

**FACTORS INFLUENCING DEPREDATION OF XANTUS'S MURRELETS BY BARN OWLS ON SANTA BARBARA ISLAND: SUMMARY RESULTS FROM THE 2010 FIELD SEASON.**



FINAL REPORT  
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## EXECUTIVE SUMMARY

Barn Owl (*Tyto alba*) abundance on Santa Barbara Island appears to track the population fluctuations of native deer mice (*Peromyscus maniculatus elusus*), the only extant small mammal population on this 2.6 km<sup>2</sup> island (Drost and Fellers 1991). However, in years when mice are less numerous, Barn Owls appear to prey heavily on Xantus's Murrelets (*Synthliboramphus hypoleucus scrippsi*), a small (~167 g) pursuit diving seabird which is listed as Threatened in the State of California (Burkett et al. 2003). Mortality of breeding individuals due to depredation by Barn Owls could have a significant impact on the murrelet population, particularly if they are already in decline (Sydeman et al. 1998). Determining patterns of Barn Owl foraging behavior and habitat associations is critical to developing our understanding of island ecosystem dynamics and ultimately will assist in murrelet conservation efforts. In 2010, we initiated a pilot study that focused on collecting baseline information on the current population status, habitat use, diet, and nesting activity of Barn Owls on Santa Barbara Island.

Between December 2009 and August 2010, we have completed 1) trail surveys following the methods of Drost (1989) as well as dusk observations of known roosts to determine numbers of owls 2) periodic searches of all accessible habitat for current or historic Barn Owl roost and nest sites and mapping these sites with a handheld GPS unit 3) collection of pellets and prey remains (Xantus's Murrelets, Cassin's Auklets, Black Storm-Petrels and Ashy Storm-Petrels) from trails, murrelet monitoring plots, and owl roost sites, and mapping these locations with a handheld GPS unit, 4) capture and banding of Barn Owls and evaluation of various capture techniques, as well as 5) deer mouse population monitoring, in collaboration with the National Park Service.

Five trail surveys in late 2009 and 2010 yielded estimates of 3-5 Barn Owls (Figure 1), about the same as the lowest previously reported estimated abundance of 4-5 (Drost 1989). However, observations of owls exiting roost sites at dusk yielded higher estimates of 6-9. All accessible habitat was searched at least once for Barn Owl roosting and nesting sites, and eight roosting sites were found to be active during this time period (Figure 3). Pellets were collected from these sites and will be analyzed pending development of a protocol and locating additional assistance with analysis. Avian prey remains were also collected and totaled 106 carcasses, including 80 Xantus's Murrelets, 20 Cassin's Auklets, 4 Black Storm-petrels, and 2 Ashy Storm-petrels. These locations were all mapped with a handheld GPS (Figure 4 & 5). We initiated owl capture efforts in July and August with the use of several unsuccessful methods (noose mats, dipnets placed over roost site entrances, manually triggered leg snares). However, verbal traps proved highly effective. Three individuals were captured, banded, and color-banded in 10 hours over two nights.

We were able to collect critical information addressing most of the research objectives we had for the pilot year of this study. The results of this study have implications not only for murrelet conservation and island restoration, but also for Barn Owl / seabird interactions on islands worldwide.

## INTRODUCTION

Xantus's Murrelets (*Synthliboramphus hypoleucus scrippsi*; XAMU) are small (~167g) pursuit diving alcids that have a worldwide breeding distribution of just 12 island groups off the coast of Southern California and Mexico (Drost and Lewis 1995, Burkett et al. 2003). The largest breeding colony of this State listed Threatened seabird (estimated 500-750 breeding pairs, Burkett et al. 2003; Whitworth et al. 2005) in the U.S. is on Santa Barbara Island (SBI), the smallest of five islands comprising the Channel Islands National Park (CINP). The National Park Service (NPS) began annual monitoring of murrelet reproductive success in 1985 and since that time numbers of this rare bird have declined in monitoring plots (Burkett et al. 2003, Harvey and Barnes 2009). The population on SBI represents an estimated 51% of the population in California (Burkett et al. 2003), which makes this 2.6 km<sup>2</sup> island one of the most important colonies for the species, and underscores the need to understand the threats to survival and reproductive success in order to reverse the declining trend.

Factors that may have contributed to the decline observed in long-term monitoring plots are adult mortality due to depredation by Barn Owls (*Tyto alba*) as well as egg depredation by the native population of deer mice (*Peromyscus maniculatus elusus*), the only small mammal on the island (Drost and Fellers 1991). Deer mice have a 2-4 year population cycle during which they can reach extremely high densities followed by sharp declines (Drost and Fellers 1991) and consumed an average of 42% of murrelet eggs laid over a ten year period, ranging from 8% to 79% (Drost and Lewis 1995). Although murrelet productivity did not appear to be directly correlated with changes in mouse density over a six year period (Schwemm and Martin 2005), efforts to remove mice from one murrelet subcolony was correlated with a decrease in egg predation that year (Millus et al. 2007). The effort entailed trapping over 1,600 individual mice from a 0.24 ha area and releasing them 2km away, but this did not eliminate all depredation of eggs (Millus 2006). Additionally, it has been suggested that Barn Owls could respond to management efforts directed at reducing mouse density by increasing predation on Xantus's Murrelets (Burkett et al. 2003, Millus 2006). For example, over a six year period in the 1980s, between 16 and 130 murrelets were found preyed upon by owls each year, with the highest numbers in years with low mouse abundance (Drost 1989).

