Status of Breeding Seabirds in the San Miguel Island Group, California

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Cover Photo: Sunrise over Prince Island viewed from Cuyler Harbor, 24 April 2007 (Photo by Percy Hébert).

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EXECUTIVE SUMMARY

Population sizes, trends, and conservation issues were assessed for 15 species of breeding seabirds at the San Miguel Island (SMI) group, California, mainly during the 1975-2007 period. Most seabirds breed on Prince Island (PI) and Castle Rock, with smaller numbers on SMI proper and a few on Richardson Rock. Most recent information on population sizes and rough trends include: Leach's Storm-Petrel *Oceanodroma leucorhoa* (114 breeding birds in 1991 – trends not known); Ashy Storm-Petrel *O. homochroa* (1,354 breeding birds in 1991 – trends not known); Black Storm-Petrel *O. melania* (present in 1991 – trends not known and breeding not confirmed); Brown Pelican *Pelecanus occidentalis* (204 breeding birds in 2006 – first breeding since 1960s); Double-crested Cormorant *Phalacrocorax auritus* (mean 322 breeding birds in 2005 to 2007 – stable); Brandt's Cormorant *P. penicillatus* (3,294 breeding birds mainly in 2007 – decreasing or stable; Pelagic Cormorant *P. pelagicus* (260 breeding birds in 2007 – stable); Black Oystercatcher *Haematopus bachmani* (48 birds counted in 2007 – stable); Western Gull *Larus occidentalis* (2,770-3,070 breeding birds mainly in 2007 – increasing); Common Murre *Uria aalge* (maximum of 70 birds counted in 2007 – increasing but no breeding since 1912); Pigeon Guillemot *Cepphus columba* (731 birds counted in 2007 – stable); Xantus's Murrelet *Synthliboramphus hypoleucus* (20-100 breeding birds in 2007 – possibly declining; Cassin's Auklet *Ptychoramphus aleuticus* (less than 11,582 breeding birds in 1991 – declining); Rhinoceros Auklet *Cerorhinca monocerata* (10 birds counted in 2007 – colonized by 1991 and stable); and Tufted Puffin *Fratercula cirrhata* (none seen in 2007 – recolonized by 1991 but abandoned since 1997). About 31,000 breeding seabirds were estimated in 1991; a lack of recent estimates for storm-petrels and Cassin's Auklets prevents a 2007 total estimate. Additional work is needed to collate additional unpublished data and analyze trends for storm-petrels, cormorants, and Cassin's Auklets. Past and present anthropogenic impacts to seabirds at the SMI group include: removal of remaining Chumash people in 1812-16; marine mammal hunting; sheep ranching; black rats (*Rattus rattus*) and other past introduced mammals on SMI proper; pollution (light, organochlorine, oil, plastic, etc.); loss of nesting habitats at PI (historic bombing and guano harvesting); human disturbance (aerospace, military, recreational, commercial fishing, research, monitoring); prey changes due to climate change; historic overfishing of key prey species; enhanced gull food sources (garbage dumps, offal); historic gull egg harvesting; historic murre and puffin egg collecting at PI; and extinction of western spotted skunks (*Spilogale gracilis*) on SMI proper. Natural impacts include: decline in San Miguel island fox (*Urocyon littoralis littoralis*) on SMI proper; loss of Peregrine Falcons (*Falco peregrinus*) and Bald Eagles (*Haliaeetus leucocephalus*) due to organochlorine pollution and reintroduction of falcons, eagles, and increased Barn Owls (*Tyto alba*); natural variation in prey availability (including El Niño events); and variable or reduced immigration. Needed management actions include: a) black rat eradication to prevent extirpation of Xantus's Murrelets; b) nesting habitat restoration at PI; c) reduction or prevention of various forms of human disturbance (light pollution from squid fishing; recreational and commercial boats; research and monitoring); and d) carefully manage commercial fishing of key prey species. A long-term seabird monitoring and research program for the SMI group is needed.

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Chapter 1.

Seabird population sizes, trends, and conservation issues

INTRODUCTION

The San Miguel Island (SMI) group (here defined as including SMI proper and offshore islets Prince Island, Castle Rock and Richardson Rock; see Figures 1-1 to 1-5) hosts the largest and most diverse seabird breeding assemblage (13 known and 1 possible breeding seabird species) within the Southern California Bight (SCB), with about 28,000 and 31,000 breeding seabirds estimated in 1975-77 and 1991, respectively (Hunt et al. 1979, 1980; Sowls et al. 1980; Carter et al. 1992, this study). Prince Island and Castle Rock provided suitable nesting habitat for all SMI species, including a high proportion of the 3 most numerous species at the SMI group (Cassin's Auklet [*Ptychoramphus aleuticus*], Brandt's Cormorant [*Phalacrocorax penicillatus*], and Western Gull [*Larus occidentalis*]), all breeding Leach's Storm-Petrels (*Oceanodroma leucorhoa*), Double-crested Cormorants (*P. auritus*), and Tufted Puffins (*Fratercula cirrhata*), and all possibly-breeding Black Storm-Petrels (*O. melania*) in the SMI group. However, the San Miguel island fox (*Urocyon littoralis littoralis*) has certainly limited breeding by seabirds on SMI proper (Hunt et al. 1979, 1980), where relatively low seabird numbers have been noted there since seabirds were first described at the SMI group in 1886 (Streator 1887, 1888). Only 8 species have been reported breeding at SMI proper, including relatively high proportions of Pelagic Cormorants (*P. pelagicus*) and Pigeon Guillemots (*Cepphus columba*). Very small numbers of 4 species also bred on extremely limited nesting habitats on Richardson Rock. Xantus's Murrelets (*Synthliboramphus hypoleucus*), Rhinoceros Auklets (*Cerorhinca monocerata*), and Ashy Storm-Petrels (*O. homochroa*) bred primarily on Prince Island and Castle Rock. Small numbers of Black Oystercatchers (*Haematopus bachmani*) also bred at SMI proper and offshore islets along with seabirds and this shorebird species has been included in this and past seabird summaries, making a total of 15 SMI species. Brown Pelicans (*Pelecanus occidentalis*) and Common Murres (*Uria aalge*) were not reported breeding at the SMI group in 1975-77 or 1991 but bred historically at Prince Island.

In 2007, Carter Biological Consulting (CBC) and the California Institute of Environmental Studies (CIES) were contracted by the U.S. Fish and Wildlife Service, on behalf of the Montrose Trustee Council, to: a) conduct surveys of 7 species of breeding seabirds at the SMI group (especially SMI proper) to provide updated information on abundance, distribution, and trends; and b) summarize available historical literature and unpublished data on the abundance, distribution, trends, and conservation issues for all 15 species at the SMI group. This information is needed by federal and state agencies to: a) better assess potential impacts of black rats (*Rattus rattus*) on breeding seabirds at SMI proper and potential benefits of proposed rat eradication to breeding seabirds; and b) address other various conservation and management issues. With limited funding, survey efforts in 2007 were focused on: a) examining the status of 6 species of breeding seabirds on portions of SMI proper, using boat surveys; b) examining the status of the Xantus's

Murrelet on the east side of SMI proper and Prince Island, using spotlight surveys, at-sea captures, and nest searches; and c) gathering ancillary information on the status of 7 species of breeding seabirds at Prince Island, Castle Rock, and Richardson Rock, using boat surveys. Emphasis was placed on Xantus's Murrelet surveys to assess: a) the degree to which they breed on SMI proper and are exposed to rat predation; and b) a possible population decline noted in 2004 (Whitworth et al. 2005a). We supplemented our 2007 surveys with aerial survey data obtained by the University of California, Santa Cruz, for certain SMI colonies of Double-crested Cormorants, Brandt's Cormorants, Pelagic Cormorants, Brown Pelicans, and Western Gulls in 2005-07 (Capitolo et al. 2008a,b). Historical literature on seabirds at the SMI group prior to 1991 has been summarized previously (Hunt et al. 1979, Carter et al. 1992). To assess status, we draw mainly upon the most comparable data from 1975-77 and 1991 to compare to 2007 data but supplement these comparisons where possible with unpublished data gathered by: Humboldt State University in 1994-2003 (Carter et al. 1996, unpubl. data; McChesney et al. 2001; Capitolo et al. 2004; key field personnel H. Carter, D. Whitworth, G. McChesney, W. McIver, L. Ochikubo Chan, and P. Capitolo); Point Reyes Bird Observatory in 1998-99 (Hebshi and Sydeman 1999; A. Hebshi and W.J. Sydeman, unpubl. data); Channel Islands National Park (P. Martin, unpubl. data); U.S. Geological Survey in 1999-2007 (J. Adams, unpubl. data); and California Institute of Environmental Studies in 2004 (Whitworth et al. 2005a; unpubl. data). However, all historical data could not be collated and analyzed for certain species, with limited funding.

In Chapter 1, we present: a) a summary of anthropogenic impacts to seabirds at the SMI group; b) information on partial recovery of wildlife populations and proposed rat eradication; c) 2007 survey findings for 8 seabird species (Brandt's Cormorants, Pelagic Cormorants, Black Oystercatchers, Western Gulls, Common Murres, Pigeon Guillemots, Rhinoceros Auklets, and Tufted Puffins) and summaries of historical data (primarily from 1975-77 and 1991) to assess status and trends for all 15 species (also including Leach's Storm-Petrel, Ashy Storm-Petrel, Black Storm-Petrel, Brown Pelican, Double-crested Cormorant, and Cassin's Auklet); d) summary of seabird impacts from black rats; and e) suggestions for additional seabird colony protection, research, and monitoring.

In Chapter 2, we present our 2007 survey findings, summarize historical data and trends, and discuss benefits of rat eradication for Xantus's Murrelets.

ANTHROPOGENIC IMPACTS

Prior to assessing data on seabird population sizes, trends and conservation issues, we have collated a brief chronological summary of anthropogenic impacts to seabirds at the SMI group for general background. Despite the great importance of the SMI group to breeding seabirds in the SCB, severe anthropogenic impacts to marine wildlife populations and their marine and terrestrial habitats have occurred at or near the island over time, especially at SMI proper, but such impacts have been poorly described in the seabird and general literature (Hunt et al. 1979, 1980; Roberts 1991; Carter et al. 1992; Baird 1993; McChesney and Tershy 1998). Impacts or potential impacts include:

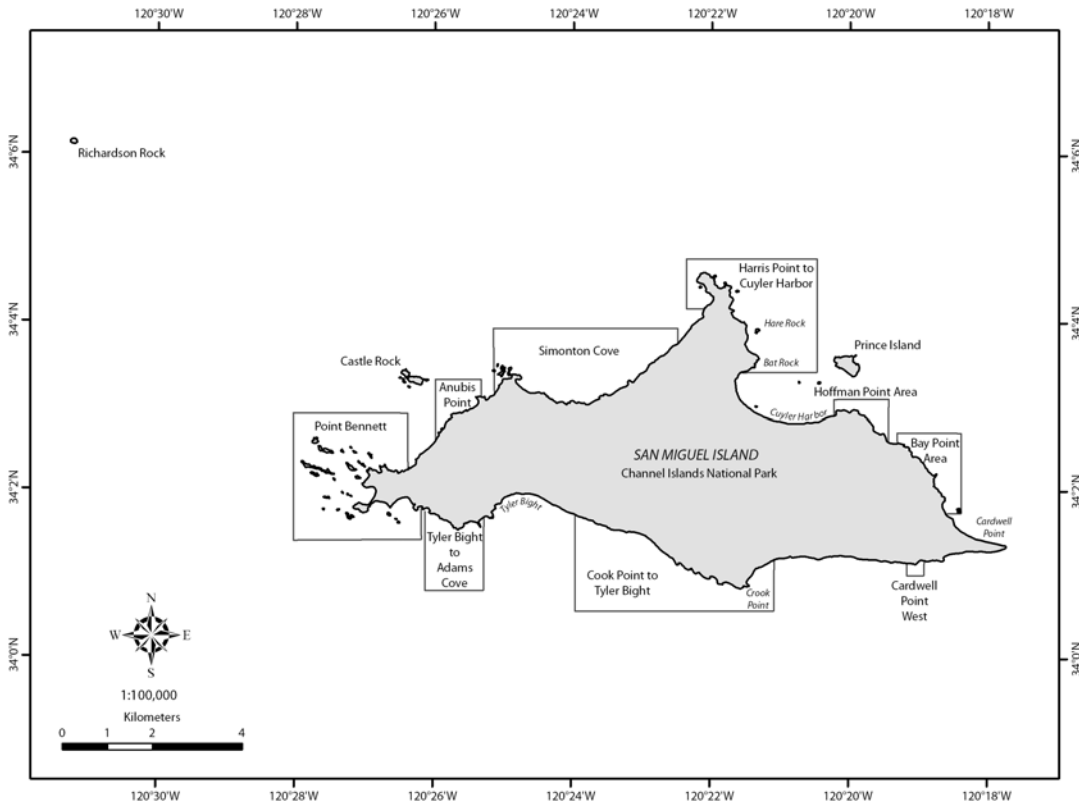


Figure 1-1. Locations of seabird breeding colonies at SMI proper, Prince Island, Castle Rock, and Richardson Rock, California.

● ***Chumash*** **-** SMI proper was occupied by a large population of Chumash people for about 10,000 years, prior to the arrival of Europeans which resulted in population decline and removal of about 30 remaining Chumash from SMI proper in 1812-16 (Roberts 1991). Marine mammals and marine birds were important food sources for these people (Guthrie 1980).

● ***Egg Harvesting*** - Harvesting of Western Gull eggs at Prince Island probably occurred from the 18th century to the early 20th century. Prince Island was relatively accessible to small row boats from ships anchored in nearby Cuyler Harbor. Egg harvesting at Prince Island may have increased from the 1850s (when ranch personnel first lived year round in the Cuyler Harbor area) until World War II (when all non-military personnel left the island). In particular, gull eggs were likely harvested by Captain G. Nidever (island leaser from 1851-70) who was known to harvest gull eggs in the Channel Islands.

Figure 1-2. Southeast end of Prince Island, 23 April 2007 (Photo by Percy Hébert). Thirteen known and one possible seabird species in the SMI group breed, have bred, or may breed here.

Figure 1-3. Northeast view of Castle Rock, 23 May 2007 (Photo by Percy Hébert). Seven seabird species have bred here.

Figure 1-4. Southeast view of the Harris Point-Cuyler Harbor colony, SMI proper, 2 May 2007 (Photo by Percy Hébert). Seven known and one possible seabird species have bred here.

Figure 1-5. Southeast view of Hoffmann Point, SMI proper, 1 May 2007 (Photo by Percy Hébert). Five known and one possible seabird species have bred here.

● ***Marine Mammal Hunting -*** In the 1800s, sea otter (*Enhydra lutris*), Guadalupe fur seal (*Callorhinus ursinus*), and northern elephant seal (*Mirounga angustirostris*) were intensively hunted to local extinction while California sea lion (*Zalophus californianus*), and Steller sea lion (*Eumetopias jubatus*) were intensively hunted to low numbers (Scammon 1968, Roberts 1991). Shooting of marine mammals continued at a reduced level into the early 1900s. During this hunting period, seabird populations were undoubtedly affected (especially at Point Bennett and Castle Rock where large numbers of marine mammals and nesting seabirds co-occur) although impacts were not described.

● ***Shipwrecks and Rats -*** Many shipwrecks also occurred in the 19th and early 20th centuries, causing some oil spills and with at least 1 apparently introducing black rats to SMI proper (Collins 1979, Erickson and Halvorson 1990, Roberts 1991), but impacts to seabirds have not been noted.

● ***Loss of Skunks -*** Western spotted skunks (*Spilogale gracilis*) went extinct at SMI proper after 1893 but it is not known if a population existed historically or whether small numbers of skunks were transported by humans to the island (Walker 1980). Impacts or benefits to seabirds have not been noted.

● ***Guano Harvesting -*** In 1895, about 18 tons of guano were removed for agricultural fertilizer and seabird breeding habitats probably were severely impacted (SDU 1895; SFC 1895; Doran 1980). This guano was considered to be of "inferior quality and hard to gather", apparently prompting future guano harvesting efforts in Baja California. However, some harvesting likely occurred before and after 1895, especially for fertilizer for island crops (Weinman 1978, Roberti 2008).

