (natural rocky crevice, native shrub, artificial nest box, and manmade structures) for first clutches only to exclude factors related to sequential clutch success (see Harvey et al. 2013b for discussion; Table 10). Of the four site types, first CS was highest when associated with manmade structures (78%), followed in decreasing order by native shrub (72%), artificial nest box (70%), and natural rocky crevices (68%; Tables 9, 10). Depredation rates of first eggs (from first clutches only) were highest in rocky crevice sites (ED=30%; n=30 eggs) and very low in shrub sites (ED=5%; n=38 eggs; Table 10). However, site type is strongly related to plot location (see Table 9, above), and results must be interpreted with caution (see Harvey et al. 2013 for further discussion).

Table 9. Active Scripps's Murrelet nest site types at Santa Barbara Island in 2012.

Site Type	**BH**	**CC**	**DO**	**LC**	**Total**
Rock Crevice	0	38	2	1	41
Nest Box	0	0	10	0	10
Native Shrub	2	7	0	51	60
Manmade	3	0	6	0	9
Total	**5**	**45**	**18**	**52**	**120**

Table 10. Scripps's Murrelet first clutch success (CS) and egg depredation rates by site type and plot at Santa Barbara Island in 2012.

		CS per Monitoring Plot				
Site Type	**First Egg Depredation Rates (all plots combined)**	**BH**	**CC**	**DO**	**LC**	**Total**
Rock Crevice	30% (n=30)	*na*[1]	68%	50%	100%	**68%**
Nest Box	11% (n=9)	*na*	*na*	70%	*na*	**70%**
Native Shrub	5% (n=38)	0%	83%	*Na*	74%	**72%**
Manmade	0% (n=5)	67%	*na*	83%	*na*	**78%**
Total	**15% (n=82)**	**40%**	**70%**	**72%**	**75%**	**71%**

[1] *na= no active sites in this category*

Summary of Baseline SCMU Reproductive Monitoring at Four Land-Based Plots on Santa Barbara Island. Baseline reproductive monitoring indicated that island-wide clutch success over the past four years was lowest in 2009, peaked in 2010, and remained moderate in 2011-2012 (Figure 15). Egg depredation rates were substantially lower in 2010-2012 than in the preceding three years. Clutch success was generally poorest at the CC monitoring plot, reflecting greater egg depredation rates there. Overall clutch success at the SBI colony was lower in each year than at Anacapa Island (Anacapa data reproduced from Whitworth et al. 2012, Harvey et al. 2013a).

Figure 15. Scripps's Murrelet clutch success on Santa Barbara Island in 2008-2012 and comparative data from Anacapa Island. Anacapa data from 2008, 2009, and pre-rat eradication years reproduced from Whitworth et al. (2012); Anacapa data from 2011 and 2012 from Harvey et al. (2013a).

SCMU At-sea Captures and Banding. We captured 93 individual SCMU during dipnet captures in 2012, as follows: we banded (USGS incoloy size 2; BBL permit #22539) 84 novel birds and recaptured an additional nine, for a recapture rate of approximately 10% (Table 11). 22% of captured birds had brood patches (n=93). Of the nine recaptures, one was a same-night recapture, two were originally banded in 2009 (reported in Whitworth et al. 2011), five were banded in 2010, and one was banded in 2011 (reported in Harvey et al. 2013; Table 12, Appendix 3). All recaptured individuals were originally banded at SBI during dipnet captures in Landing Cove area (Figure 16). One additional banded adult SCMU carcass was found in the LC plot on 27 April; this bird was originally banded on 16 March 2010 in Landing Cove during at-sea captures (Whitworth et al. 2011). We did not capture any other species during dipnet captures in 2012.

At-sea SCMU capture and banding efforts cannot be adequately standardized due to: (1) significant seasonal and nightly variations in at-sea congregation densities, (2)differences in capture and banding crew experience, (3) weather conditions, and (4) the availability of support vessels, . Therefore, we do not consider these capture efforts to be appropriate for standardized analyses. However, we provide capture location effort data from a representative sample of capture nights in 2012 for general reference (Figure 16).

Table 11. Scripps's Murrelets captured during at-sea banding efforts at Santa Barbara Island in 2012.