Even a single pair of nesting Barn Owls can have a significant impact in some years, as demonstrated in 2009 when at least 79 Xantus's Murrelet carcasses were discovered at a known owl breeding site on the island (Harvey, unpubl. data). Population modeling based on an average of 57 depredated murrelets per year revealed that this represented 2-3% of the population and this alone could drive a population decline (Sydeman et al. 1998). Therefore, determining patterns of Barn Owl hunting behavior and habitat use during times of low and high mouse abundance is critical to our understanding of island ecosystem dynamics and ultimately will assist Xantus's Murrelet conservation. To better understand these dynamic relationships and inform

future management actions, we focused pilot research in 2010 on collecting baseline information on the current population status, habitat use, diet, and nesting activity of Barn Owls on Santa Barbara Island.

## **METHODS:**

### **Barn Owl Abundance**

We attempted to estimate Barn Owl abundance with both trail surveys and roost site counts. First, we repeated the trail survey methods developed by Drost (1989) to monitor the relative abundance of Barn Owls on the island compared to previous years. Surveys were conducted on the evenings of December 15, 2009, February 28, 2010, April 10, 2010, June 7, 2010, and July 17, 2010. All surveys had similar conditions of winds <15 knots, and no precipitation or fog. All surveys took place within 7 days of the new moon, with the exception of the February 28<sup>th</sup> survey, which was conducted on the full moon. We began the surveys approximately one hour after sunset, when one to three observers walked the island trails and recorded the times and locations of any observations (including both auditory or visual detections) of Barn Owls. Detections definitely known to be from the same bird were excluded, otherwise the total of all detections from all observers were added together to obtain a minimum and maximum count.

We also developed an alternative method of estimating the number of owls on the island by conducting dusk observations of active roost sites. Due to unique topography and the unusual lack of nesting pelicans preventing access to the area in 2010, it was possible to view the entrance to Barn Owl Cave from above in 2010. The observer arrived within 30 minutes after sunset and counted the numbers of owls exiting the cave from this vantage point. This technique was also used at Signal Peak, where a roost located ~10m below the peak permitted the observer to view owls as they departed from this site.

### **Barn Owl Nest and Roost Searching**

We began searching the island in December 2009 for signs of current or past use by Barn Owls as roosting or nesting sites. This included crevices and small caves within all five canyons (Cliff Canyon, Cave Canyon, Middle Canyon, Graveyard Canyon, and Cat Canyon; Figure 2) as well as shoreline cliff habitat accessible by hiking and non-technical climbing from the top of the island. We also searched six of the nine sea caves (including Barn Owl Cave, Cave A, Cave B, Cave C, Cave G, and Cave H) and parts of Sutil Island; these sites are best accessed by being dropped off in the rocky intertidal by a skilled Zodiac boat driver in calm ocean conditions. All sites were mapped with a handheld GPS unit.

### **Avian Prey Remains and Pellets**

We assessed the diet of Barn Owls through the collection of pellets from roost sites and the collection of avian prey remains (Xantus's Murrelets, Cassin's Auklets (*Ptychoramphus aleuticus*, CAAU), Black Storm-Petrels (*Oceanodroma melania*; BLSP) and Ashy Storm-Petrels (*O. homochroa*; ASSP)) from trails, murrelet monitoring plots, and roost sites. Not all areas were searched with the same frequency, but generally all trails were checked 1-2 times a week, and murrelet plots as per regular monitoring schedules (every 3-14 days) from March to June 2010. All other locations, including Barn Owl roost sites, were visited opportunistically once they were found during nest searches.

Once a carcass was found, we noted the species, the date, condition of the carcass, and the specific body parts found. The exact location of each carcass was recorded with both a handheld GPS and with digital photographs of the area around the carcass. If a depredated murrelet was found in a nest monitoring plot, we also recorded the site numbers of the nearest murrelet nests to the carcass. Carcasses were then collected into polyethylene bags to prevent double counting and then frozen.

### **Barn Owl Capture and Banding**

We began Barn Owl capture efforts in July 2010 and continued until a successful method was found in August 2010. Capture efforts took place over a total of 19 nights (July 3 - 6, 17 - 20, 28 - 31, August 1 - 3, 5, 8, and 22- 23). All trapping efforts took place on nights with winds <10 knots and with no fog or precipitation. Several methods were attempted, although most of the effort (17 nights) involved noose mats placed on artificial perches constructed of wooden dowels attached to metal conduit pipe. Noose mats were custom made and consisted of ¼ inch wire mesh cut to fit the perches with 30 - 50 nooses tied to it out of 20lb test monofilament line. Four to eight of these perches were placed in an array along trails, around the NPS bunkhouse and northeast side of Cave Canyon, in places where owls were assumed to be perch-limited on this treeless island. Noose mats were checked every 45 minutes while trapping and removed before dawn.

On nine of the nights, we also tried manually triggered leg snares. One night we also placed a noose mat inside a Cave Canyon roost site, and also tried sneaking up to this same roost site during the day with a dip net to block the exit. We did not find any of these methods to be successful, despite that they have all been used effectively by other researchers (Bloom et al. 2007; Colvin and Hegdal 1986; Kildaw pers comm).