● ***Scientific Collecting -*** In the late 19th and early 20th centuries, scientific collecting of seabirds and their eggs at Prince Island was extensive and likely contributed to loss of Common Murre and Tufted Puffin colonies at Prince Island in the early 20th century (Hunt et al. 1979, Carter et al. 1992, 2001).

● ***Sheep Ranching -*** SMI proper was used for sheep ranching (and to a limited degree for farming) starting in about 1850 (shortly after the island was transferred from Mexico to the U.S. under the 1848 Treaty of Guadalupe Hidalgo) and extensive ranching continued until the 1940s, although sheep and feral burros were not completely removed until 1966 and 1977, respectively (Weinman 1978, Roberts 1991). Sheep ranching probably greatly reduced disturbance-free breeding habitats for surface-nesting seabirds on SMI proper. Overgrazing and farming with extensive droughts led to severe vegetation stripping and erosion which greatly modified vegetation and environment on SMI proper. Cats, horses, cattle, and pigs were all introduced to SMI proper during ranching operations but none remained after the 1940s. Any impacts to seabirds have not been described.

● ***U.S. Navy -*** Since about 1909, the SMI group has been claimed by the U.S. federal government for lighthouse purposes. Ownership of the SMI group was transferred from the U.S. Department of Commerce to the U.S. Navy in 1934 and claimed for military use in 1941 during World War II. Portions of the island became a bombing range in 1948.

During the Korean War (1950-53), the island was used for aerial bombing. From the late 1950s to the early 1970s, it was used as a target for missile testing (Roberts 1991, Roberti 2008). In the 1950s, D. Bleitz visited Prince Island after a bombing exercise and noted that the top of the island had been cindered; since 1965, the island was not used as an impact area (Hunt et al. 1980). In 1965, a danger zone was created on the water within 3 miles (5 km) from shore around the eastern half of SMI proper, including Prince Island (Weinman 1978). This danger zone was closed during missile firings, indicating that Castle Rock was not being targeted at this time. Castle Rock and Point Bennett may have been spared bombing because of large populations of marine mammals. Seabird breeding probably was disrupted in many areas due to explosions; some birds probably were killed. Loss of breeding habitats for burrow- and crevice-nesting seabirds likely occurred on Prince Island due to explosions, and periodic human disturbance of seabirds likely occurred from military personnel. None of these potential impacts has been noted.

● ***Organochlorine Pollution -*** Extensive pollution from organochlorine pesticides occurred in the 1940s to 1971, but use of these chemicals in the U.S. was banned in 1972. These chemicals persist in the environment in marine sediments and continue to occur in the marine food chain (ref). In the 1960s and 1970s, thin-shelled eggs and poor reproductive success was documented for Brown Pelicans, Double-crested Cormorants, and Brandt's Cormorants in southern California and northwestern Baja California (Anderson et al. 1975; Hunt et al. 1979, 1980; Anderson and Gress 1983; Gress 1995). Effects on other species were not studied until the 1990s when Ashy Storm-Petrels also were found to have relatively high levels of these pollutants, moderate eggshell thinning, and moderate reproductive success (Fry 1994; Kiff 1994; McIver 2002; Carter et al. 2008). Severe impacts also were noted in predatory birds, such as Bald Eagles (*Haliaeetus leucocephalus*) and Peregrine Falcons (*Falco peregrinus*), which were extirpated from the SMI group due to impacts from these chemicals (Kiff 1980).

● ***Oil Spills -*** From February to at least May 1969, the major Santa Barbara oil spill occurred from a blowout of an offshore oil platform in northern Santa Barbara Channel, with some oil reaching west to the SMI group (Hancock and Hancock 1970, Straughan 1971, Nash et al. 1972). However, overall impacts to seabirds were poorly assessed (Carter 2003) and impacts to breeding seabirds at the SMI group were not examined. Since the 1960s, many offshore oil platforms have been operating in Santa Barbara Channel and off Point Conception but few spills have occurred (Anderson et al. 1993, McCrary et al. 2003). Oil spillage from ships in southern California occurs regularly (Hampton et al. 2003) but has not been reported to affect areas near the SMI group. Prior to the late 1980s, there was poor documentation of oil spills and effects on marine birds in California (Carter 2003). Natural oil seeps do not occur near the SMI group but are found off the Santa Barbara County mainland, north of the SMI group (Anderson et al. 1993).

● ***Industrial Effluents -*** Various industrial effluents (in addition to organochlorines), municipal wastewater, power plants, chemicals, radioactive materials, dredging materials, surface runoff, and atmospheric fallout have affected waters in Santa Barbara Channel and near the northern Channel Islands but not near the SMI group (Anderson et al. 1993). No impacts to seabirds at the SMI group from these sources have been reported.

● ***Channel Islands National Park -*** As early as 1962, the U.S. Navy entered into agreements with the National Park Service for management of natural resources (Roberts 1991). By the late 1960s, use of the bombing range had reduced greatly. In the early 1970s, all use of the bombing range ceased. Weapons testing continued in offshore waters in the Sea Test Range but no evidence of seabird impacts has been found (Carter et al. 2000). In 1975, all natural resource management was transferred to the National Park Service, although the U.S. Navy retained island ownership. In 1980, the SMI group was included within the newly-established Channel Islands National Park (CINP). Since the 1970s, small numbers of park rangers and researchers have lived or worked on SMI proper, with only brief visits to Prince Island and Castle Rock. SMI proper has been managed for very limited visitor access, with few accessible areas on SMI proper (in particular, Point Bennett is off limits without a permit due to marine mammals and seabirds) and no access without a permit to Prince Island and Castle Rock.

● ***Channel Islands National Marine Sanctuary -*** In 1980, the Channel Islands National Marine Sanctuary (CINMS) also was established, including waters within 6 miles (10 km) of shore around the SMI group. CINMS prevents offshore oil development and increases protection for seabirds and their marine habitats. Motorized aircraft are restricted below 1000 feet (305 m) to prevent disturbance to seabirds and marine mammals.

● ***Sonic Booms -*** Since the 1970s, sonic booms from rocket and spacecraft launches at Vandenberg Air Force Base have had potential to impact seabirds and their breeding habitats in the SMI group (Jehl 1984). Most concern has focused on potential collapse of Cassin's Auklet burrows, but a brief trial indicated that adults will rapidly re-excavate collapsed burrows (Schrieber and Schrieber 1980). No impacts have been reported but booms usually occur when researchers are not present in seabird breeding colonies.

● ***Marine Reserves -*** In 2002-07, three state marine reserves (i.e., Richardson Rock, Harris Point, and Judith Rock) were established around the SMI group within the CINMS by the California Fish and Game Commission and CINMS. Extractive activities (e.g., commercial and recreational fishing) and activities that impact sanctuary resources are prohibited within marine reserves. Reduction of human disturbance of seabird breeding colonies and limited protection of certain seabird prey resources may result.

● ***Global Warming -*** Recent warming trends in ocean temperatures may be linked to changes in prey type and availability which is affecting reproductive success for some seabird species in southern and central California (Roemmich and McGowan 1995, Veit et al. 1996, Sydeman et al. 2001). Poor reproductive success of Cassin's Auklets at Prince Island in 2006-07 and population decline since 1975-77 may reflect changes in prey resources, differences in survey techniques, loss of nesting habitats, and predation (Carter et al. 1992; Adams et al. 2004, unpubl. data). Similar factors likely are affecting other species in the SMI group but insufficient data are available to demonstrate changes in diet, reproductive success, or population size.

PARTIAL RECOVERY OF WILDLIFE

For further background, we collated some information about wildlife responses to lessened anthropogenic impacts at the SMI group. A significant reduction of anthropogenic impacts at the SMI group has occurred since the 1950s and 1960s, with the end of both sheep grazing and on-island military activities. In association with various restoration actions and island protections by CINP, CINMS, and other state and federal agencies and private groups, partial recovery of marine and terrestrial wildlife has occurred at the SMI group. Populations of marine mammals have rebounded tremendously but this topic has been well covered elsewhere. However, current effects of higher populations of marine mammals on breeding seabirds have not been described (see later). Less well known is the return of raptors that prey on seabirds. Through a hacking program conducted by the Santa Cruz Predatory Bird Group, nesting Peregrine Falcons were partly restored in the northern Channel Islands (including the SMI group) in the 1990s (B. Walton and B. Latta, pers. comm.). Reintroduction of nesting Bald Eagles (*Haliaeetus leucocephalus*) to Santa Cruz Island was conducted in 2002-06 through a special program arranged by the Montrose Trustee Council and CINP (K. Faulkner, pers. comm.). Nesting eagles will likely spread from Santa Cruz Island to the SMI group and occupy historical nesting locations (e.g., Castle Rock and Prince Island) after a period of a few years. Island fox dropped from several hundred to less than 20 individuals in the mid to late 1990s (only 15 remained in 1999), due to unusual predation by Golden Eagles (*Aquila chrysaetos*) which regularly visited SMI proper at this time (Coonan et al. 2000, 2005). In 1999, 14 individuals were taken temporarily into captivity by CINP, before being released back onto the island in 2006 after Golden Eagles were removed (K. Faulkner, pers. comm.).

Relatively large seabird populations have occurred on Prince Island and Castle Rock at least since the late 1880s but standardized population counts did not occur in the SMI group until 1975-77 and 1991, making it difficult to determine degree of recovery of seabird populations (Hunt et al. 1979, 1980; Carter et al. 1992). By 1991-94, Tufted Puffins had recolonized Prince Island after a multi-decade absence and Rhinoceros Auklets were first documented attending Prince Island and SMI proper, reflecting either range expansion or recolonization (Carter et al. 1992; McChesney et al. 1995; this report). By 1999, Common Murres also were once again attending nesting habitats at Prince Island after a multi-decade absence, reflecting substantial population recovery in central California (Carter et al. 2001). In 2006, Brown Pelicans nested on Prince Island for the first time since the 1960s, reflecting substantial population recovery from organochlorine pollution and other factors (Capitolo et al. 2008a). But while nesting by certain seabird species on Prince Island and Castle Rock has returned to relatively high levels, seabird nesting on SMI proper has remained at relatively low levels, although numbers of Brandt's Cormorants and Western Gulls at Point Bennett increased between 1975-77 and 1991 (Carter et al. 1992). Much of the coastline of SMI proper has remained unused or has been underused by breeding seabirds, apparently due to predation by island fox and low availability of fox-free nesting habitats. In addition, predation by introduced rats and human disturbance occur in some areas.

MONTROSE SETTLEMENTS RESTORATION PROGRAM: ERADICATION OF BLACK RATS

To better understand the purposes and emphases of this report, we provide more information on the Montrose Settlements Restoration Program (MSRP 2005). This program has targeted the eradication of rats at SMI proper as a potential seabird restoration project to partly compensate for injuries to seabirds and the marine environment from organochlorine pollution. Rat eradication has been widely recognized as an effective management tool for improving seabird nesting habitats by either: a) permitting expansion of reduced seabird breeding populations to larger population sizes where rats have caused population reduction; b) permitting recolonization of islands where seabirds had been extirpated by rats; and c) preventing future extirpation or reduction of seabird breeding populations by rats. In the Southern California Bight, rat eradication at Anacapa Island was recently completed in 2002, with seabird restoration funds from the American Trader Trustee Council (ATTC 2001; Howald et al. 2005). Rats occurred widely in shoreline and gully habitats at Anacapa Island (Erickson and Halvorson 1990) and appeared to have greatly reduced population size and breeding distribution of Xantus's Murrelets (McChesney et al. 2000). Post-eradication monitoring has already documented an increase in murrelet reproductive success and numbers of nests in sample areas compared to pre-eradication baseline data (Whitworth et al. 2005b). Ashy Storm-Petrels and Cassin's Auklets also are likely to benefit from rat eradication at Anacapa Island.

At SMI proper, rats had a limited distribution prior to 1990, mainly in shoreline habitats on the west and north sides of the island (Collins 1979, Erickson and Halvorson 1990). Brandt's Cormorants and Western Gulls formed the bulk of breeding seabirds in these areas, although smaller numbers of Pelagic Cormorants, Black Oystercatchers, and Pigeon Guillemots also bred there. Colonies or nests of these 5 seabird species would appear at first glance to be most susceptible to potential impacts from rat depredation. While specific impacts to seabirds at SMI proper by rats have not been recorded in the literature, no studies of seabird breeding biology have been conducted on SMI proper and rat impacts may have gone undetected. Erickson and Halvorson (1990) did note that dead seabirds likely provided some food for rats at SMI proper because 8% of rat stomachs contained feathers. Whether feathers were derived from scavenging dead birds or actively killing birds was not determined. For the most part, rat diet was found to be composed mainly of sea-fig fruits (*Carpobrotus aquilalaterus*), carrion, beach amphipods, and kelp fly adults and larvae (*Coelopa vanduzeei*). Black rats are known to eat seabird eggs, chicks and adults, and have had major impacts on seabird populations on many islands. However, several studies have documented little or no impact to certain seabirds on some islands (see reviews in Moors and Atkinson 1984, Erickson and Halvorson 1990). Certainly, the degree of seabird depredation by Black Rats depends on various factors, such as alternate food sources for rats at different times of year, effects of predators or competitors on rats, accessibility of seabird breeding areas to rats, and abilities of different seabird species to fend off attempted predation by rats. Island fox likely exclude rats from many areas, although they also prey on seabird eggs and chicks themselves.

METHODS

2007 Survey Schedule, Strategy, and Logistics

Four trips to survey seabirds at the SMI group were conducted by CBC and CIES personnel in April-June 2007. Support vessels (research vessel *Shearwater* operated by CINMS or charter boat *Miss Devin* operated by Santa Barbara Ocean Sports) provided transportation for personnel and equipment from Santa Barbara to the island and acted as research platform, accommodations, and emergency rescue craft while anchored at Cuyler Harbor at the island. Trips occurred on: 1) 23-25 April, *Shearwater* with Carter, Hébert, Whitworth, and Koepke; 2) 1-4 May, *Miss Devin*, with Carter, Hébert, Whitworth, and Koepke; 3) 22-24 May, *Miss Devin*, with Carter, Hébert, and Koepke; and 4) 19-20 June, *Shearwater*, with Carter. Timing of trips reflected known timing of breeding of Xantus's Murrelets and other seabirds, plus vessel and staff availability. Given windy spring conditions at the SMI group and variable timing of breeding between years, our survey strategy ensured that: a) Xantus's Murrelets were counted with spotlight surveys 2 or 3 times during pre-breeding and incubation periods between late April and late May, in case murrelets nested or abandoned early (see Chapter 2); and b) 8 other species (i.e., Brandt's Cormorants, Pelagic Cormorants, Black Oystercatchers, Western Gulls, Common Murres, Pigeon Guillemots, Rhinoceros Auklets, and Tufted Puffins) were surveyed during the period of peak counts of birds or nests for these species in late April to late May (Carter et al. 1992). Carter and Hébert, with assistance from Whitworth, Koepke, and CINMS Teacher-At-Sea Wendy Gorton, focused on counts of 8 species, while Whitworth and Koepke focused mainly on Xantus's Murrelet data collection, with assistance from Carter, Hébert, and volunteers from the Channel Islands Naturalist Corps (McClesky and Strojny) (see Chapter 2).

2007 Boat Surveys

In 2007, boat surveys were conducted by 1-2 observers from 14-foot inflatable Zodiac boats powered by 20-25 hp outboard engines. Use of these small boats allowed close approach within 25-100 m of coastlines for best counts of visible nests and birds in all coastal areas, while staying outside of breaking waves and preventing or reducing disturbances of cormorants and marine mammals. We were not able to survey close to shore at: a) Point Bennett, with treacherous seas and large populations of marine mammals; b) north side of Castle Rock, with extensive kelp beds and wary cormorants; and c) southwest of Cardwell Point, with extensive kelp beds. Counts of birds included: a) birds attending nests or nesting habitats; b) birds standing or roosting in non-nesting habitats; and c) birds flying by or sitting on the water adjacent to nesting or non-nesting habitats. Potential nest sites or "sites" (where nest structures, eggs and chicks were not visible but could have been present in the survey year based on habitat type and behavior of adults) also were counted. Avian predators also were recorded. All counts were made with binoculars or the unaided eye and recorded in a notebook, with digital photographs of nesting habitats taken periodically. Disturbance of large numbers of seabirds or marine mammals was avoided whenever possible, although some disturbance did occur on

occasion. At several locations, personnel landed to inspect potential nesting habitats for Xantus's Murrelets and other crevice-nesting seabirds (see Chapter 2). For certain species (e.g., Common Murre, Pigeon Guillemot, and Rhinoceros Auklet), counts of birds tend to be highest early in the day (< 09:00 h [PDT]). In addition, calmest weather conditions usually occur early in the morning. Thus, we attempted to conduct boat surveys in the early morning at several colonies to best document these species but not all colonies could be surveyed at this time of day with available time. Castle Rock, Richardson Rock, and small colonies on the west and south sides of SMI proper were surveyed only on 23 May, when calm weather conditions occurred throughout the day.