Survey Night	New	Recapture	Total	Brood Patch Present (Total)
11-12 April 2012	12	3	15	1
15-16 April 2012	28	1	29	6
16-17 April 2012	9	4	13	6
20-21 May 2012	19	1	20	5
21-22 May 2012	16		16	3
Total	**84**	**9**	**93**	21

Table 12. Scripps's Murrelet recaptures in 2012 of birds banded in previous years at Santa Barbara Island.

Band Number	First Banding Date[1]	Recapture Date	Brood Patch Present
1262-03034	4/26/2009	4/15/2012	No
1262-03046	4/26/2009	4/12/2012	No
1262-03118	3/16/2010	4/16/2012	Yes
1262-03133	3/16/2010	4/11/2012	No
1262-03146	*3/16/2010*	*4/27/2012*	*Carcass*
1262-03159	5/4/2010	5/21/2012	Yes
1262-03163	5/4/2010	4/16/2012	Yes
1262-03189	5/5/2010	4/17/2012	Yes
1262-03277	5/13/2011	4/16/2012	No

[1] Birds originally banded in 2009 and 2010 were reported in Whitworth et al. (2011); those banded in 2011 were reported in Harvey et al. (2013a).

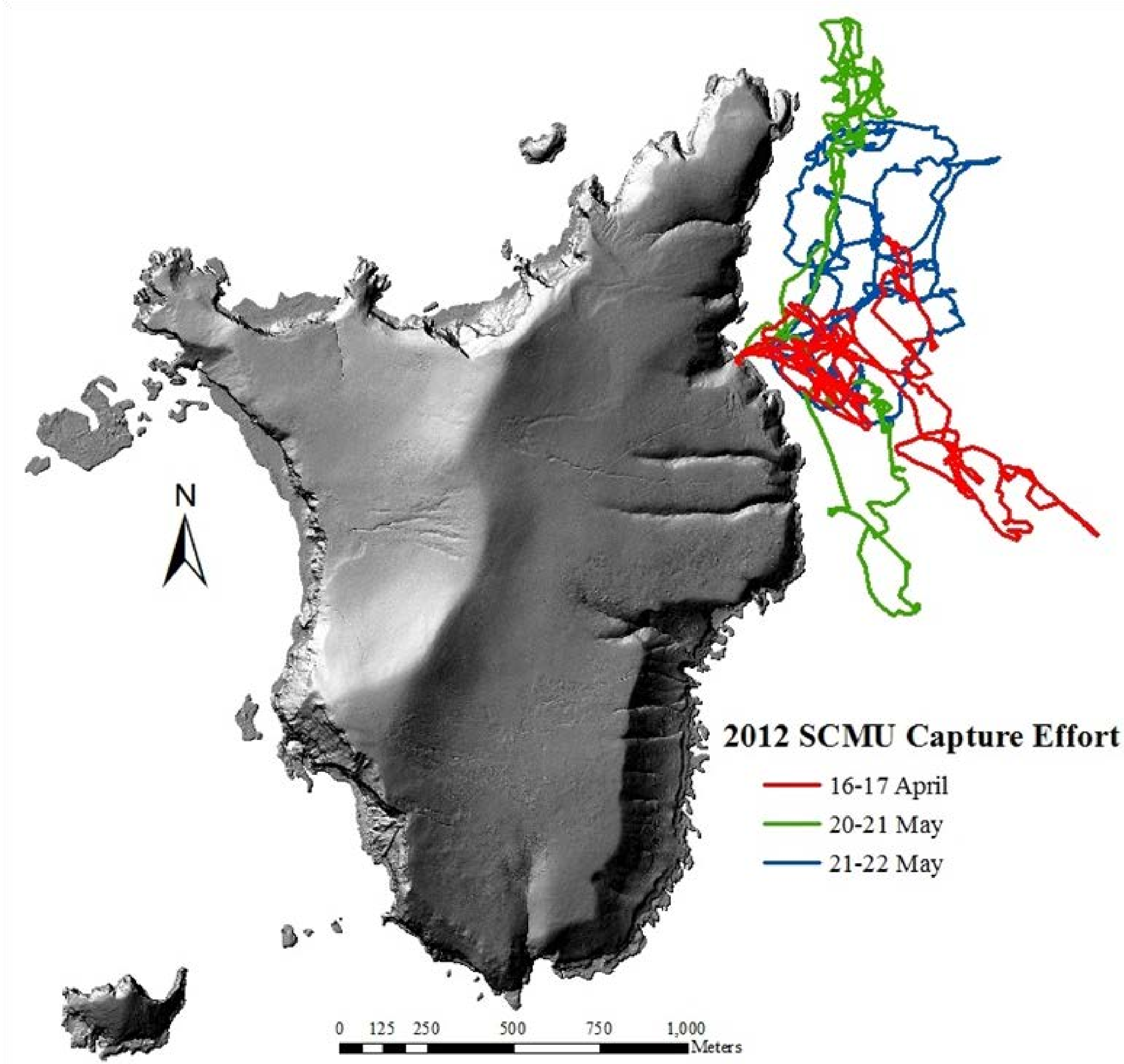

Figure 16. Search areas for Scripps's Murrelet at-sea mark-recapture efforts at Santa Barbara Island in April and May 2012.

DISCUSSION

The SBI alcid habitat restoration project has been implemented annually since 2007. Plot-based reproductive monitoring for SCMU, social attraction for CAAU, and on-island native plant propagation and restoration work were implemented annually in 2007-2012, with approximately 20,000 plants outplanted in five main restoration areas during this time period (Harvey and Barnes 2009, Harvey et al. 2012, 2013b, this report). Reproductive assessments and mark-recapture studies for SCMU and other species, including the rare ASSP, were also conducted in some years. This report provides results of baseline monitoring efforts conducted for SCMU and CAAU in 2012, as well as recommendations for continued monitoring, for use in assessing the long-term outcome of the native plant restoration work.

In 2012, SCMU reproductive performance on SBI was moderate; clutch success and egg productivity both declined slightly from the previous two years, but egg depredation rates remained relatively low with respect to long-term statistics. Clutch success ranged from 33% (BH) to 70% (LC); we estimated island-wide clutch success at 62%. In comparison, clutch success at Anacapa in 2012 was 72% (n=36; Harvey et al. 2013a). Egg productivity and depredation rates in 2012 were 54% and 20%, respectively. Nests in the CC plot continued to experience the highest egg depredation rates, but lowest egg productivity occurred at the BH plot in 2012.