On the nights of August 22 and 23, four or five verbal traps were placed around the NPS bunkhouse and campground area, and along Nature Trail. Exact sites were chosen due to proximity to a nearby giant coreopsis (*Coreopsis gigantea*) or trail posts that had guano, which

indicated a site where an owl may be tempted to land on an even taller perch. Verbaile traps are wire spring-loaded perch traps (video available at: <http://www.migrationresearch.org/research/shortear/verbaile.MOV>; Stewart et al. 1945). When the trap is set, the bent spring creates an open noose made of soft 4mm line that surrounds a treadle trigger mechanism at the top of a ~2.5m tall perch. The weight of an owl landing on the treadle releases the spring to jump up and as the spring opens it quickly closes the noose around the owl's legs. The spring is securely attached to the perch by another length of line, so the owl flutters safely to the ground. Radio transmitters were used with each verbaile, so that when a trap was triggered a radio signal was sent out to a receiver so that we could respond immediately to retrieve the owls for processing.

Captured individuals were placed immediately into a bird bag prior to handling. All birds were weighed, banded, aged by examining for molt limits, and had feather samples taken using standard procedures. Weights were obtained using a 500 or 600 g Pesola scale while birds were held in the banding bag. Owls were banded with an aluminum USGS lock-on band, as well as color-marked with unique colors of Darvic leg bands, the same color on each leg. Colored reflective tape was applied to the bands to enhance visibility at night (Allison and Destefano, 2006). One to two body feathers were plucked from the breast for potential genetic or stable isotope analyses.

### **Deer Mouse Monitoring**

Mouse trapping was completed during spring and fall 2010 on the two grids, Terrace Coreopsis (TC) and Terrace Grassland (TG), which have been monitored since the 1980s by NPS staff. Wildlife Biologist Helen Fitting led the spring trapping effort, assisted by SKT, on February 25 - 27 in the TC grid and March 1 - 3 in the TG grid. Fall mouse trapping was completed by Angela Guglielmino (NPS Biotech) on these same grids on October 21- 23, and 25 - 27, 2010. Monitoring methods are described in detail in the CHIS Terrestrial Vertebrate Monitoring Handbook (Fellers et al. 1988). Briefly, 100 permanent trap stations are arranged in a 10 X 10 grid spaced 7m apart. Trap sessions were conducted over 3 consecutive nights in each grid, with traps baited each night with dry oats. In the morning, each trap was checked and the mice were examined for reproductive status and were aged, sexed, weighed, and received a numbered ear tag before being released.

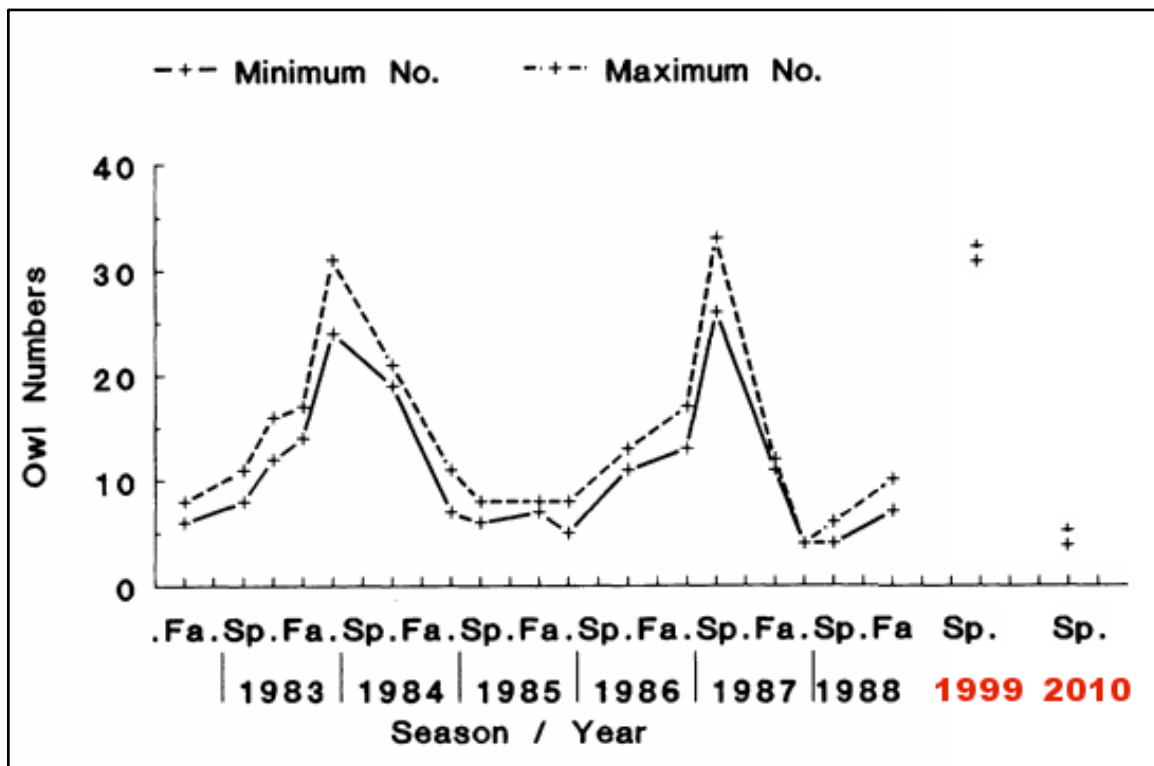
## **RESULTS AND DISCUSSION**

### **Barn Owl Abundance**

During trail surveys on December 15, 2009 and February 28, 2010, there were only three detections of Barn Owls. On April 10 and June 7, 2010 there were four detections and on July 17, 2010 there were five detections (Figure 1). These represented some of the lowest estimates