Data Handling

Numbers of seabird nests, birds, and sites determined from 2007 boat surveys were summarized for each survey by subcolony (see Appendix 4). In a few cases, new subcolonies were created within or adjacent to existing colonies (see Appendix 3 for colony and subcolony maps, showing all numbered subcolony locations). In the text and figures, we report sums of numbers of nests, birds, sites, or nests/sites for each species and colony, as appropriate. For Brandt's Cormorants, we reported numbers of nests and birds. For Pelagic Cormorants and Western Gulls, we reported numbers of nests, sites, nests/sites, and birds. For Western Gulls at Prince Island, we also reported population estimates derived from the numbers of nests or using K correction factors (which allow estimation of numbers of breeding birds based on bird counts [Carter et al. 1992]). For Black Oystercatchers, Common Murres, Pigeon Guillemots, Rhinoceros Auklets, and Tufted Puffins, we reported numbers of birds only, because few nests or sites usually could be identified from boat surveys. Highest counts and sums were used for population estimates although they underestimate actual breeding population size. Correction factors should be applied to raw counts to best estimate annual population size by accounting for nests or birds not present at the time and date of counts (Carter et al. 1992). Avian predator observations are summarized in Appendix 1.

Historical Data and Assessment of Trends

Two main sources of standardized historical data on population sizes and distribution of breeding seabirds exist for the SMI group: a) 1975-77 surveys by the University of California Irvine (Hunt et al. 1979); and b) 1991 surveys by Humboldt State University (HSU) and U.S. Fish and Wildlife Service (Carter et al. 1992). Hunt et al. (1979) also summarize most historical data prior to 1975 but we referred to these data only when more recent data were not available. We supplemented these sources with other published and unpublished information after 1991 (McChesney et al. 1995, 1998, 2001; Carter et al. 1996a, 2008; Capitolo et al. 2004, 2008a,b; McChesney and Carter 2008; H.R. Carter, unpubl. data; P.J. Capitolo, unpubl. data; A. Hebshi and W.J. Sydeman, unpubl. data; P. Martin, unpubl. data; J. Adams, unpubl. data). All 1994-96 HSU surveys, except storm-petrel mistnetting and aerial surveys, were included (H.R. Carter, unpubl. data). Various other data could either not be summarized or not analyzed with available funding, including: a) some HSU aerial surveys between 1996-2003; b) 1994-95 storm-petrel and auklet mistnet surveys by HSU at Prince Island (H.R. Carter, unpubl. data); and c) 2004-

07 storm-petrel and auklet mistnet surveys (analysis only) by the U.S. Geological Survey at Prince Island (J. Adams, unpubl. data). For storm-petrels at Prince Island and Brandt's and Double-crested Cormorants at the SMI group, substantial effort is required to collate and analyze all data from 1991 to 2007 to best assess trends. We also have not collated or analyzed substantial data from nest monitoring of Cassin's Auklets at Prince Island (which has occurred since 1986) to help assess auklet trends. For these 6 species, our assessment of status and trends at the SMI group must be considered to be preliminary. For Xantus's Murrelets, we have provided a summary of all known historical data at the SMI group in Chapter 2 and Appendix 2.

In the text and figures, we mainly compared 1991 and 2007 data for each colony because: a) data were gathered largely in the same standardized fashion in these years; b) for several species and colonies, little or no data were available for intervening years; and c) trends or impacts were evident in some colonies and not others. For 1991, we used raw totals of nests, birds, sites, and nests/sites for comparison to 2007. In some cases, 2006 data were available for comparison. Some comparisons to 1975-77 data also were conducted. We did not attempt to compare 2007 data to pre-1975 observations because methodology and survey effort largely were not comparable. Rough trends were determined by comparing 1975-77, 1991, and 2007 data, when data were considered comparable and accounting generally for differences in methodology and annual variability in breeding. Only relatively large changes are considered to reflect increasing or decreasing trends to account for annual variation in nesting numbers.

RESULTS

Leach's Storm-Petrel

Prince Island: In 1976-77, 4+ breeding birds were estimated, based on mist-net captures of 4 birds in 1976 and 3 birds in 1977. In 1991, 7 birds were captured and 114 breeding birds were estimated, based on Leach's:Ashy capture ratios (Carter et al. 1992). Additional mist-net captures occurred in 1994-95 but data were not available with funding provided (H.R. Carter, unpubl. data). In May-August 2005 and 2007, 8 birds (7 light-rumped and 1 dark-rumped) were captured during mistnetting efforts (J. Adams, unpubl. data). In 2007, no Leach's Storm-Petrels were noted during nest searches (although few if any would have laid eggs by late April) or at-sea spotlight surveys around Prince Island (see Chapter 2). Trends were not determined with available data. Collation and analysis of all mistnetting data (especially from 1994-95; H.R. Carter, unpubl. data) is needed.

Castle Rock: No nests or birds were reported in 1975-77 or 1991 but an adult was reportedly collected on the rock in 1968 that has been finally re-identified as an Ashy Storm-Petrel (Hunt et al. 1979; G.J. McChesney, unpubl. data). In 2007, no surveys were conducted. Trends were not determined with available data.

Ashy Storm-Petrel

Prince Island: In 1976-77, 300 ± 100 birds were estimated, based on mistnet captures of 161 birds. In 1991, 309 birds were mistnetted and 1,154 breeding birds estimated, using mark-recapture analyses (Carter et al. 1992). Based on counts of potential nest sites using a correction factor for burrow occupancy, 1,451 breeding birds also were estimated. Additional mist-net captures occurred in 1994-95 but data were not available with funding provided (H.R. Carter, unpubl. data). During 2004 spotlight surveys for Xantus's Murrelets (see Chapter 2), relatively large numbers of Ashy Storm-Petrels (possibly some double-counted) were observed on the nights of 29-30 March (>30 birds but exact numbers not recorded) and 26-27 May (10 birds counted; Whitworth et al. 2005a; unpubl. data). In May-August 2005 and 2007, 189 birds were captured during mistnetting efforts (J. Adams, unpubl. data). No mistnetting data were obtained in 2007. No nests were found during nest searches in 2007 but few if any birds would have laid eggs by late April. However, a total count of 45 flying Ashy Storm-Petrels (possibly some double-counted) were recorded during at-sea spotlight surveys around Prince Island on the night of 22-23 May between 01:13 and 01:38 h, although only 3 were recorded on the night of 1-2 May between 01:45 and 02:12 h and none were recorded on the night of 2-3 May (see Chapter 2). Trends were not determined with available data. Collation and analysis of all mistnetting data (especially from 1994-95; H.R. Carter, unpubl. data) is needed.

Castle Rock: In 1968, one adult was collected on the rock (see Leach's Storm-Petrel above). In 1976-77, no evidence of nesting or presence was found, but 100 breeding pairs were estimated based on the 1968 estimate of 50-100 birds, presence of suitable nesting habitat, and past evidence of breeding. On 21-22 October 1991, 1 bird was captured in a mistnet and 1 nest with a chick was found. Based on counts of potential nest sites using a rough correction factor for burrow occupancy (see Carter et al. 1992), 341 breeding birds were estimated. On 3 August 1998, a wing was found on the rock (Hebshi and Sydeman 1999). In 2007, no surveys were conducted. Trends were not determined with available data.

Harris Point-Cuyler Harbor: On 24 June 1976, 3 birds with brood patches were mistnetted near the south end of this colony, behind a sandy beach (probably near SC 15). Other birds were seen flying and heard calling from cliffs above the beach. This region of SMI proper consists of a large landslide that occurred in about 1940-42 above an area where two major fault lines intersect (Johnson 1972). From this limited evidence, a small breeding population was considered to exist on SMI proper. On 25 June 1976, a burrow on Hare Rock (SC 10) also had strong petrel odor. In 1991, 1994-96, and 2007, no effort was expended to mistnet storm-petrels in this colony and no nests were found during brief nest searches in SC 4, 10 (Hare Rock), and 12 (see Cassin's Auklet below and Chapter 2). Nest searches in 1991-2007 were generally conducted too early in the season to detect nesting activity. On 12 July 1994, several carcasses of Ashy Storm-Petrels apparently killed by Peregrine Falcons were found at SC 14-15 (see Appendix 1). During 2004 spotlight surveys for Xantus's Murrelets (see Chapter 2), single birds were recorded near Nifty Rock on both survey nights of 29-30 March and 26-27 May (Whitworth et al. 2005a; unpubl. data). During 2007 spotlight surveys, raw counts of 2, 0, and 3 flying

storm-petrels were recorded on the Harris Point to Cuyler Harbor segment on the nights of 1-2 May, 2-3 May, and 22-23 May between 00:06-00:36 h, 23:10-23:40 h, and 23:30-00:00 h, respectively (see Chapter 2 for survey details). Spotlight survey observations may indicate continued attendance or breeding by small numbers in the Harris Point-Cuyler Harbor colony or these birds may have belonged to the nearby Prince Island colony. Trends were not determined with available data and breeding has not been confirmed.

Hoffman Point Area: Huber (1968) noted that presence and abundance would be nearly impossible to determine but storm-petrels may breed in cliffs on the point directly south of Prince Island. During 2007 spotlight surveys, 1 bird was seen off this area on the night of 1-2 May but none were seen on the nights of 2-3 May and 22-23 May (see Chapter 2).

Bay Point Area: During 2004 spotlight surveys for Xantus's Murrelets (see Chapter 2), 3 and 2 birds were recorded on the nights of 29-30 March and 26-27 May, respectively (Whitworth et al. 2005a; unpubl. data). During 2007 spotlight surveys, none were seen on the nights of 1-2, 2-3 and 22-23 May (see Chapter 2).

Black Storm-Petrel

Prince Island: Presence or nesting was not noted in 1975-77 surveys. On the night of 8-9 July 1991, 1 bird was captured briefly in a mistnet but escaped before being handled and closely examined. Vocalizations of this bird and another bird were heard clearly. In May-August 2005 and 2007, none were captured or heard during mistnetting efforts (J. Adams, unpubl. data). No Black Storm-Petrels were noted during nest searches (although few if any would have laid eggs by late April) or during spotlight surveys around Prince Island in 2007 (see Chapter 2 for survey details). Presence of this species was established in 1991 but nesting has not been confirmed and trends were not determined with available data. Collation and analysis of all storm-petrel mistnetting data (especially from 1994-95; H.R. Carter, unpubl. data) is needed to best assess effort for detecting presence and absence.

Brown Pelican

Prince Island: Nesting was not reported in 1975-77 or 1991-2005. Prior nesting had been recorded as recently as the 1960s (G.J. McChesney, unpubl. data), but most known historical nesting occurred prior to 1940. In 2006, 102 nests were counted on the 16 May aerial survey (Capitolo et al. 2008a). In 2007, nesting did not occur. On 3 May 2007 at 08:24-08:27 h, 600 pelicans roosted at the south end of the island but otherwise only small numbers were seen roosting on other survey dates in 2007. In 2006, nesting likely reflected continuing recovery of this species and the possible redistribution of their principal prey species, the northern anchovy (*Engraulis mordax*). Regular breeding may reoccur in the future.

Double-crested Cormorant

Prince Island: In 1976-77, 75 nests were estimated, although only 63 nests were noted in 1976. Estimated nest numbers increased from 50 in 1986 to 240 in 1990 (Ingram 1992). In 1991, 230 nests and 259 birds were counted on the 15 June 1991 aerial survey. Annual nesting has been documented at Prince Island since 1991, except for 2004 when no surveys occurred. A complete summary and analysis of these data are beyond the scope of this report. However, we have provided recent and other available information for perspective. During intense El Niño conditions in 1992-93, reduced numbers of 107 nests were found during ground counts in 1992 (Ingram and Carter 1997) but aerial surveys found relatively high numbers in 1992 (279 nests and 327 birds on 15 May) and 1993 (194 nests and 292 birds on 12 May) (McChesney 1997). In 1998, about 24-36 well-built nests were ground counted, apparently reflecting lower breeding during intense El Niño conditions (Hebshi and Sydeman 1999). On 13 June 2005, 174 nests, 0 sites and 189 birds were counted (Capitolo et al. 2008a). On 16 May 2006, 186 nests, 4 sites, and 193 birds were counted (Capitolo et al. 2008a). In 2007, few birds were seen during boat surveys but nesting areas on the top of the island are difficult to view from a boat. On the 12 June aerial survey, 123 nests, 0 sites, and 143 birds were counted (Capitolo et al. 2008a; see Figure 1-14a). Numbers in 2007 were lower than in 2005-06 but close to 2001 (i.e., 140 nests and 162 birds on 23 May [Capitolo et al. 2004]). On 9 October 2007, about 12 fledged juveniles roosted along the southeast hillside (J. Adams, unpubl. data). This isolated colony is well established and slightly lower numbers in 2007 apparently reflected poor marine conditions.

Brandt's Cormorant

Harris Point-Cuyler Harbor: In 1976, 5 nests were noted on Hare Rock (SC 10). In 1991, only 1 nest (SC 6) and 6 birds were reported. Nesting in greater numbers was first reported in 1995 when 20 nests and 27 birds were reported in May aerial surveys (Carter et al. 1996a). Regular nesting by small numbers has occurred near Harris Point since 1995. In 2007, nesting did not occur. On 24 April, the nesting area in SC 2 was guano-covered, with 35 roosting birds and another 57 birds observed throughout the rest of the colony (Figure 1-6a). In May, no roosting or nesting birds were noted at SC 2, although 47 birds were counted elsewhere in this colony on 22 May. On the 15 May aerial survey, no birds were seen but some nesting material (possibly 20-30 nests) was strewn about SC 2; however, it was not clear if materials were from 2006 or 2007 nests (Capitolo et al. 2008a; unpubl. data). On 24 May, 1 empty nest was seen at SC 2. For comparison, 50 nests and 63 birds were counted on 23 May 2001 (Capitolo et al. 2004). Nesting may not have occurred at this location in 2007 due to poor marine conditions. Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Hoffman Point Area: Nesting was not reported in 1975-77 but 5 nests and 13 birds were counted on the 11 May 1991 boat survey. In 2007, 4 birds and no nests were noted on 24 April and nothing was seen on 22 May (Figure 1-6a). This colony location apparently was abandoned, likely due to human disturbance. This area is easily accessible to humans by foot from ranger and camping facilities at Nidever Canyon. Plant research activities were