Social attraction (nocturnal audio broadcast) for CAAU was implemented at the LC restoration area in 2010-2011 (Harvey et al. 2013b), but discontinued thereafter in response to predation by BNOW (see Thomsen and Harvey 2012, Thomsen et al. 2013, Harvey et al. 2013a, Nur et al. in prep). In 2012, CAAU continued to attend the small new sub-colony that was established in the social attraction area in the preceding two years. However, of the active or visited nests in the LC area, no fledging was confirmed.

Study and Monitoring Recommendations for SCMU. Recommendations for the SBI SCMU colony have been extensively described in previous documents (e.g. Burkett et al. 2003, Carter et al. 2005, 2011, Whitworth et al. 2009, 2011, 2012, Harvey et al. 2012, 2013b, and references therein); we provide here a summary of recommended studies for the SCMU and CAAU colonies on SBI.

- The SCMU colony at SBI exhibits substantial interannual variability in nest success; annual monitoring should be continued to document these fluctuations as well as to add to a long-term reproductive time series that is available only from SBI for this species.

- In most cases, weekly nest surveys are sufficient to provide phenology and egg productivity estimates. Survey intervals that exceed 10 days may not be sufficient to calculate egg depredation rates, but may be used to estimate the clutch success statistic for areas that cannot be regularly surveyed (i.e. sea caves).

- Annual reports should continue to provide, at minimum: phenology, egg productivity, egg depredation, and clutch success estimates for comparison to both the long-term SBI dataset and to reproductive success estimates from other colony locations (e.g. Anacapa Island [Whitworth et al. 2013], Islas Coronado [Carter et al. 2006], and San Benitos [Wolf et al. 2005].

- Land-based nest monitoring from the four basic plots described herein (CC, LC, DO, BH) appears to provide a robust sample size that is both representative of island-wide productivity and useful for assessing and responding to impacts from routine island use by CINP and the public.