of Barn Owl abundance ever recorded on the island, with four to five being the previous minimum estimate (Figure 1; data from Drost 1989, Wolf et al. 2000). However, these counts are best thought of as an index of relative abundance rather than a true population estimate. As long as observations are separated in time, there is no way to prevent double-counting of individuals. In addition, there is also the potential for undercounting due to issues of detectability. For example, during non-survey periods, occasionally an owl was observed circling overhead without making any vocalizations, which highlights a bias towards detections of conspicuously vocalizing individuals during the trail surveys. In addition, the trails around the southeast section of the island have been moved up to ~200m from the route used in the 1980s (Drost 1989; his Figure 1 pg 89.) and it is unknown what impact, if any, this may have on the estimates derived from this method.

However, despite these potential biases, the method is arguably still useful due to its ease of use as well as for adding to an existing dataset covering several years. With the continuation of mark-recapture efforts of Barn Owls in 2011, these trail surveys will also be useful for re-sighting banded owls. This may be used to quantify the rates of double-counting by determining how frequently banded owls are observed more than once during a single trail survey.

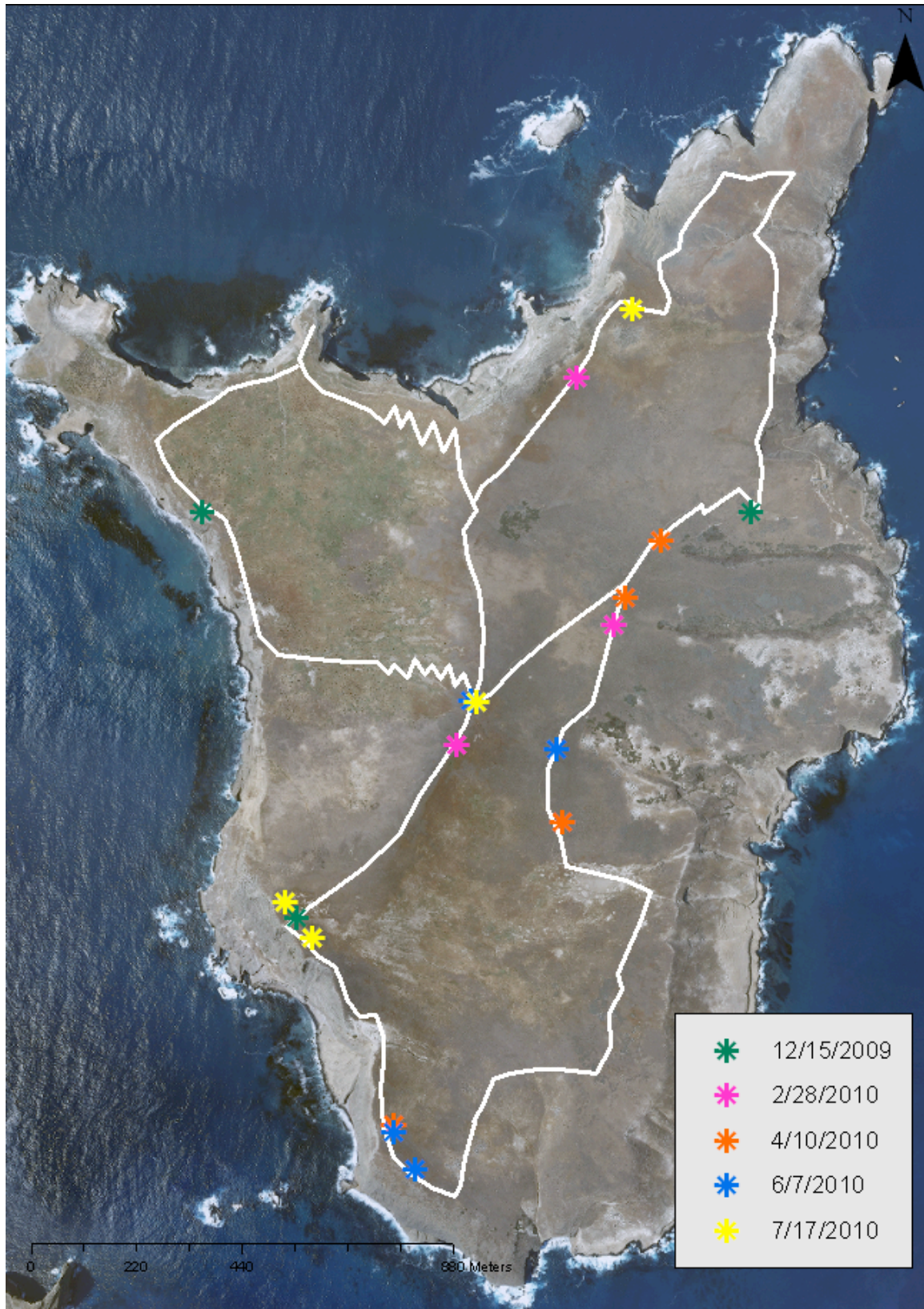


**Figure 1.** Numbers of owls counted on trail surveys from 1983 to 1988, 1999 and 2010. Data from Drost (1989), Wolf et al. (2000), and this study.