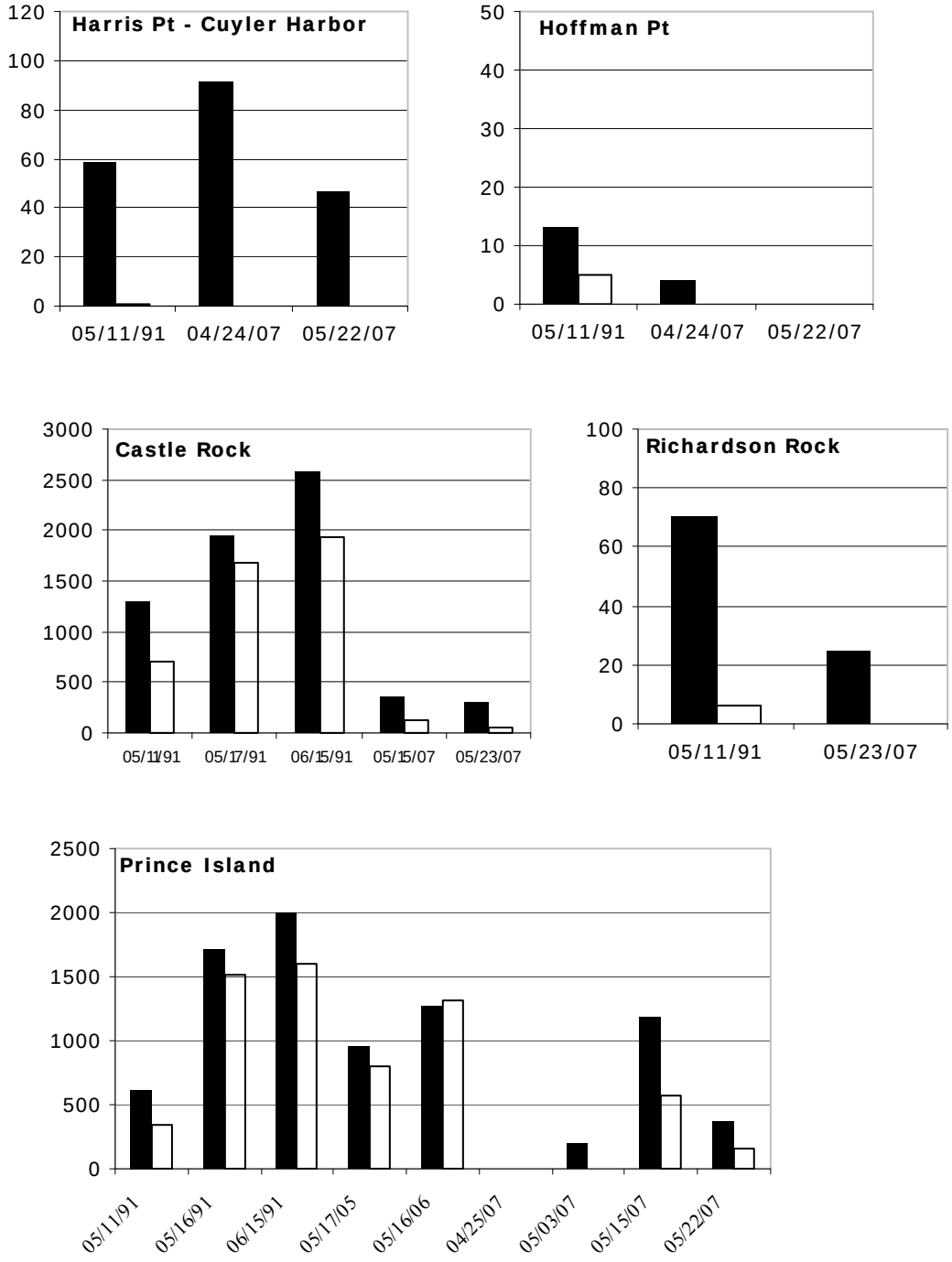


Figure 1-6a. Number of Brandt's Cormorant individuals (solid bars) and nests (open bars) counted during aerial and boat surveys at San Miguel Island breeding colonies in 1991 and 2005-07.

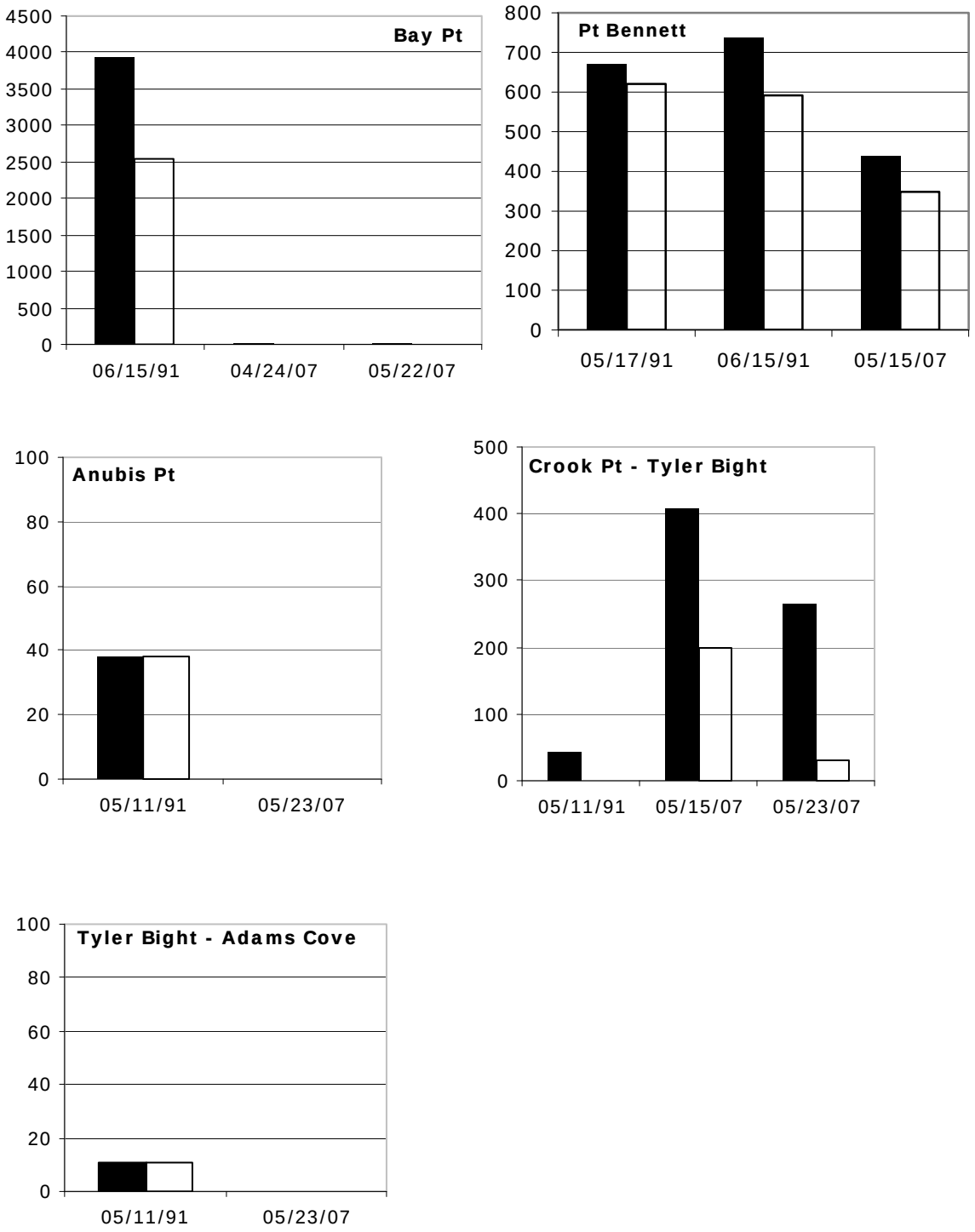


Figure 1-6b. Number of Brandt's Cormorant individuals (solid bars) and nests (open bars) counted during aerial and boat surveys at San Miguel Island breeding colonies in 1991 and 2007.

conducted in this area during the winter of 1991-92. Peregrine Falcon research occurred here in many years during the 1990s.

Bay Point Area: Nesting was not reported in 1975-77 but 2,548 nests and 3,938 birds were counted on the 15 June 1991 aerial survey. Nesting has not been noted since 1991. In 2007, 4 birds and no nests were noted on 24 April and nothing was seen on 22 May (Figure 1-6a). This large colony apparently was abandoned, likely due to human disturbance (see Hoffman Point above).

Prince Island: In 1975, 1976, and 1977, 860, 590, and 907 nests were counted, respectively. On the 15 June 1991 aerial survey, 1,601 nests and 1,998 birds were counted. Nesting has occurred at Prince Island almost annually since 1991. Reduced numbers bred during intense El Niño conditions in 1992-93 (171 nests and 244 birds on 15 May 1992; 386 nests and 1,269 birds on 12 May 1993; McChesney 1997) and 1998 (none nested; Hebshi and Sydeman 1999). In 2007, 150 nests and 369 birds were noted on the northwest corner on 22 May (Figure 1-6a). Late nesting was evident, with only 3 birds seen on 25 April and 207 birds without nests on 3 May. During aerial surveys on 15 May, 567 nests (59% poorly-built), 331 sites and 1,192 birds were counted (Capitolo et al. 2008a). Less nests were counted in 2007 than 2006 (i.e., 1,265 nests, 17 sites, and 1,316 birds on 16 May) but 2007 numbers were similar to 2005 (796 nests, 47 sites, and 960 birds on 17 May) and 2001 (i.e., 601 nests and 1,038 birds on 23 May [Capitolo et al. 2004]). With late breeding in 2007, many sites likely became nests after surveys were completed, lessening the apparent disparity in nest counts between 2006 and 2007. This colony is well established but low numbers and late breeding in 2007 apparently reflected poor marine conditions (Capitolo et al. 2008a). However, occasional disturbances from boats and seabird researchers also occur at Prince Island. Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Castle Rock: In 1975, 1976, and 1977, 216, 363, and 916 nests were counted, respectively. In 1991, 1,962 nests and 2,618 birds were counted, when highest subcolony counts from 17 May and 15 June aerial surveys were combined. Annual nesting has occurred at Castle Rock since 1991. After intense El Niño conditions in 1992, lower numbers bred in 1993 (623 nests and 1,803 birds on 12 May; McChesney 1997). In 2007, about 50 nests and 300 birds were noted during the 23 May boat survey (Figure 1-6a). We could not approach closely for counts because birds on SC 1 reacted to our presence and non-nesting birds began to flush and walk around on the rock. Nests and birds on flat-topped SC 2 also were difficult to see from the boat. Late nesting was evident. On the 15 May aerial survey, 133 nests, 93 sites, and 355 birds were counted. Empty and poorly-built nests accounted for 40% of nests, but 21 widely-scattered nests with medium-sized chicks were counted on SC 1. Some successful early breeding apparently began in March, with another pulse in nest initiations in May (Capitolo et al. 2008a, unpubl. data). Breeding numbers in 2007 were far below: a) the 16 May 2006 aerial survey when roughly twice as many nests were visually estimated by Capitolo (unpubl. data) from photographs (i.e., photographs have not been counted); and b) the 23 May 2001 aerial survey count of 280 nests and 580 birds (Capitolo et al. 2004). This colony is well established but low numbers in 2007 apparently reflected poor marine conditions. Disturbances from marine mammal researchers may occur occasionally at Castle Rock (R. DeLong, pers. comm.), but often visits occur after

aerial surveys are conducted each year. Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Richardson Rock: Nesting was not reported in 1975-77 but 6 nests and 70 birds were counted on the 11 May 1991 boat survey. No nests and 25 birds were noted on the 23 May 2007 boat survey (Figure 1-6a). Nesting by small numbers occurred until at least 2001 (i.e., 8 nests and 38 birds on 23 May [Capitolo et al. 2004]) but none were noted in 2005-07 (Capitolo et al. 2008a; unpubl. data). Nesting appears to have been discontinued for natural reasons or occurs sporadically. Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Point Bennett: In 1977, 27 nests were reported. In 1991, 996 nests and 1,210 birds were counted, when highest subcolony counts from 17 May and 15 June aerial surveys were combined. Lower numbers bred after the intense 1992 El Niño event (183 nests and 410 birds on 12 May 1993; McChesney 1997). In 1998, 60 well-built nests were counted, reflecting reduced breeding numbers during the intense 1997-98 El Niño event (Hebshi and Sydeman 1999). In 2007, 438 nests, 45 sites, and 348 birds were recorded on an aerial survey on 15 May (Figure 1-6b; Capitolo et al. 2008a; unpubl. data). Abandoned nests (n = 224) and empty nests (n = 13) together comprised 54% of nests counted and may have reflected disturbance or poor marine conditions. However, some nests had chicks, 2 wandering chicks were noted, and nest materials were more strewn about (typical after chicks depart nests), suggesting that some birds may already have completed breeding. In 2001, lower levels were noted (i.e., 224 nests and 266 birds on 23 May [Capitolo et al. 2004]), indicating that fluctuating numbers may be occurring at Point Bennett. This colony appears to be well established but appears to be suffering mainly from disturbance from marine mammals. No researcher disturbance has been noted (R. DeLong, pers. comm.). Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Anubis Point (Northwest San Miguel Island): Nesting was not reported in 1975-77 but 38 nests and 38 birds were counted on the 11 May 1991 boat survey. No birds or nests were reported on the 23 May 2007 boat survey (Figure 1-6b). Nesting may not have occurred at this location in 2007 due to poor marine conditions, or nesting may have been discontinued earlier for natural reasons, disturbance from researchers, or impacts of introduced rats.

Crook Point-Tyler Bight: Nesting was not reported in 1975-77 but 44 birds without nests were counted on the 11 May 1991 boat survey. Nesting was first reported in 1998 (i.e., 40 nests and 49 birds in May; H.R. Carter, unpubl. data). From the ground on 8 May 1998, B. Stewart reported about 45 nests underneath a sign and, on 30 May 1998, D. Richards observed 35 nests at this location (P. Martin, unpubl. data). On 28 April 1999, 209 nests (172 well-built) were counted (A. Hebshi and W.J. Sydeman, unpubl. data). Nesting numbers had increased by 2001 (i.e., 224 nests and 266 birds on 23 May [Capitolo et al. 2004]). In 2007, 200 nests, 115 sites, and 407 birds were recorded on an aerial survey on 15 May (Figure 1-6b; Capitolo et al. 2008a; unpubl. data). Colony disturbance was suspected because many abandoned well-built nest structures (n > 150, but numbers were

difficult to determine and some likely were 2006 nests) were evident in SC 1 (not included in the nest count total) and remaining active nests were isolated and spread out rather than being in a tight group as usual. Nesting east of Crook Point had not been noted in previous years and may reflect movement of disturbed birds from west of Crook Point. During the boat survey on 23 May, only 30 nests and 265 birds were counted, suggesting continued disturbance, but some nesting areas also were difficult to see from the boat. This colony appears to be suffering greatly from disturbance, possibly from marine mammals, researchers, island fox, or rats. Collation and analysis of all aerial survey data from 1991-2007 is needed to best assess trends.

Tyler Bight-Adams Cove: Nesting was not reported in 1975-77 but 10 birds without nests were counted on the 11 May 1991 boat survey. No birds or nests were reported on the 23 May 2007 boat survey (Figure 1-6b). Nesting has not been confirmed at this location.

Pelagic Cormorant

Harris Point-Cuyler Harbor: In 1977, 62 nests were noted. In 1991, 89 nests, 7 sites, and 173 birds were counted. On 5 May 1994 (08:31-10:05 h), 68 nests and 139 birds were counted (H.R. Carter, unpubl. data). In 1998, about 11 well-built nests were noted on cliffs above northwest Cuyler Harbor (Hebshi and Sydeman 1999). In 2007, maximums of 20 nests on 22 May and 51 birds on 24 April were noted (Figure 1-7a). Lower numbers of nesting birds occurred in 2007 than in 1991-94.

Hoffman Point Area: Nesting was not reported in 1975-77 but numbers were likely lumped with Bay Point Area (see below). In 1991, 7 nests and 14 birds were counted on 11 May. On 5 May 1994, 11 nests, 2 sites, and 16 birds were counted (H.R. Carter, unpubl. data). In 2007, 20 nests and 22 birds were counted on 22 May (Figure 1-7a). Little change in nesting numbers was evident between 1991 and 2007.

Bay Point Area: In 1977, 26 nests were noted between Cuyler Harbor and Cardwell Point which were assigned to this colony but likely included Hoffman Point Area. In 1991, 11 nests and 15 birds were counted on the 11 May 1991 boat survey. On 5 May 1994, no nests and 5 birds were noted (H.R. Carter, unpubl. data). In 2007, only 1 nest and 4 birds were noted on 22 May (Figure 1-7a). Little change in nesting numbers was evident between 1991 and 2007.

Prince Island: In 1975, 1976, and 1977, 1, 10 and 20 nests were counted, respectively, although the lower 1975 count reportedly reflected lower survey effort. In 1991, 20 nests, 1 site, and 33 birds were noted in 1991. On 5 May 1994, 8 nests, 3 sites, and 18 birds were counted (H.R. Carter, unpubl. data). In 2007, maximums of 11 nests and 21 birds were recorded on boat surveys on 23 May and 24 April, respectively (Figure 1-7a). Aerial surveys detected: a) 9 nests, 2 sites, and 11 birds in 2005; b) 8 nests and 10 birds in 2006; and c) 14 nests, 2 sites and 17 birds in 2007 (Capitolo et al. 2008a). Change in nesting numbers was not evident between 1976 and 2007.