- However, expanded surveys to reassess nesting distribution and to sample reproductive success from additional areas should be conducted periodically as funding and the availability of experienced monitoring staff allow (see Whitworth et al. 2011, Harvey et al. 2013b for results from expanded surveys in 2009-2011).

- The APNC plot is of particular interest because a standardized area has been monitored periodically (see Whitworth et al. 2011, Harvey et al. 2012) and changes in nesting density may assist in estimates of population change on the island. However, this plot is more technically challenging than the routinely monitored areas described in the present report, and highly skilled observers are therefore required to safely survey this cliff location.

- Population trend data for SCMU are difficult and relatively expensive to obtain, and as a result are very sparse. Available data indicate a continued population decline since 1991 (Carter et al. 1992, Nur et al. 2013). A long-term plan to gather standardized data with which to assess the SBI population is urgently needed. Colony size can be estimated using the combined at-sea spotlight surveys and land-based survey regime described by Whitworth et al. (2011). To avoid biased results from sampling in anomalous years, these periodic assessments should be performed for a *minimum* of two consecutive breeding seasons.

- Adult mortality estimation techniques for SCMU and other seabird species should be further improved and incorporated into the long-term dataset for future demographic modeling and more robust annual analyses.

- Images from the nest camera study conducted in 2010-2012 should be analyzed to provide novel data regarding the little-known breeding biology of the SCMU, which has not been updated since the Murray (1983) study. Nest cameras have proven to be effective tools for non-invasive studies of SCMU on SBI, but a dedicated project to analyze the extensive footage is required.

- The degree of intraspecific competition for nest sites should be further investigated both to refine reproductive success estimates (e.g. per clutch versus per pair chick production estimates) and to provide insight into restoration techniques, which to date are passive for this species.

- Accordingly, genetic analysis of eggshells collected in 2009-2012 from sites that hosted more than one clutch per season should be undertaken to determine nest site utilization by multiple pairs versus same-pair relay attempts, the frequency of which is currently unknown.

Study and Monitoring Recommendations for CAAU. We attributed the reproductive failure of the small CAAU colony established by the social attraction system in LC primarily to predation by BNOW at LC in 2011-2012 (Harvey et al. 2013b, Thomsen et al. 2013). While there was no evidence that the social attraction altered BNOW foraging area or behavior (see behavioral study conducted in 2011 *in* Harvey et al. 2013b), we did not implement social attraction in 2012. We continue to recommend that social attraction be delayed until appropriate strategies for preventing adult mortality are identified. Additionally, new colony establishment should not be attempted until native plantings reach sufficient size to provide adequate soil stability to prevent burrow collapse, as noted in previous years. The small CAAU colony located at Elephant Seal Point (Whitworth et al. 2010, 2011) should be assessed periodically via nocturnal passive audio surveys and/or mist-net mark-recapture efforts (see Harvey et al. 2013a). Finally, island-wide surveys, including sea cave and shoreline habitats (see Whitworth et al. 2011), should be conducted periodically to assess breeding distributions outside of restoration and monitoring plots.

General Recommendations for Actions to Benefit the SBI Seabird Colony. We continue to recommend that disturbance reduction efforts should be implemented as suggested in prior documents as follows:

1. Schedule routine maintenance activities to avoid the nesting season. Examples include hydraulic repairs of the crane, pumping of the septic or outhouse facilities, and weed abatement and trail maintenance activities using weedwhackers or mowers.

2. Conduct annual clean up of SCMU nesting areas associated with the CINP structures on the island prior to the breeding season (early January). For example, loose materials should be organized to avoid disturbance during the nesting season.
3. Maintain the blackout curtains in the housing structures.
4. Educate visitors about the need to stay on clearly marked trails.
5. Continue to document bright lights from boats around SBI (including those from commercial and recreational vessels) and develop an outreach program to inform boaters of possible impacts.
6. Regularly inspect and maintain island infrastructure to avoid creating drowning or entrapment hazards.
7. Analyze noise abatement possibilities for crane operation and water delivery tasks.
8. Prevent nonnative introductions (flora and fauna) by improving biosecurity protocols and public outreach efforts.

In summary, we recommend that nest monitoring and disturbance reduction activities, as well as expanded studies described herein, 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. Data collection fields used for standardized Scripps's Murrelet monitoring.