In contrast to the trail survey counts, dusk observations of active roost sites yielded slightly higher estimates. The number of owls seen exiting at dusk from Barn Owl Cave area increased from two in December 2009 to up to five in June 2010. There were also four owls seen in June 2010 associated with another presumed nest site at Signal Peak. Although simultaneous counts at these two sites were not conducted, Barn Owls are territorial in the immediate area around nest sites (Marti et al. 2005), therefore we feel it is reasonable to combine the numbers for a minimum count of 9 individuals as of June 2010. However, the maximum number of owls observed at any one time was six in June 2010, which is still slightly higher than our trail survey counts.

Barn Owls, like most raptors, are difficult to survey and monitor (Andersen 2007). We will continue to evaluate methods for monitoring owls on Santa Barbara Island. Immigration and emigration cannot entirely be ruled out as contributing to the numbers detected through any method. Although mainland Barn Owl populations are generally believed to be non-migratory (Marti et al. 2005, Taylor 1994), individuals can also disperse widely, evidenced by band recoveries where owls have flown distances up to 800km (Stewart 1952) and in some cases traveling >1000km over the open ocean to reach islands (McCafferty and Lurcock 2002; Soucy 1985). There have even been rare observations of Barn Owls flying at sea (Mueller and Berger 1979; Young 1954; Sprunt 1932), including one that was seen 24km beyond San Clemente Island in 1996 (Schoenherr et al. 2003). Therefore, mark-recapture and re-sighting efforts in 2011 should provide the most robust and precise population estimates. We will also continue taking feather samples from all birds captured, as well as collecting molted feathers, for later analysis of the genetic structure of the population, including evidence of previous bottlenecks, inbreeding and dispersal.





**Figure 2.** Locations of Barn Owl observations on Santa Barbara Island during dusk trail surveys in December 2009, and February, April, June and July 2010.

## **Barn Owl Nest Searching**

We found several sites with piles of pellets suggesting recent use as a roosting area (Table 1), but only two of these sites, Barn Owl Cave and Middle Canyon, had evidence of having been used as a nest site prior to 2010. A crevice site in Middle Canyon contained pellets, feathers, and small white eggshell fragments mixed into the decomposing pellet material indicating this may have been active as recently as 2009. It did not appear to be active in February 2010 when it was found, but it will be checked for activity again in 2011 after the Brown Pelican nesting season. Young downy barn owl chicks were observed in Barn Owl Cave in May 2008 (Whitworth, Harvey unpubl. data.), and there was a very decomposed chick carcass collected in December 2009. However, no nesting activity within the cave itself was evident during spring and summer 2010, and instead owls appeared to have nested in a crevice above the cave. Therefore we were unable to locate Barn Owl nest sites in accessible locations where cameras could be installed to monitor prey choice and activity patterns.

Despite the apparent lack of Barn Owl nests in accessible locations, breeding apparently occurred in two locations: 1) in an inaccessible crevice just above Barn Owl Cave, and 2) in an inaccessible crevice near Signal Peak. Evidence of breeding activity at both locations included auditory observations of chicks begging, the vigorous behavioral response of adults once the observer's presence was known, and later the observations of newly fledged chicks begging. This means there was a minimum of two successful breeding pairs on the island in 2010, although other breeding pairs may have gone undetected.

The number of pellets at these roost sites ranged from estimates of <10 pellets to upwards of several hundred. Barn Owl Cave, in particular, contained an extensive collection of many hundreds of pellets covering the floor in places at least 10 cm thick, which partially reflects its long history of known occupancy (Table 2). We reviewed all available previous reports and field notes to determine locations of owl roost sites in years prior to this study, however due to inconsistent survey efforts among years these data are presented below for summary reference only and may not be complete.

**Table 1. Barn Owl Roost Sites in 2010**

Site	Months checked	Notes
(1) Barn Owl Cave	Dec 09, Feb, Mar, Apr, June.	Several hundreds of pellets; June 7 visit was limited to area above intertidal and the first 2m of the talus slope (ie, the "Lower Landing").
(2) South side of Cave Canyon	Dec 09, June, July, Aug	Several sites, some of those found in Jul/Aug were under shrubs; <20 pellets,
(3) South side of Graveyard Canyon	Dec 09, Jan, Apr, June, Aug	Three separate sites but nearby each other; >100 pellets present in Dec but rains disintegrated most by January, <10 found Apr, Jun, Aug.
(4) North side of Middle Canyon	Feb	Possible nest site from before 2010
(5) East side of Cat Canyon	Mar, Aug	<10 pellets present in Mar, nothing new found in Aug
(6) West Cliffs- XAMU site 1392	Mar-June, Aug	<10 pellets & XAMU remains found in March, nothing thereafter
(7) Signal Peak	July, Aug	<20 pellets & XAMU, ASSP/BLSP remains
(8) Cave A	Feb, Apr	In Feb had zero pellets but several old ASSP skulls, by April <10 pellets, CAAU, XAMU remains