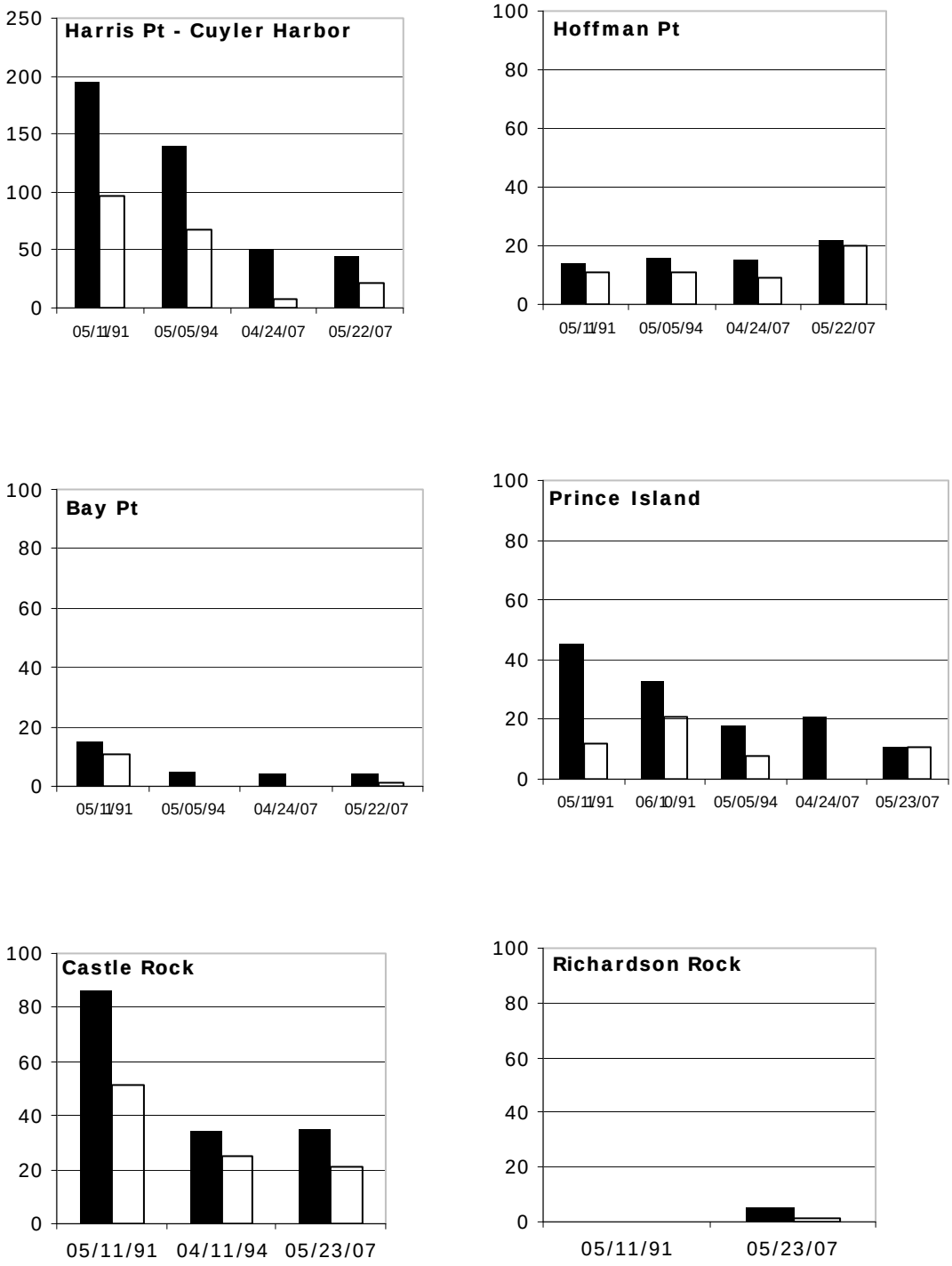


Figure 1-7a. Number of Pelagic Cormorant individuals (solid bars) and nests (open bars) counted during boat surveys at San Miguel Island breeding colonies in 1991, 1994, and 2007.

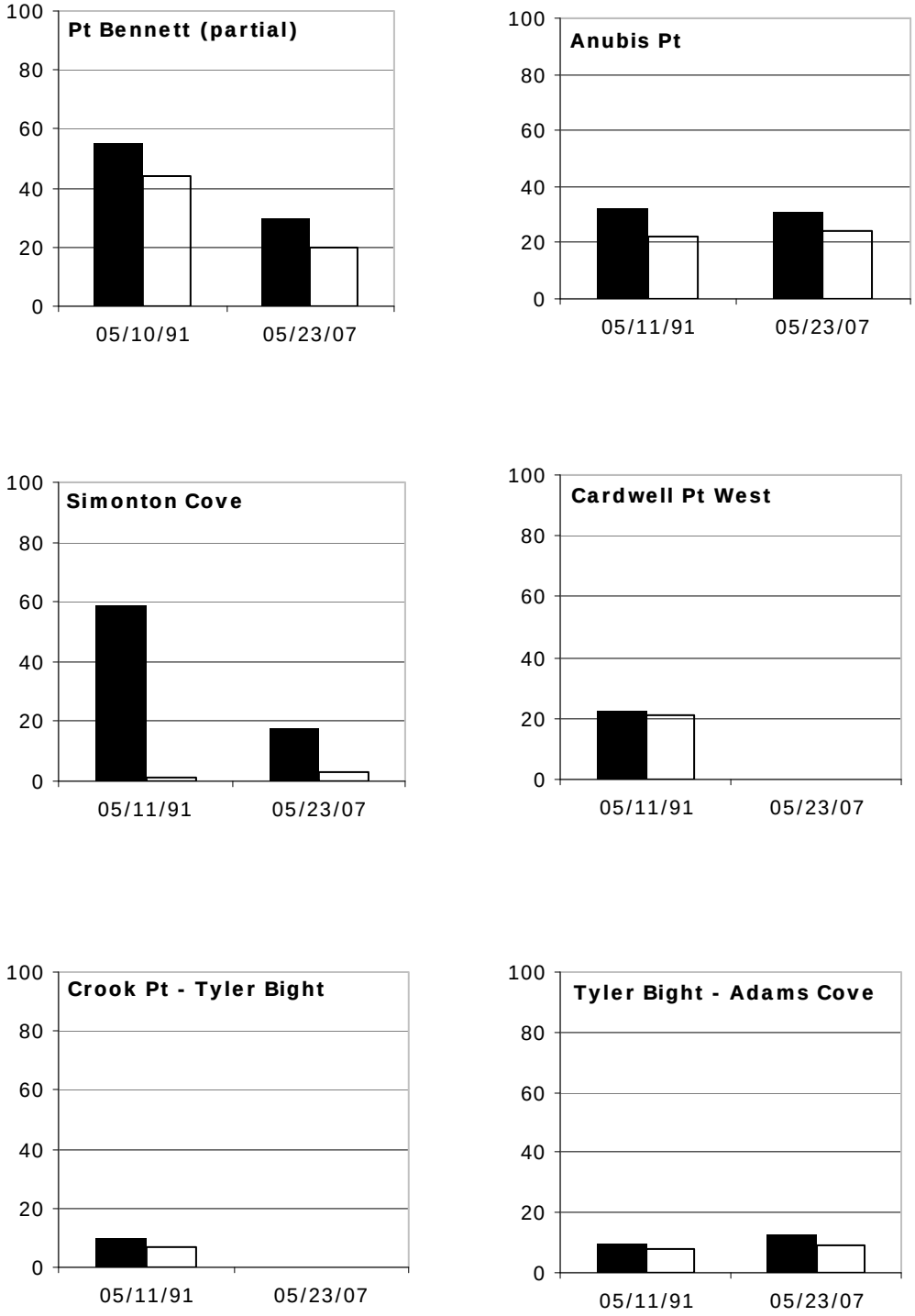


Figure 1-7b. Number of Pelagic Cormorant individuals (solid bars) and nests (open bars) counted during boat surveys at San Miguel Island breeding colonies in 1991 and 2007.

Castle Rock: In 1975, 1976, and 1977, 15, 34, and 25 nests were counted, respectively, although the lower 1975 count reflected lower survey effort. In 1991, 48 nests, 3 sites, and 86 birds were noted. On 11 April 1994 (12:33-13:19 h), 25 nests, 1 site, and 34 birds were counted (H.R. Carter, unpubl. data). In 2007, only 21 nests and 35 birds were counted on 23 May (Figure 1-7a). Lower levels of nesting were evident in 2007 and 1975.

Richardson Rock: Nesting was not reported in 1975-77 or 1991. In 2007, 1 nest and 5 birds were reported on the 23 May boat survey (Figure 1-7a). Earlier breeding may have gone undetected or been sporadic. Status cannot be determined with available data.

Point Bennett: In 1977, 12 nests were reported. In 1991, 79 nests and 85 birds were counted. In 1998, 17 well-built nests were noted from Little Cove to one cove north of Buoy Cove (Hebshi and Sydeman 1999). On 23 May 2007, an incomplete survey of Point Bennett (SC 8, 9, 10 only) was conducted and 20 nests and 30 birds were counted (Figure 1-7b). In 1991, 44 nests and 55 birds were recorded at these subcolonies. Little change in nesting numbers was evident between 1991 and 2007. Lower numbers in 1977 may have reflected an incomplete survey.

Anubis Point (Northwest San Miguel Island): Nesting was not reported in 1975-77 but 23 nests and 32 birds were counted on the 11 May 1991 boat survey. On the 23 May 2007 boat survey, 24 nests and 31 nests were recorded (Figure 1-7b). Little change in numbers of nests was evident between 1991 and 2007. A lack of reported nesting in 1975-77 may have reflected incomplete surveys or sporadic nesting.

Simonton Cove: Nesting was not reported in 1975-77 but 1 nest and 59 birds were recorded on 11 May 1991. In 2007, 3 nests and 18 birds were noted on 23 May (Figure 1-7b). Little change in nesting numbers was evident between 1991 and 2007. A lack of reported nesting in 1975-77 may have reflected incomplete surveys or sporadic nesting.

Cardwell Point West: Nesting was not reported in 1975-77 but 21 nests and 22 birds were counted in 1991. In 2007, no nests or birds were noted, although our survey was conducted far from shore in this area due to extensive kelp beds and they may have been missed. Status cannot be determined with available data.

Crook Point-Tyler Bight: Nesting was not reported in 1975-77 but 7 nests and 10 birds were counted on the 11 May 1991 boat survey. In 2007, no nests or birds were noted on the 23 May boat survey (Figure 1-7b). Little change in nesting numbers was evident between 1991 and 2007. A lack of reported nesting in 1975-77 may have reflected incomplete surveys or sporadic nesting.

Tyler Bight-Adams Cove: Nesting was not reported in 1975-77 but 8 nests and 10 birds were counted on the 11 May 1991 boat survey. In 2007, 9 nests and 13 birds were reported on the 23 May 2007 boat survey (Figure 1-7b). Little change in nesting numbers

was evident between 1991 and 2007. A lack of reported nesting in 1975-77 may have reflected incomplete surveys or sporadic nesting.

Black Oystercatcher

Harris Point-Cuyler Harbor: In 1977, 20 nests were estimated for SMI proper, with presence noted at Harris Point-Cuyler Harbor, Bay Point Area, and Point Bennett. Two nests were estimated for other offshore rocks (possibly Hare Rock and Nifty Rock in this colony). In 1991, 27 birds and 4 nests were noted. On 11 April, 5 May, and 13 July 1994, 32, 17, and 17 birds were counted, respectively; on 11 April, some birds occurred in large roosting groups and may have belonged to other colonies (H.R. Carter, unpubl. data). In 2007, a maximum of 20 birds was noted on 22 May, with 17 birds noted on 24 April and 23 May (Figure 1-8a). Little change in numbers was evident between 1991 and 2007.

Hoffman Point Area: Presence was not reported in 1977 but any birds seen may have been assigned to Bay Point Area. In 1991, 4 birds were counted on the 11 May boat survey. On 5 May 1994, 4 birds were counted (H.R. Carter, unpubl. data). In 2007, a maximum of 5 birds was counted on 22 May (Figure 1-8a). Little change in numbers was evident between 1991 and 2007.

Bay Point Area: In 1977, 20 nests were estimated for SMI proper, with presence noted at Harris Point-Cuyler Harbor, Bay Point Area, and Point Bennett. In 1991, 1 bird was counted on the 11 May boat survey. On 5 May 1994, 4 birds were counted (H.R. Carter, unpubl. data). In 2007, none were observed on 24 April and 22 May (Figure 1-8a). Little change in numbers was evident between 1991 and 2007 and breeding may not occur.

Prince Island: In 1977, 3 nests were estimated, but a maximum of 9 birds were seen. In 1991, 8 birds were seen on the 11 May boat survey. In 2007, 2 birds were seen on 22 and 24 May (Figure 1-8a). Little change in numbers was evident between 1991 and 2007.

Castle Rock: In 1977, 3 nests were estimated, compared to 2 birds seen in 1991. On 5 May 1994, 6 birds were counted (H.R. Carter, unpubl. data). In 2007, 2 birds also were seen (Figure 1-8a). Little change in numbers was evident between 1991 and 2007.

Richardson Rock: Presence was not reported in 1977 or 1991. In 2007, 1 bird was noted on 23 May (Figure 1-8a). Earlier presence may have gone undetected or been sporadic.

Point Bennett: In 1977, 20 nests were estimated for SMI proper, with presence noted at Harris Point-Cuyler Harbor, Bay Point Area, and Point Bennett. In 1991, 6 birds were counted on 10 May. On 23 May 2007, an incomplete survey of Point Bennett (SC 8, 9, 10 only) was conducted and 4 birds were counted (Figure 1-8b). In 1991, 4 birds also were seen in these subcolonies. Little change in numbers was evident between 1991 and 2007.

Anubis Point: Presence was not reported in 1977 or 1991. In 2007, 1 bird was noted on 23 May (Figure 1-8b). Earlier presence may have gone undetected or been sporadic.

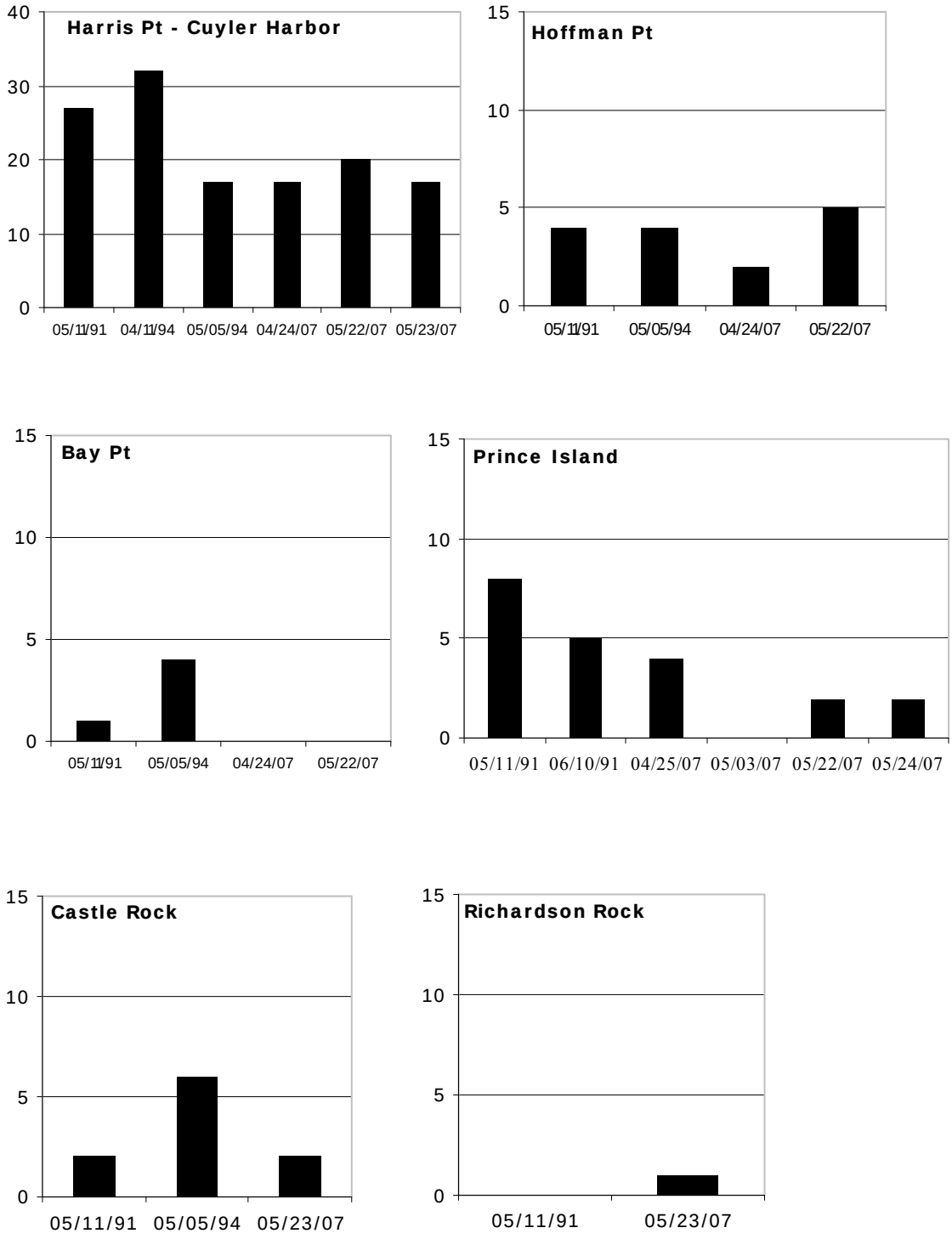


Figure 1-8a. Number of Black Oystercatchers counted during boat surveys at San Miguel Island breeding colonies in 1991, 1994, and 2007.