PDA Field Name	Type	Description
Program Code	Text	2 letter program code (SB for Seabird Program)
Year	Text	YYYY. Year in which survey was conducted
Island Code	Text	2 letter island code (SB= Santa Barbara Island)
Event Code	Text	Alphabetical code assigned chronologically per sampling event per year.
Observation Date	Date/Time	DD/MM/YYYY. Actual date when data collection took place.
Plot	Text	2 letter code for monitoring plot (BH=Bunkhouse, CC=Cat Canyon, DO=Dock, LC=Landing Cove, NT=Nature Trail)
Nest Number	Text	Unique identifier for an individual nest site (name or number)
Species	Text	4 letter code indicating species of bird occupying a site. Options include: ASSP=Ashy Storm-Petrel, CAAU= Cassin's Auklet, XAMU/SCMU=Scripps's Murrelet, N/A= Not applicable, empty site, Other (list in comments)
Observer	Text	Initials of primary observer.
Recorder	Text	Initials of data recorder.
Proofer	Text	Initials of the data proofer.
Adult Disturbed	Text	Y/N. Disturbance to adult murrelets during monitoring is a concern. Any disturbances should be described in the comments field.
Nest Contents	Text	The number of adults (SIN), eggs [E], and chicks [C] is recorded in the Nest Contents field. Options include: 0, 1SIN, 1E, 2E, 1SIN+1E, 1SIN+2E, 1SIN+1C, 1SIN+2C, 1C, 2C, 2SIN, Comments, NC (not checked), 2SIN + 1E, 2SIN+2E, 2SIN+1C, 2SIN+2C
Egg1	Text	The status of the first (or only) egg. Options include: 0 (no egg), E (intact egg), DE (depredated egg), HE (hatched egg), BE (broken egg), Comments.
Egg 2	Text	The status of the second egg found. Options include: 0 (no egg), E (intact egg), DE (depredated egg), HE (hatched egg), BE (broken egg), Comments.
Egg Order Known	Text	Y/N. If the order in which the eggs were laid is known because the first egg was depredated or marked before the second egg was laid, then Yes is selected.
Chick1	Text	The status of the first (or only) chick found. Options include: 0 (no chick), C (live chick), DC (dead chick), Comments.
Chick2	Text	The status of the second chick found. Options include: 0 (no chick), C (live chick), DC (dead chick), Comments.
Comment List	Memo	Comments generated by multi-selection list in PDA. See Protocol for Monitoring SCMU Nesting Sites for definitions.
Comments	Memo	Comments manually entered into the PDA. Should begin with list of nest contents for active sites. The size characteristics and color of eggshells should be noted. If the fate of the egg is uncertain detailed notes should be entered.
Egg1 Length	Number	Length of Egg1 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.
Egg1 Width	Number	Width of Egg1 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.
Egg2 Length	Number	Length of Egg2 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.
Egg 2 Width	Number	Width of Egg2 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.

Appendix 2. Survey Dates for Scripps's Murrelet routine surveys (x) and additional surveys of video-monitored sites (O) at Santa Barbara Island in 2012. See text for details.

Date	APNC	BH	CC	DO	ESC	LC
3/1/2012		x		x		
3/2/2012						x
3/3/2012	x					
3/4/2012					x	
3/6/2012			x			
3/7/2012		x				
3/8/2012				x		
3/9/2012						x
3/10/2012	x					
3/11/2012			x			
3/14/2012		x		x		
3/15/2012			x			
3/16/2012	x					
3/17/2012						x
3/19/2012					x	
3/20/2012			x			
3/21/2012		x		x		
3/23/2012		O				x
3/24/2012			x			
3/28/2012		x		x		
3/30/2012			x			
3/31/2012				O		x
4/1/2012					x	
4/2/2012						O
4/3/2012			x			
4/4/2012		x		x		
4/5/2012						O
4/6/2012		x		O		x
4/7/2012			x			
4/8/2012		O				
4/11/2012		x		x		O
4/12/2012			x			
4/13/2012				O		
4/14/2012						x
4/17/2012			x			
4/18/2012		x		x		
4/19/2012					x	
4/20/2012						x
4/21/2012			x			
4/23/2012	x					
4/25/2012		x		x		
4/26/2012			x			
4/27/2012						x
4/29/2012					x	
5/1/2012			x	O		