**Table 2. Barn Owl Roost Sites Occupied in Previous Years**

Site	Years active
Cat Canyon XAMU site 68	1997, 1999 (NPS Field notes)
Barn Owl Cave	Hunt et al. 1979 (refers to a "roost south of LACO"), Drost (pers comm), 1999 (NPS Field notes)
West cliffs from E seal point "near rock path"	1999 (NPS Field notes)
Below LC XAMU occupancy site 332	1999 (NPS Field notes)
Cave canyon	1999 (NPS Field notes)
Graveyard canyon	Drost 1989 ("up to 4 owls typically roosted") 1999 (NPS Field notes)
Cliff canyon	1999 (NPS Field notes)

Although habitat searches during the day incur some risk of flushing unsuspecting owls during a time when they may be vulnerable to diurnal raptors (Bahm and Sullivan 2009), we found no depredated Barn Owls during habitat searches even though they were flushed from roosts in Barn Owl Cave, Cat Canyon, Cave Canyon and Graveyard Canyon. Three decomposed Barn Owl carcasses were found completely intact, suggesting the cause of death was either starvation or disease. Barn Owl mortality can be as high as 75% in the first year of life, so this does not appear to be unusual (Marti et al. 2005). Interestingly, two dead Barn Owls had spines of cholla (*Opuntia prolifera*) stabbed through a foot, an observation also noted by Drost (1989), which suggests this could be a factor contributing to Barn Owl mortality on the island.

### **Collection and Analysis of Avian Prey Remains**

Avian prey remains were collected from all island trails, murrelet nest monitoring plots, and Barn Owl roost sites. The total through August 2010 was 106 carcasses, including 80 Xantus's Murrelets, 20 Cassin's Auklets, 4 Black Storm-Petrels and 2 Ashy Storm-Petrels. These locations have all been mapped with a handheld GPS, which show that the majority of carcasses have been found around the Bunkhouse and Landing Cove area near Barn Owl Cave (Figures 4 & 5). Search effort in this area is comparable only to other murrelet plots and trails and not the island as a whole, but it is not known what factors influence carcass persistence, and if more frequent searching influences how many carcasses are recovered from an area.

Carcasses are currently being stored in a freezer in the NPS office of the Annex building.



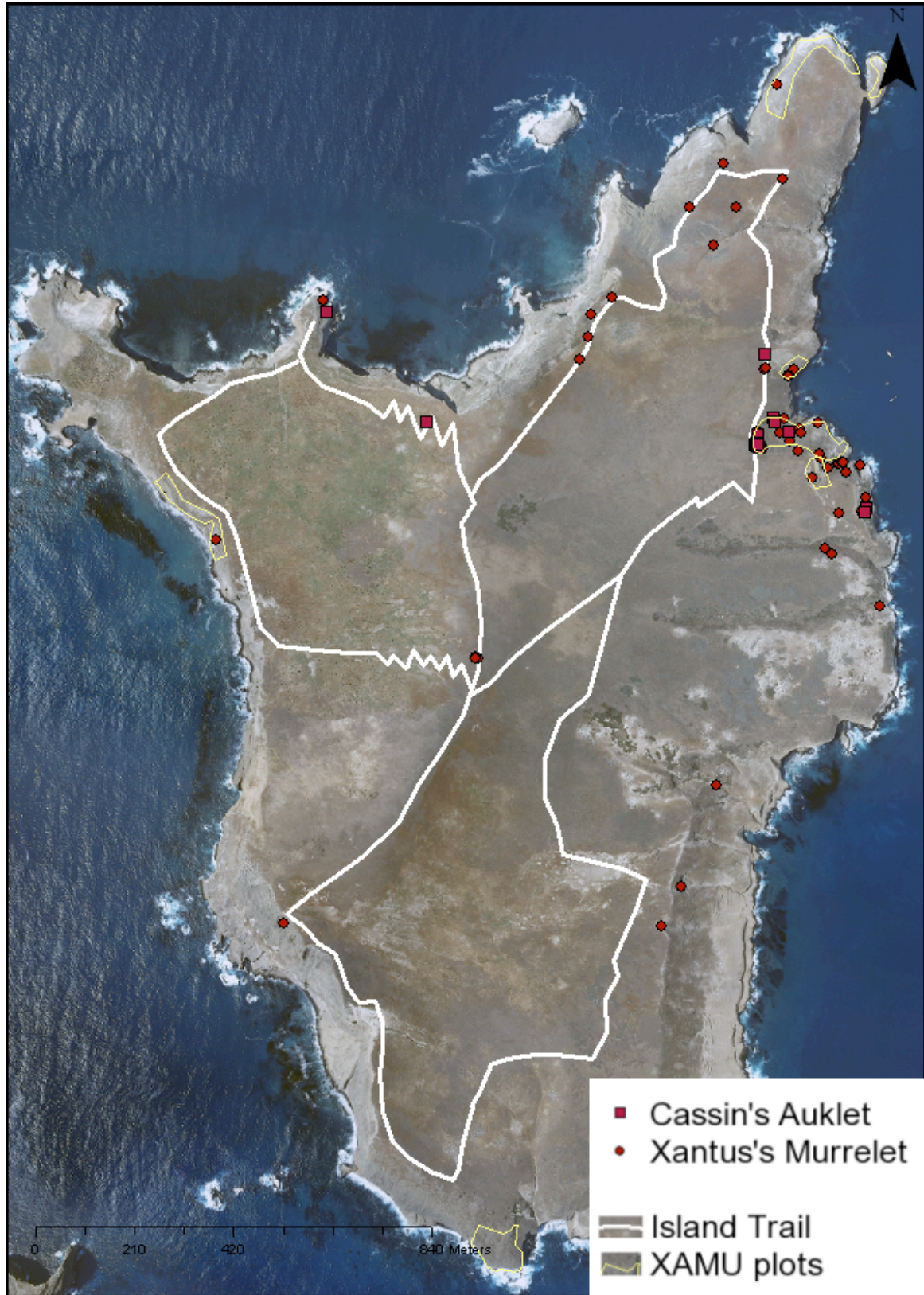
**Figure 3.** Locations of Barn Owl roosting sites on Santa Barbara Island December 2009 – August 2010.