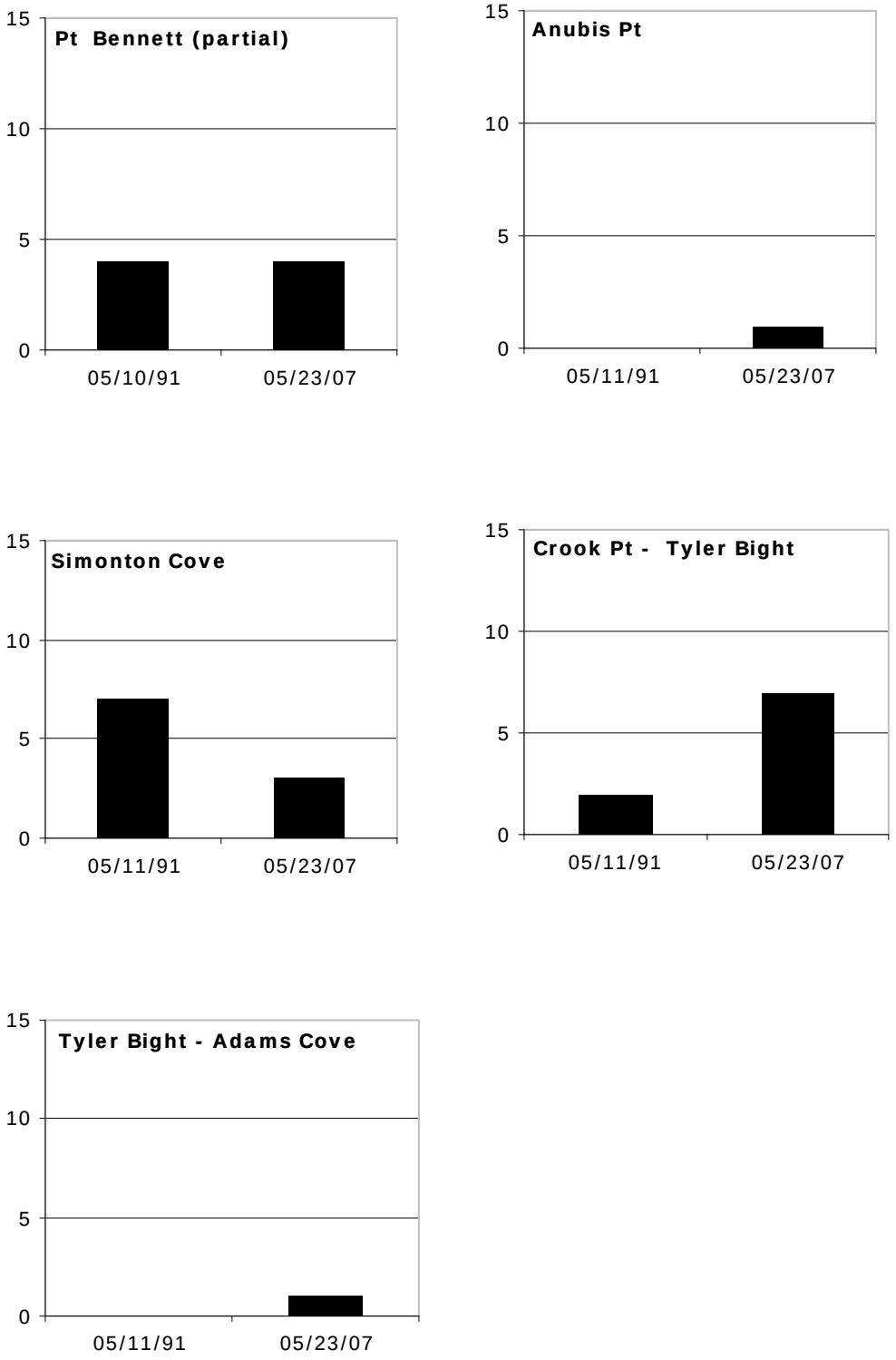


Figure 1-8b. Number of Black Oystercatchers counted during boat surveys at San Miguel Island breeding colonies in 1991 and 2007.

Simonton Cove: Presence was not noted in 1977 but 7 birds were noted on the 11 May 1991 boat survey. In 2007, 3 birds were noted on 23 May (Figure 1-8b). Little change in numbers was evident between 1991 and 2007.

Cardwell Point West: Presence was not noted in 1977 but 2 birds were counted in 1991. In 2007, no birds were seen but we did not conduct a survey close enough to shore to ensure that all birds were seen. Status cannot be determined with available data.

Crook Point-Tyler Bight: Presence was not reported in 1977 but 2 birds were noted in 1991. In 2007, 7 birds were noted on 23 May (Figure 1-8b), possibly indicating an increase over the 1977-2007 period.

Tyler Bight-Adams Cove: Presence was not reported in 1977 or 1991. In 2007, 1 bird was noted on 23 May (Figure 1-8b). Little change in numbers was evident between 1991 and 2007 and breeding may not occur.

Western Gull

Harris Point-Cuyler Harbor: In 1976-77, 28 breeding birds or 14 nests were noted, with 7 nests on Hare Rock and 7 nests on SMI proper near Nifty Rock. In 1991, 27 nests, 22 sites, and 98 birds were noted. In 2007, 272 and 270 birds were noted on 24 April and 22 May, respectively, and 190 nests were counted on 22 May (Figure 1-9a). Increased numbers of breeding birds are evident since 1977.

Hoffman Point Area: Nesting was not reported in 1977, although small numbers were noted nesting in 1968. In 1991, 2 sites and 4 birds were noted on the 11 May boat survey. On 5 May 1994, 4 sites and 8 birds were counted (H.R. Carter, unpubl. data). In 2007, 5 nests were counted on 24 April and 22 May, with a high count of 31 birds (Figure 1-9a). Little change in numbers of nesting birds was evident between 1991 and 2007. Earlier breeding may have gone undetected or was not reported.

Bay Point Area: In 1977, nesting was not reported. In 1991, 3 sites and 2 birds were noted. On 5 May 1994, 3 sites and 6 birds were counted (H.R. Carter, unpubl. data). On 8 May 2003, 2 nests (each with 3 eggs) and 6-7 other pairs of adults on possible territories without nests were found at the edge of the terrace overlooking Cardwell Beach, along the north side of the end of the Cardwell Point Trail (C. Drost, unpubl. data). Gulls have not been noted previously to nest in this area by island rangers and researchers. This area occurs near the south end of the Bay Point Area colony but may be located farther inland than areas visible from a boat. In 2007, 34 nests and 52 birds were counted on 22 May (Figure 1-9a). Increasing numbers of breeding birds are evident since 1991. Breeding prior to 1991 may have gone undetected or was not reported.

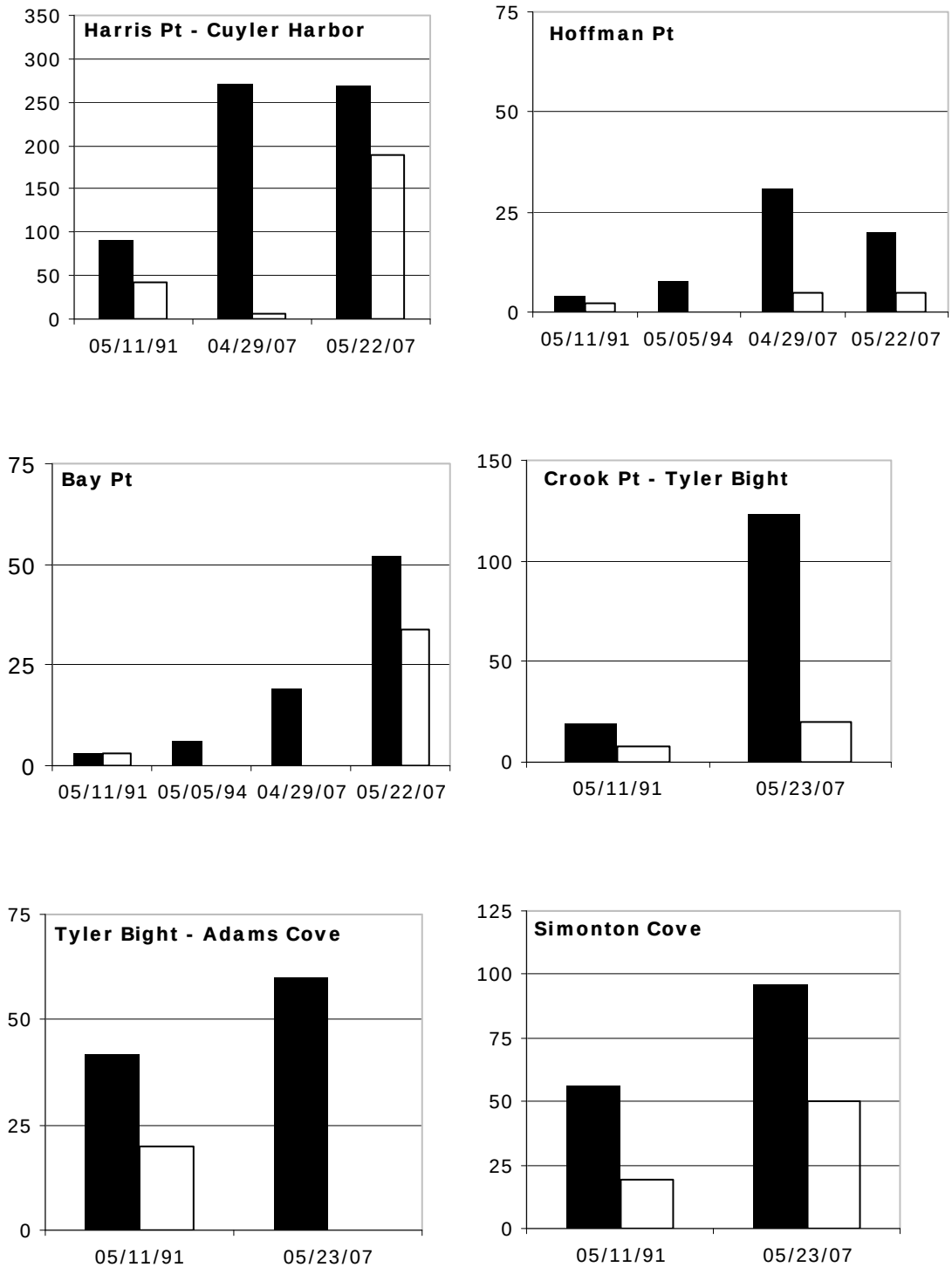


Figure 1-9a. Number of Western Gull individuals (solid bars) and nests (open bars) counted during boat surveys at San Miguel Island breeding colonies in 1991, 1994, and 2007.

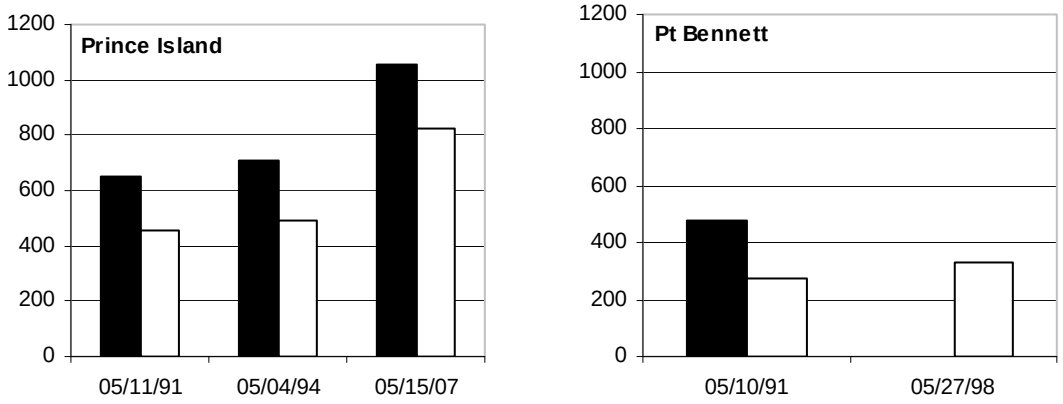


Figure 1-9b. Number of Western Gull individuals (solid bars) and nests (open bars) counted during boat, aerial, and ground surveys at San Miguel Island breeding colonies in 1991, 1994, 1998, and 2007. For Prince Island, numbers of nests were estimated from numbers of birds counted (see text).

Prince Island: In 1975, 1976, and 1977, 600, 500, and 480 breeding pairs were estimated, respectively. In 1991, 916 breeding birds or 458 nests were estimated, based on a count of 654 birds in nesting areas (excluding 22 roosting birds) on the 11 May boat survey adjusted with a K correction factor (1.4; see Carter et al. 1992; Figure 1-9b). On 5 May 1994, 606 attended sites (i.e., birds in incubation posture or standing) in nesting areas and 705 birds were counted during a boat survey between 08:26 and 09:36 h (H.R. Carter, unpubl. data). If a nest was assumed for each attended site noted, 1,212 breeding birds or 606 nests were estimated. Using the same K correction factor of 1.4, about 987 breeding birds were estimated. Given difficulty of counting sites and possible undercounting of birds on the top of the island, we believe that the estimate of 987 breeding birds is most reliable and consistent with data collection methods from other years. Increase between 1991 and 1994 could not be detected. In 2007, we did not conduct any boat-based surveys of this colony but an aerial photographic survey was conducted on 15 May with incomplete counts for the top of the island of 1058 birds and 671 nests or sites (Capitolo et al. 2008b). Between 1,500 and 1,800 breeding birds (750-900 nests) were estimated, and an increase of at least 35% was assessed between 1991 and 2007 by roughly accounting for differences between survey methods. An increase in nesting numbers was evident between 1977 and 2007.

Castle Rock: In 1976, 50 breeding pairs or 25 nests were estimated. In 1991, 52 nests, 11 sites, and 151 birds were counted on the 8 May boat survey. In 2007, we did not survey this colony by boat because of concern about disturbance to Brandt's Cormorants and no aerial survey was conducted. An increase in nesting numbers was not evident between 1976 and 1991.

Richardson Rock: Nesting was not reported in 1975-77 or 1991, although 35 birds were noted on the 11 May 1991 boat survey. In 2007, 1 nest and 8 birds were noted. Earlier breeding by small numbers may have gone undetected or been sporadic.

Simonton Cove: Nesting was not reported in 1975-77 but 19 nests and 56 birds were noted in 1991. In 2007, 36 nests, 14 sites, and 96 birds were counted on 23 May (Figure 1-9a). In the Otter Harbor area (SC 3), gull nests were first reported by CINP personnel in 2000 (after the island fox population crash) and 3-6 nests have been noted each year from 2000-07 (D. Richards, pers. comm.). Increased numbers of nesting birds are evident, at least between 1991 and 2007. Earlier breeding by small numbers may have gone undetected.