Date	BH	CC	DO	ESC	LC
5/2/2012	x		x		
5/3/2012					x
5/4/2012					O
5/5/2012		x			
5/7/2012				x	
5/9/2012	x		x		
5/10/2012		x			
5/11/2012					x
5/12/2012				x	
5/15/2012		x			
5/16/2012	x		x		
5/18/2012					x
5/19/2012		x			
5/23/2012	x		x		
5/24/2012		x			
5/25/2012					x
5/26/2012				x	
5/29/2012		x			
5/30/2012	x		x		
6/1/2012					x
6/2/2012		x			
6/3/2012				x	
6/6/2012	x		x		
6/7/2012		x			
6/8/2012					x
6/12/2012		x			
6/13/2012	x		x		
6/15/2012					x
6/16/2012		x			
6/20/2012	x		x		
6/21/2012		x			
6/22/2012					x
6/26/2012		x			
6/27/2012	x		x		
6/29/2012					x
6/30/2012		x			
7/4/2012			x		
7/5/2012		x			
7/6/2012					x
7/10/2012		x			
7/13/2012					x
7/14/2012		x			
8/1/2012	x		x		
8/2/2012		x			
8/3/2012					x

Appendix 3. Scripps's Murrelet new bands deployed in 2012 at Santa Barbara Island. See report text for recapture data.

Band Number	Banding Date	Band Number	Banding Date	Band Number	Banding Date
1262-03295	11 April 2012	1262-03423	16 April 2012	1262-03469	20 May 2012
1262-03296	11 April 2012	1262-03424	16 April 2012	1262-03470	20 May 2012
1262-03297	11 April 2012	1262-03425	16 April 2012	1262-03471	20 May 2012
1262-03298	11 April 2012	1262-03426	16 April 2012	1262-03472	21 May 2012
1262-03299	11 April 2012	1262-03427	16 April 2012	1262-03473	21 May 2012
1262-03300	11 April 2012	1262-03428	16 April 2012	1262-03474	21 May 2012
1262-03401	11 April 2012	1262-03430	16 April 2012	1262-03475	21 May 2012
1262-03402	11 April 2012	1262-03431	16 April 2012	1262-03476	21 May 2012
1262-03403	11 April 2012	1262-03432	16 April 2012	1262-03477	21 May 2012
1262-03404	11 April 2012	1262-03433	16 April 2012	1262-03478	21 May 2012
1262-03405	12 April 2012	1262-03434	16 April 2012	1262-03479	21 May 2012
1262-03406	12 April 2012	1262-03435	16 April 2012	1262-03480	21 May 2012
1262-03407	15 April 2012	1262-03437	16 April 2012	1262-03481	21 May 2012
1262-03408	15 April 2012	1262-03438	16 April 2012	1262-03482	21 May 2012
1262-03409	15 April 2012	1262-03439	16 April 2012	1262-03483	21 May 2012
1262-03410	15 April 2012	1262-03440	16 April 2012	1262-03484	21 May 2012
1262-03411	15 April 2012	1262-03441	16 April 2012	1262-03485	21 May 2012
1262-03412	15 April 2012	1262-03442	16 April 2012	1262-03486	21 May 2012
1262-03413	15 April 2012	1262-03443	16 April 2012	1262-03487	22 May 2012
1262-03414	15 April 2012	1262-03444	16 April 2012	1262-03488	22 May 2012
1262-03415	15 April 2012	1262-03445	17 April 2012	1262-03489	22 May 2012
1262-03416	15 April 2012	1262-03462	20 May 2012	1262-03490	22 May 2012
1262-03417	15 April 2012	1262-03463	20 May 2012	1262-03491	22 May 2012
1262-03418	15 April 2012	1262-03464	20 May 2012	1262-03492	22 May 2012
1262-03419	16 April 2012	1262-03465	20 May 2012	1262-03493	22 May 2012
1262-03420	16 April 2012	1262-03466	20 May 2012	1262-03494	22 May 2012
1262-03421	16 April 2012	1262-03467	20 May 2012	1262-03496	22 May 2012
1262-03422	16 April 2012	1262-03468	20 May 2012	1262-03497	22 May 2012