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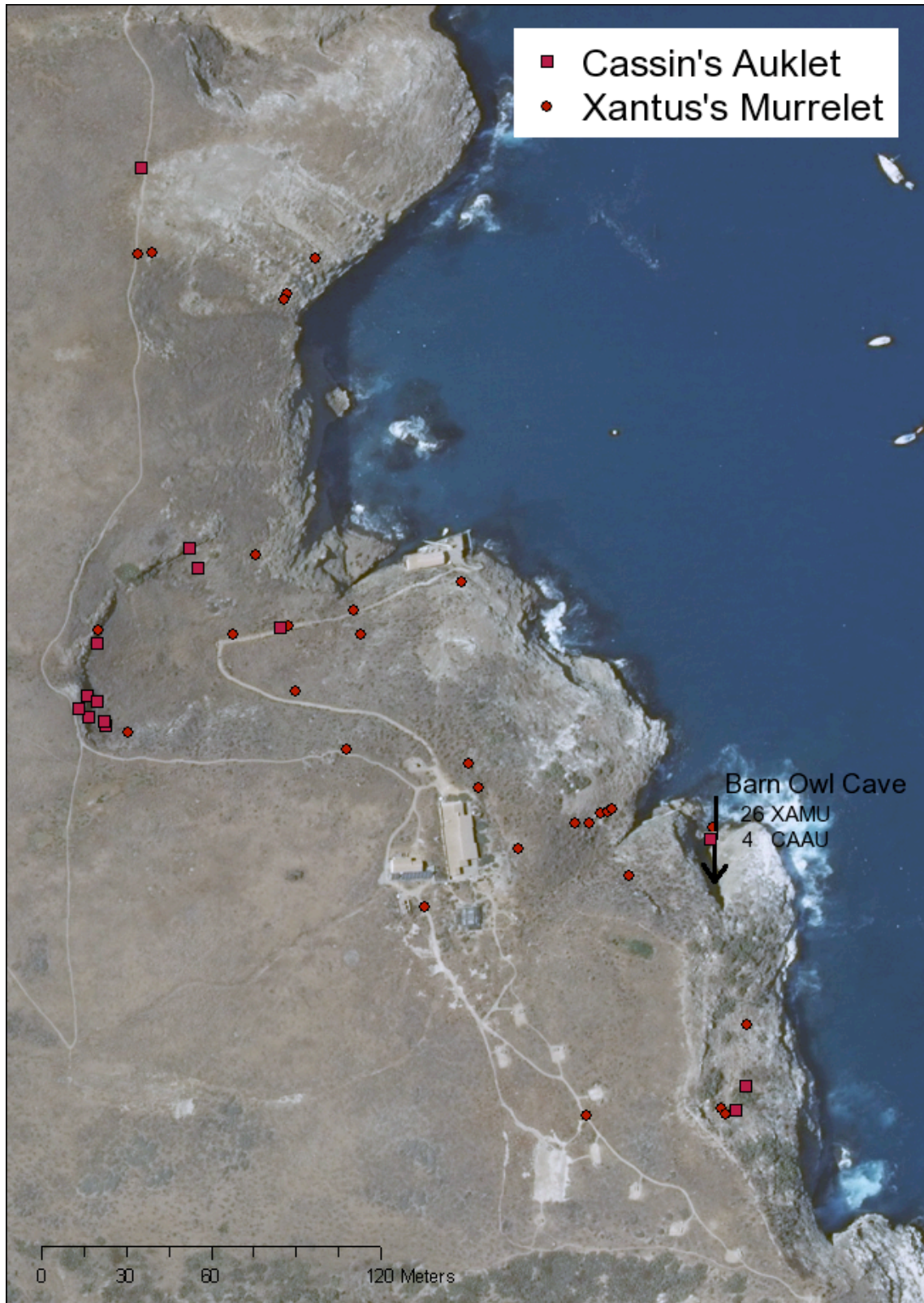
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**Figure 4.** Spatial distribution of depredated Xantus's Murrelet and Cassin's Auklet carcasses recovered from Santa Barbara Island from February –June 2010.