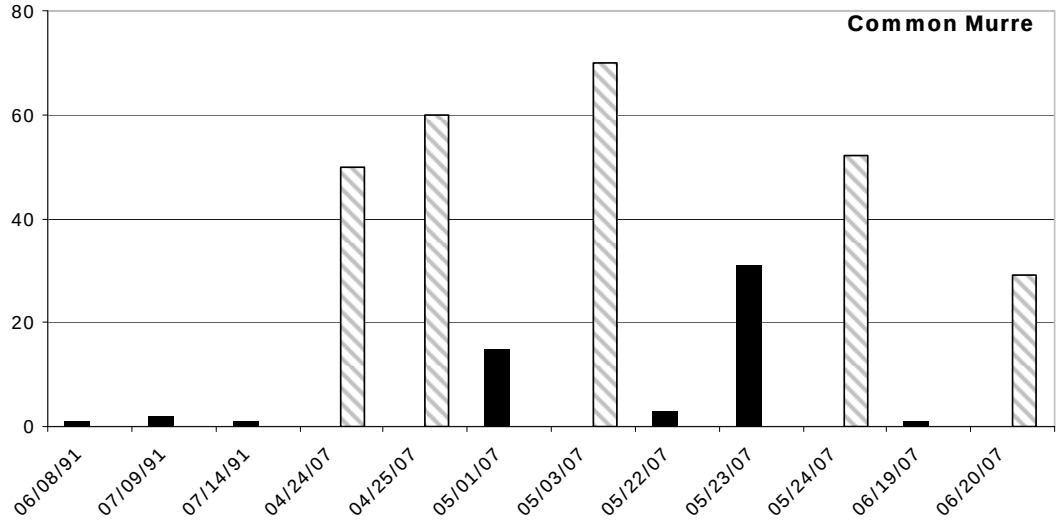
Point Bennett: In 1977, 25 nests were reported. In 1991, 277 nests, 42 sites, and 476 birds were counted on the 10 May ground survey (Figure 1-9b). On 27 May 1998, 333 nests were counted (Hebshi and Sydeman 1999). In 2007, we did not survey this colony and no aerial survey was conducted. R. DeLong (pers. comm.) noted that the nesting gull population has an expanded distribution and increased numbers over the past decade. A relatively large increase in nesting numbers occurred between 1977 and 1991 and a continued increase is likely from 1991 to 2007.

Crook Point-Tyler Bight: Nesting was not reported in 1975-77 but 2 nests, 6 sites, and 19 birds were counted on the 11 May 1991 boat survey. In 2007, 20 nests and 123 birds were noted, although many nests may not have been visible from the boat (Figure 1-9a). An increase in nesting numbers was likely between 1991 and 2007 and may expand further in association with increased nesting by Brandt's Cormorants.

Tyler Bight-Adams Cove: Nesting was not reported in 1975-77 but 5 nests, 20 sites, and 42 birds were counted on the 11 May 1991 boat survey. In 2007, 60 birds and no nests were noted on 23 May, although nests may not have been visible from the boat (Figure 1-9a). Little change in nesting numbers was evident between 1991 and 2007.

Common Murre

Prince Island: In 1975-77, Common Murres did not breed at Prince Island. Prior breeding had been recorded between 1885 and 1912 (Hunt et al. 1979, 1980; Carter et al. 2001). A single individual was noted flying by the cliffs on 22 May 1976 and an oiled bird was seen on intertidal rocks in 1977. In 1991, birds were noted on 8 June (n = 1), 9 July (n = 2), and 14 July (n = 1). On 15 July 1993, 1 bird was seen at Prince Island (P. Martin, unpubl. data). On 7 August 1994, 1 bird, possibly oiled on breast, was seen on the water off the north cliffs (H.R. Carter, unpubl. data). On 18 March 1998, 1 bird was observed off the southeast end (P. Martin, A. Hebshi, and W.J. Sydeman, unpubl. data). Greater numbers of attending birds first were noted in 1999, when 3-9 birds were observed on the north cliffs in March-July (Carter et al. 2001; A. Hebshi and W.J. Sydeman, unpubl. data). In May 1999, murres were not attending potential breeding sites at the north cliffs (A. Hebshi and W.J. Sydeman, unpubl. data). In 2004 at least 10 birds were observed roosting



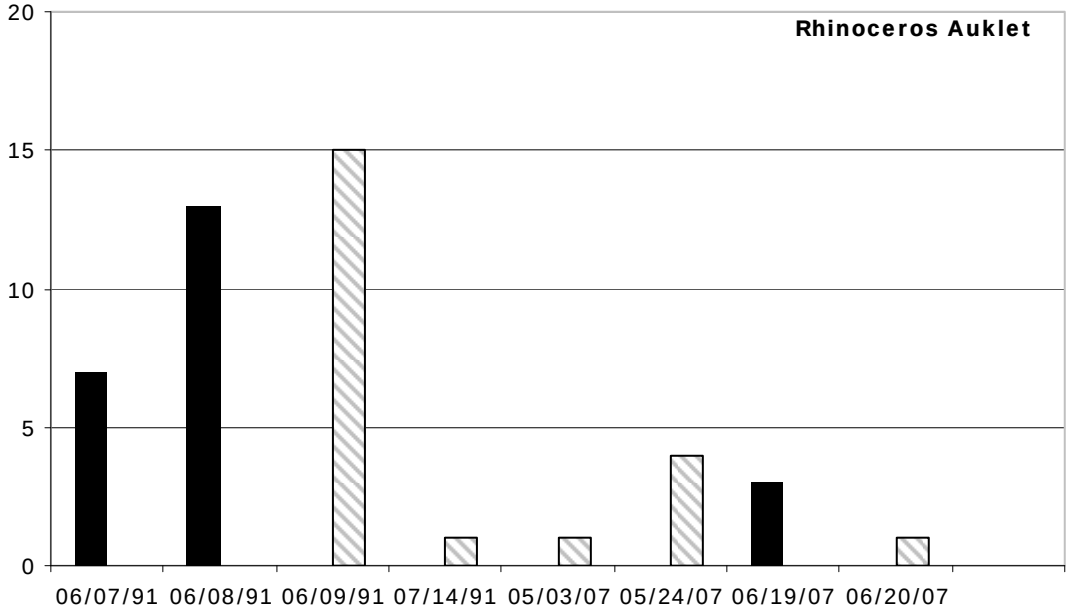


Figure 1-10. Numbers of Common Murres and Rhinoceros Auklets counted during boat surveys at Prince Island in 1991 and 2007. Striped bars indicate early morning counts (see text for details).

Figure 1-11. North Cliffs area, Prince Island, 25 April 2007 (Photo by Percy Hébert). A flock of 5-6 Common Murres can be seen flying by a section of the lower cliffs. Murres frequently circled close to or sat on the water off this section of cliffs (in sunlight in center of photograph) where 10-15 murres were observed standing on the rocks in apparent non-breeding habitat on 1 May 2007. In right center, the dark entrance to a cave is visible where past murre nesting may have occurred. This cave was explored on 8 June 1991 (Carter et al. 1992, unpubl. data). Suitable murre breeding habitat was found on the level entrance floor. Farther inside the accessible front portion of the cave, 5 Ashy Storm-Petrel and 7 Pigeon Guillemot nests were found, 1 Cassin's Auklet was heard vocalizing, and 1 Rhinoceros Auklet attempted to land during the cave search.

on ledges on the north cliffs on 21 May (09:00 h), although none were seen there on 29 March (16:26 h) or 26 May (14:00 h; D. Whitworth, unpubl. data).

In 2007, a high count of 70 birds was obtained on 3 May and the 4 highest counts (> 40 birds) occurred in the early morning (Figure 1-10). During nest searches on 24 April at 08:30 h, 50 murres were noted circling by the NW end of the island (see Chapter 2). Increased numbers of murres were attending Prince Island in 2007 compared with the 1975-1999 period. All 2007 observations at Prince Island were made along the north cliffs (Figure 1-11) and all birds were in breeding plumage. In the center of these cliffs, 10-15

birds were observed on land less than 40 m above the water on 1 May at 11:24 h. Murres also have been observed attending this same part of the cliffs in recent years (J. Adams, unpubl. data). Little or no breeding habitat (i.e., suitable breeding ledges) was evident on this small section of cliff. All other observations were associated with this section of cliffs, including birds sitting on the water in tight flocks within 300 m of these cliffs or groups of birds conducting wide circles up to these cliffs (without landing) and back out to sea, 200-300 m from shore. On 20 June, several early morning visits were made to Prince Island to observe murres. At 06:54-07:00 h, 5 birds were noted on the water. At 07:02-07:06 h, 17 birds circled by the cliffs in groups of 5, 5, and 7 birds. Apparently, these birds had just arrived at the colony. At 07:21-07:23 h, we returned to find 17 birds on the water within 5 m of shore below the cliffs and another 12 birds circling by the cliffs. At 08:06-08:19 h, we returned to find 21 birds on the water at the base of the cliff and another 5 birds on the water about 100 m offshore. These observations suggested that murres arrived at the colony in the early morning but then began to leave in late morning, producing lower counts later in the day. Murres did not appear to remain on or near cliffs overnight.

Harris Point-Cuyler Harbor: In 1975-77 and 1991, no murres were observed at this colony. In 2007, murres were observed as follows: a) 3 murres flying SE towards Prince Island off SC 3 at 11:55 h on 19 June; c) 1 weak but not visibly oiled murre on the intertidal rocks at SC 5 at 12:30 h on 19 June; and c) 1 murre flying NW off SC 4 at 07:47-07:53 h on 20 June. Most murres, probably from Prince Island, appeared to be passing by this colony to forage off the north side of SMI proper. No evidence of breeding behavior was found. On 24 April, 1 murre flew by the *Shearwater* anchored in Cuyler Harbor at 06:30 h.

Pigeon Guillemot

Prince Island: In 1976, 150 breeding pairs were estimated, with a high count of 656 birds on 22 May and an average of 368 birds in May-June. In 1991, a high count of 238 birds was obtained on 11 May. On 8 April 1994, 379 birds were counted around the island, with 370 off the north cliffs at 08:16 h (H.R. Carter, unpubl. data). On 11 April 1994, 229 birds were counted around the island, with 225 off the north cliffs at 07:49 h (H.R. Carter, unpubl. data). On 12 April 1994, 338 birds were counted around the island, with 328 off the north cliffs (H.R. Carter, unpubl. data). On 5 May 1994, 247 birds were counted around the island, with 223 off the north cliffs (H.R. Carter, unpubl. data). Between 6 June and 21 July 1998, large numbers of birds (200-350) were observed rafting in the lee of the island at sundown (Hebshi and Sydeman 1999). A high count of 500 birds on 12 July included birds flying in after sunset until darkness prevented counts. On the morning of 16 April 1999, a high count of 400 birds was obtained on the water off the north cliffs; and, on 8 and 15 July 1999, high counts of 800 birds were obtained off the southeast end at dusk, although birds from other colonies also may have been involved in July (A. Hebshi and W.J. Sydeman, unpubl. data). On 21 May 2004 at about 09:00 h, 200+ birds were estimated during an incomplete survey of the waters and cliffs along the north side (D. Whitworth, unpubl. data). In 2007, a high count of 364 birds was obtained on 24 May and

highest counts occurred in early morning (Figure 1-12a). Given seasonal and diurnal variability in counts, little change in numbers was evident between 1976 and 2007.

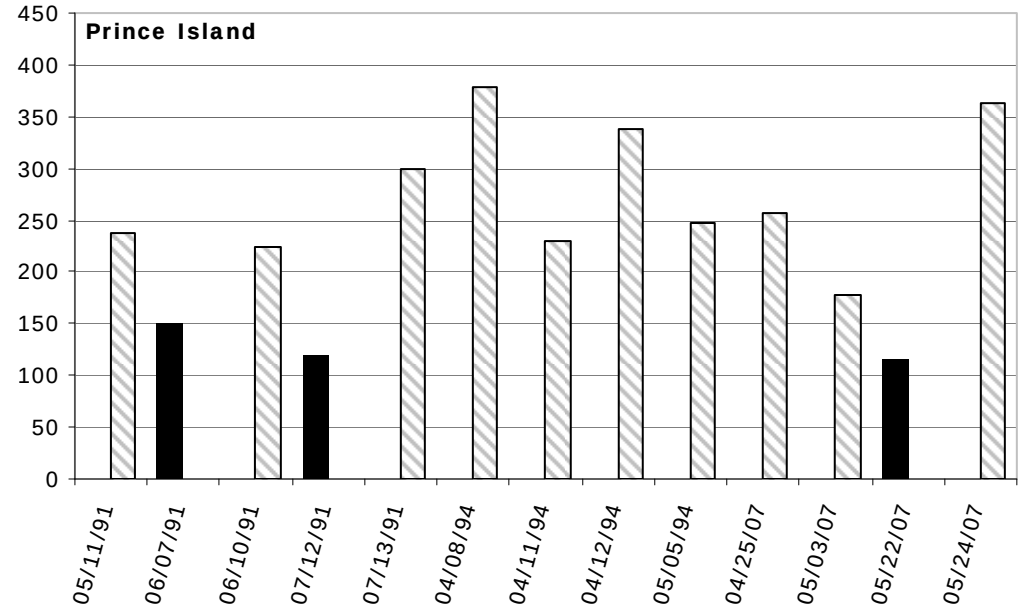
Harris Point-Cuyler Harbor: In 1976, 140 breeding pairs were estimated, apparently based on an average count of 166-170 birds in May-June. In 1991, a high count of 176 birds was obtained on 12 July. On 11 April 1994 (07:14-09:06 h), 233 birds were counted (H.R. Carter, unpubl. data). On 5 May 1994 (08:31-10:05 h), 313 birds were counted (H.R. Carter, unpubl. data). In 2007, the same high count of 203 birds was obtained on 24 April and 24 May in early morning (Figure 1-12a). Little change in numbers was evident between 1976 and 2007.

Hoffman Point Area: Nesting was not reported in 1975-77 but 14 birds were counted in 1991. On 12 April 1994 (08:11 h), 63 birds were counted (H.R. Carter, unpubl. data). On 5 May 1994 (09:44-10:00 h), 88 birds were counted (H.R. Carter, unpubl. data). In 2007, a high count of 39 birds was obtained on 24 April and 1 pair was observed copulating at SC 5 at 08:11 h (Figure 1-12b). On 23 May at 10:01-10:06 h, another pair was observed copulating at SC 4, with 1 member in partial alternate plumage. During nest searches on 24 April, 1 adult was flushed from a large horizontal crevice at SC 2 but a nest was not found (see Chapter 2). Little change in nesting numbers was evident between 1991 and 2007. A lack of counts from 1976 may reflect lumping of counts into the Bay Point Area count (see Bay Point).

Bay Point Area: In 1976, 60 breeding pairs were estimated, apparently based on an average count of 70 birds between Cuyler Harbor and Cardwell Point in May-June. Most birds apparently were observed near Bay Point, but it is not clear if all birds were found within the current boundaries of this colony (see Figure 1-1; Appendix 3). It is likely that some birds were included from the Hoffman Point Area colony. In 1991, only 9 birds were counted on the 11 May boat survey. In 1994, 44 birds were counted on 12 April (08:23 h) and 29 birds were counted on 5 May 1994 (10:01-10:17 h; H.R. Carter, unpubl. data). In addition, 5-6 grey buckets and a blue tarp were noted at the base of the cliff on 5 May, indicating researcher presence since 12 April. In 2007, a high count of 20 birds was noted on 24 April (Figure 1-12b). Assuming 1976 numbers were not directly comparable and given seasonal and diurnal variability in counts, little change in nesting numbers was evident between 1991 and 2007.

Castle Rock: In 1976, 100 breeding pairs were estimated, based on an average count of 86 birds in May-June. In 1991, a high count of 102 birds was noted on the 11 May boat survey. In 2007, 97 birds were counted in early morning on 23 May (Figure 1-12b). Little change in nesting numbers was evident between 1976 and 2007.

Richardson Rock: Nesting was not reported in 1975-77 but 9 birds were counted on the 11 May 1991 boat survey. In 2007, 8 birds were noted during the 23 May boat survey (Figure 1-12b). Little change in nesting numbers was evident between 1991 and 2007. Earlier presence of birds may have gone undetected.