**Figure 5.** Spatial distribution of depredated Xantus's Murrelet and Cassin's Auklet carcasses recovered from the Landing Cove / Campground area of Santa Barbara Island from February – June 2010.



Prey remains of murrelets and auklets were found most often either as a keel with both wings still attached (hereafter referred to as “wingsets”), or a decapitated head near a pile of plucked feathers, while less often only a single detached wing was found, or the body and feet were still partially attached to the wingset. Although there is some concern that some of the carcasses are due to depredation by Peregrine Falcons (*Falco peregrinus*), most of the remains we found seem consistent with past reports when falcons were not present on the island (C. Drost, pers comm.) and with published descriptions of Barn Owl avian prey handling, particularly the discarding of avian heads (Marti et al. 2005). We recommend locating an experienced climber to retrieve prey remains and pellets from the Peregrine Falcon aeries to monitor their diet as well.

In December 2009, Barn Owl Cave was checked to collect all avian prey remains, including skeletons, from the cave to avoid any confusion with future collections. We found 21 murrelet carcasses (wingsets) along with 26 keels representing additional mortalities. In addition, there were 11 keels that are most likely Cassin’s Auklets but this needs to be confirmed with reference skeletons. No carcasses were found in the cave when it was searched in February 2010, while in March there were 2 murrelet carcasses. In April, there were 3 murrelets and 1 auklet that were found and collected, but in June we found 21 murrelets, 3 auklets, and 2 Black Storm-Petrels.

Besides Barn Owl Cave, the majority of the rest of the carcasses were recovered on the slopes of the Landing Cove area, which were located within a ~315m radius of Barn Owl Cave. Unfortunately, most of the Cassin’s Auklets carcasses in this area were found nearest the lower speaker of the social attraction system where 20 artificial auklet burrows were placed in December 2009. Although it is encouraging that auklets appeared to be responding to the social attraction system, the mortalities underscore the need to understand the effect of depredation on the expanding colony and restoration efforts. The social attraction component of the restoration project was discontinued in response to observed mortalities and has been redesigned for future field seasons (Harvey et al., in prep.).

One XAMU found depredated had been banded in April 2009 during dipnet captures (band #: 1262-03026; Whitworth, Harvey unpubl. data). There were no other band recoveries from carcasses, although there are still many pellets left to dissect.

### **Pellet collections and analyses.**

Pellets were collected from all roosts and will be analyzed pending development of a protocol and locating additional assistance with analysis. Other avian species on the island also regurgitate pellets (ie, other birds of prey and Western Gulls (*Larus occidentalis*)) so care was taken to only collect those from Barn Owls (P. Bloom pers. comm., Elbroch et al. 2001). Preliminary analysis of pellets from Barn Owl Cave included one apparently fresh pellet collected in December that contained a numbered ear tag from a deer mouse that was tagged during the

fall 2009 trapping session in the Terrace Coreopsis grid. This grid is approximately 1km southwest of Barn Owl Cave.

### **Barn Owl capture and banding**

We are unaware of any other studies that have attempted to capture Barn Owls on Santa Barbara Island. Capture efforts with noose mats, dipnets, and manually triggered leg snares were unsuccessful after 17 nights of effort. However, verball traps proved highly effective. Three individuals were captured, banded, and color-marked in just 10 hours over two nights with only 4 or 5 traps set. These owls were all banded with an aluminum USGS lock-on band and a unique color band (Blue, Orange, Yellow; Figure 6), one on each leg. Barn Owls do not undergo their first molt until age  $\geq 13$  months and it is usually a single primary flight feather (P. Bloom pers. comm., Taylor 1993, Lenton 1984). With this criteria, all three birds were aged as hatch years by the lack of molt limits (Pyle 1997). Blue/Blue was re-sighted one night later nearby Cave Canyon and less than 200m from the capture site. Capture effort was not intended to be standardized in 2010 as the purpose was simply to evaluate the effectiveness of the techniques used.



**Figure 6.** Photographs of color-banded Barn Owls captured on Santa Barbara Island in August 2010: (a) Blue/Blue, (b) Orange/Orange, and (c) Yellow/Yellow.

### **Deer Mouse monitoring:**

The data from spring and fall 2010 have not yet been analyzed for density calculations or population estimates, but the number of individual mice (less than 10 per grid) trapped in the spring were considerably lower than in the previous several years (Schwemm 2009). Casual observations suggested mouse numbers had increased sharply since spring as they were frequently observed while researchers walked the island trails and around the Bunkhouse at night during July and August (SKT, ALH pers. obs). Fall mouse trapping occurred in October 2010 and

confirmed the mouse population had increased considerably; 115 individual mice were captured on the coreopsis grid and 62 on the grassland grid. The density calculations will be presented in a future report and related to Barn Owl abundance estimates.

**Conclusions:**

We were able to collect critical information addressing most of the research objectives we had for the pilot year of this study. We collected baseline information on the current population status, habitat use, diet, and nesting activity of Barn Owls on Santa Barbara Island. This is an important study with implications not only for murrelet conservation and island restoration, but also for Barn Owl / seabird interactions on islands worldwide.

## **ACKNOWLEDGEMENTS**

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