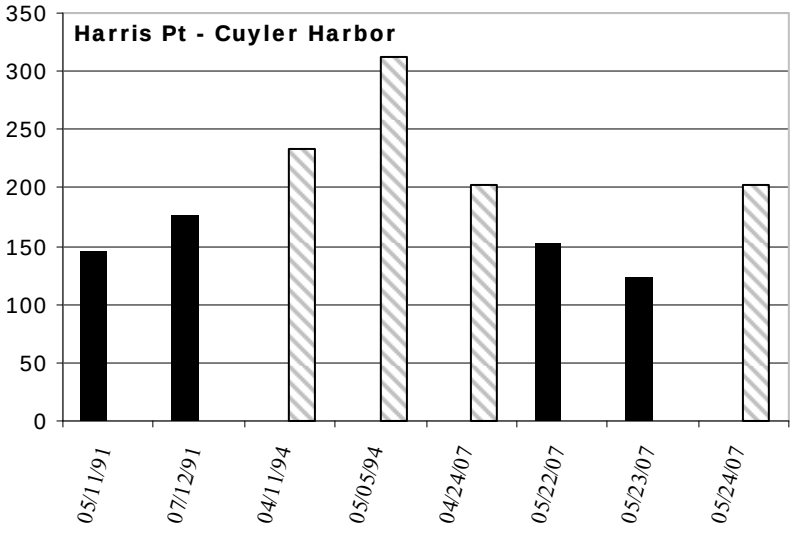


Figure 1-12a. Number of Pigeon Guillemots counted during boat surveys at San Miguel Island breeding colonies in 1991, 1994, and 2007. Striped bars indicate early morning counts (see text for details).

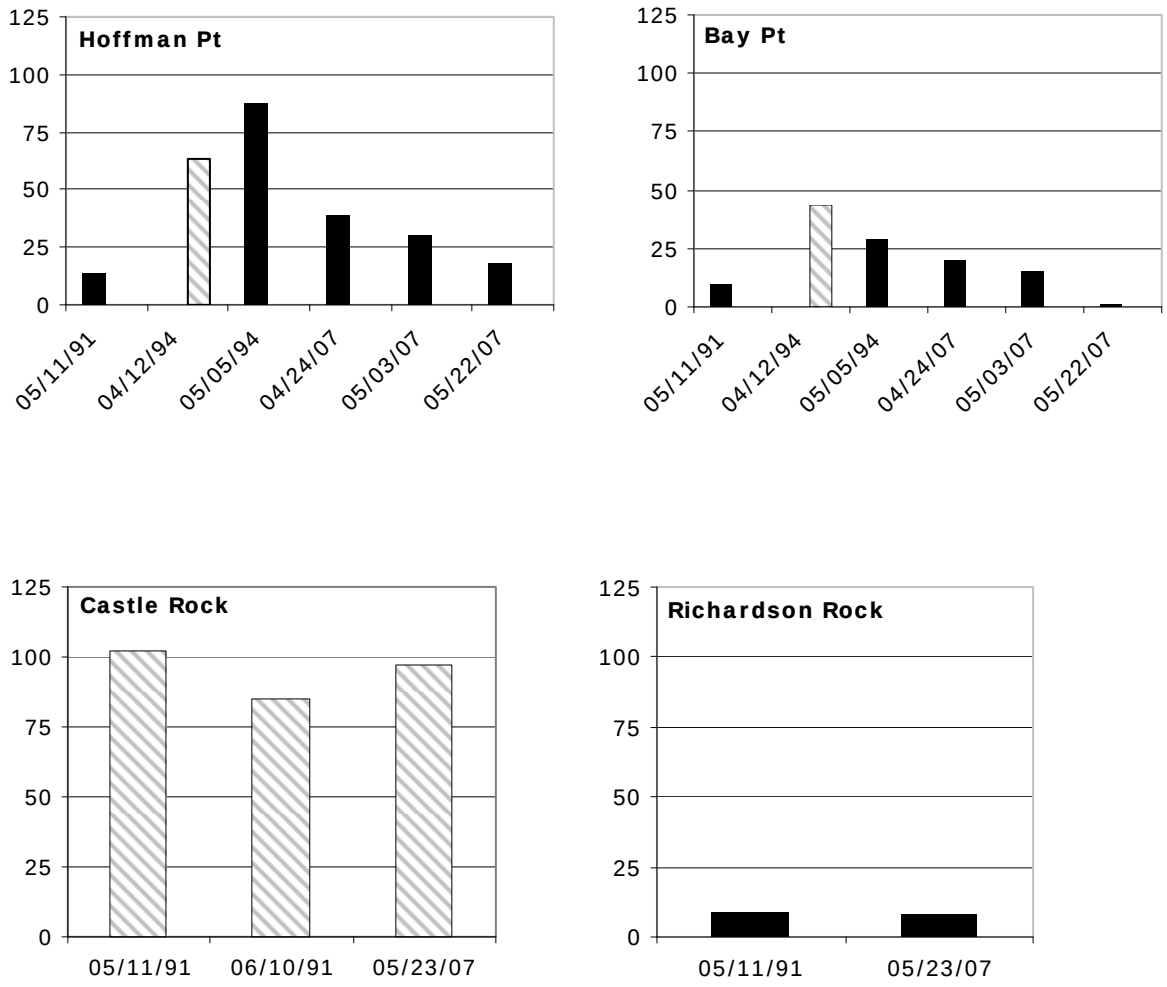


Figure 1-12b. Number of Pigeon Guillemots counted during boat surveys at San Miguel Island breeding colonies in 1991, 1994, and 2007. Striped bars indicate early morning counts (see text for details).

Xantus's Murrelet

See Chapter 2.

Cassin's Auklet

Prince Island: In 1975 and 1976-77, 9,600 and 10,200 breeding pairs were estimated, respectively, using a quadrat method to determine burrow densities for extrapolation based on estimated colony area. However, raw data were not provided to better describe the method of extrapolation or method of determining colony area. In 1991, 8,922 breeding birds were estimated, based on a total count of potential nest sites, with a rough correction factor for burrow occupancy. No other estimates of population size at Prince Island have been attempted but we have included further details of potential conservation issues, colony presence, and nest monitoring. On 22 May 1999 at 02:40 h, a Titan IV missile launched from Vandenberg Air Force Base traveled over SMI proper on a dark night (no moon and overcast) with seabirds (murrelets, auklets, and storm-petrels) vocalizing in full chorus (A. Hebshi and W.J. Sydeman, unpubl. data). The missile emitted enough light to mimic the first stages of dawn and the sonic boom hit the island like a loud firecracker. The seabird chorus stopped for 2-3 seconds and then quickly resumed at full throttle. On 10-11 January 2000, the CDFG vessel *Yellowtail* was anchored off the southeast end at night and numerous auklets landed on the boat which had 1 floodlight illuminating the deck (P. Martin and J. Adams, unpubl. data). During 2004 spotlight surveys for Xantus's Murrelets (see Chapter 2), single Cassin's Auklets were observed off the northwest and southeast sides of the island on the night of 26-27 May but none were seen on the night of 29-30 March (Whitworth et al. 2005a; unpubl. data). On 24 April 2007, no signs of active auklet nests were found during a nest search on the east side of the island (see Chapter 2). Birds seen on the water included: a) 1 bird during a spotlight survey on the night of 22-23 May between 01:13-01:38 h (see Chapter 2 for survey details); and b) 1 bird off the west side on 24 May at 07:49-07:52 h. Egg laying did not occur in monitored nest sites at Prince Island in 2006-07, although some sites were visited (J. Adams, unpubl. data). Trends cannot be determined with available data on population size but a decline has likely occurred based on nest monitoring (J. Adams, unpubl. data). Analysis of monitoring data for 50 artificial nest sites (established in 1986; Lewis et al. 1988) detected reduced occupancy of artificial nest sites in 1995-98 (Hebshi and Sydeman 1999). Occupancy increased from 1986 (36%) to 1991 (84%), was only slightly lower during intense El Niño conditions in 1992 (78%), and several artificial sites deteriorated over time which affected their re-use (Ingram 1992; Ingram and Carter 1997; J. Adams, unpubl. data). Reduced occupancy continued in 1999-2005, prior to lack of breeding in 2006-07 (J. Adams, unpubl. data). Collation and analysis of all nest monitoring data from 1986-2007 is needed to best assess trends.

Castle Rock: No evidence of active nesting was found in 1976-77. However, at least 1,000 breeding pairs were estimated for the 1976-77 period, apparently based on earlier estimates of 1,500 breeding pairs and 5,000 birds in 1968. In 1991, 2,614 breeding birds were estimated, based on counts of potential nest sites using a correction factor for burrow occupancy. In 2007, no surveys were conducted. On 23 May at 07:20 h, 1 bird was seen

on the water in kelp beds off the north side of the rock. Later on the same day (12:50-13:30 h), about 25 birds in small groups were observed within kelp beds off the east and west ends of the rock. Trends cannot be determined with available data.

Harris Point-Cuyler Harbor: No nesting or presence was noted in 1975-77 and no historical data were available from prior to 1975. In 1991, 26 breeding birds were estimated at Hare Rock (SC 10), based on 2 active nests, 2 other sites, and 17 potential nest sites. In winter 1993-94, possible auklet burrows were discovered far up steep slopes in this area, apparently near Bat Rock (SC 12-13), as reported by falcon researcher J. Gilardi (pers. comm. to H.R. Carter). In 1994, 1 active nest with 2 adults and an egg was found on 11 April at Hare Rock and 1 downy chick was found on 12 July (probably a different nest site); on 4 May 1995, no nests and faint odor were found there (H.R. Carter, unpubl. data). Much suitable nesting habitat occurs along this section of coast but most is not easily inaccessible. During 2004 spotlight surveys for Xantus's Murrelets (see Chapter 2), Cassin's Auklets were not observed on the nights of 29-30 March and 26-27 May (Whitworth et al. 2005a; unpubl. data). In 2007, nests were not found during nest searches at Hare Rock on 23 April and at other accessible areas within this colony (see Chapter 2). However, birds seen on the water included: a) 1 bird off SC 3 on 22 May at 10:12-10:19 h; b) 2 birds off SC 3 on 24 May at 06:40-06:43 h. During 2007 spotlight surveys for Xantus's Murrelets (see Chapter 2), Cassin's Auklets were not observed on the nights of 1-2 May, 2-3 May, and 22-23 May. Estimates of breeding birds have not been well determined and require more extensive surveys with climbing skills and equipment. Trends cannot be determined with available data.

Point Bennett: In 1977, 9-11 burrows and one egg were found but no estimate was determined. In 1991, 20 breeding birds were estimated, based on potential nest sites adjusted with a correction factor for occupancy. Counts of potential nest sites and evidence of nesting activity are difficult to obtain in this area due to large numbers of marine mammals. In 2007, R. DeLong (pers. comm.) noted 2 burrows on Cormorant Rock and at least 5-10 burrows on Point Bennett. Trends cannot be determined with available data.

Other 2007 observations: On 23 May at 07:11 h, 5 birds were seen on the water outside of kelp beds off Simonton Cove.

Rhinoceros Auklet

Prince Island: Nesting was not reported in 1975-77 and presence at this colony probably was not overlooked, given the extent of surveys during that period. However, presence prior to 1975 could have been overlooked. From 1986-90, birds were seen on the water near Prince Island (Ingram and Carter 1997). On 7-9 June 1991, 7-15 birds (Figure 1-10) were observed landing at the north cliffs area, standing by potential crevice sites, and conducting courtship displays, but no nests were found. On 9 June 1991, a maximum of 15 birds in breeding plumage was counted. On 6 May 1992, two birds in breeding plumage were noted (Ingram and Carter 1997). On 15 July 1993, no birds were seen (P. Martin, unpubl. data). In 1994, single birds also were observed landing and departing from

the north cliffs (McChesney et al. 1995). On 12 July 1998, 14 birds were observed rafting in the lee of the island at sundown, although no birds were seen on the evenings of 19 and 21 July and none were observed carrying fish (Hebshi and Sydeman 1999). On 21 May 1999, a high dusk count of 9 birds off the southeast end was obtained (A. Hebshi and W.J. Sydeman, unpubl. data). On 10-11 January 2000, 1 bird in non-breeding plumage was seen off the southeast side (P. Martin and J. Adams, unpubl. data). In 2004, none were noted during the day along the north cliffs on 29 March (16:26 h), 21 May (09:00 h), or 26 May (14:00 h), and none were observed during spotlight surveys on the nights of 29-30 March and 26-27 May (Whitworth et al. 2005a; unpubl. data). In 2007, a maximum of 4 birds was noted on 24 May during boat surveys; all were in breeding plumage sitting on the water off the north side. However, on 24 April 2007, 8 birds were observed rafting with Pigeon Guillemots at 19:05 h off the southeast side (J. Adams, unpubl. data). Typically, 4-8 birds have been seen in this evening rafting area during seabird studies in 1999 to 2007 but none were observed holding fish (J. Adams, unpubl. data). One bird in breeding plumage also was seen off the north side during a spotlight survey around the island on the night of 22-23 May between 01:13- 01:38 h but none were seen during spotlight surveys on 1-2 and 2-3 May (see Chapter 2 for survey details). Despite apparent colonization between 1977 and 1991, little difference in numbers was evident between 1991-94 and 2007. In 2007, breeding may have been delayed or did not occur, given a lack of evidence of birds on land in April-June.

Harris Point-Cuyler Harbor: Nesting was not reported in 1975-77 and presence at this colony in 1975-77 probably was not overlooked, given the extent of surveys during that period. Three birds were first counted on the water off SC 4 on the afternoon of 12 July 1991. No nests were located in 1991 but 1 nest with an adult in incubation posture was found at SC 4 on 13 July 1994 (Figure 1-13; McChesney et al. 1995). A maximum of 7 birds in breeding plumage also was recorded in 1994, with birds observed on land, landing, in crevices, and carrying fish. During a night-time boat survey on 23 May 1999, 2 birds were seen on land in front of a crevice located in a cove north of the NPS intertidal monitoring site (probably SC 4; A. Hebshi and W.J. Sydeman, unpubl. data). On 9 July 1999 at 20:12 h (about 5 minutes before sunset), 15-20 fish-carrying birds were observed flying into narrow sea caves at the far north end of "Intertidal-site Cove" (probably SC4). Dozens more birds were observed on the water off this area and others were observed flying west towards Harris Point (SC 3). On 29 March 2004 (15:20-15:25 h), none were noted off SC 4 and this area was not visited during the day in May; during spotlight surveys, none were observed on the nights of 29-30 March and 26-27 May (Whitworth et al. 2005a; unpubl. data). In 2007, no nests were found in the same nesting area used in 1994-95 in SC 4 during nest checks on 23 April and 1 May. However, a partly-mummified, severed head of a Rhinoceros Auklet was found at the entrance to the nesting area on 23 April. On 24 April, birds were observed on the water off SC 5 (n = 3), SC 6 (n = 1), and SC 7 (n = 1). Three birds off SC 5 were observed 200 m from the nearest shore and over 400 m from the known nesting area in SC 4, indicating that some birds sit on the water farther offshore and may not be counted during boat surveys if observers focus mainly on searching for birds on the water within 100 m of shore where most Pigeon Guillemots occur. On other dates in 2007, the only observations were: a) 1 bird on the water off SC 7 at 13:08-13:23 h on 23 April; and b) 1 bird in subadult plumage on the

Figure 1-13. Harris Point-Cuyler Harbor (SC 4), SMI proper, 23 April 2007 (Photo by Percy Hébert). A Rhinoceros Auklet nest was found in 1994 in a small cave at the far right end of the shadow area.

water off SC 13 at 07:18-07:21 h on 24 May. One bird also was seen near Harris Point during a spotlight survey on 2 May between 23:10-23:40 h but none were seen on spotlight surveys on the nights of 1-2 May and 22-23 May (see Chapter 2 for survey details). Despite apparent colonization between 1977 and 1991, little difference in numbers was evident between 1991-94 and 2007. Relatively high numbers noted in 1999 may reflect the July evening timing of observations (when larger numbers can be present) and possibly some misidentification of birds at a distance. In 2007, breeding did not seem to occur, given no evidence of birds on land in April-June and only 1 observation after April.

Castle Rock: Nesting was not reported in 1975-77 but 1 bird was observed flying about 500 m NE of the rock between 0818-0840 h on 10 June 1991. In 2007, no birds were seen on the 23 May boat survey. Definitive evidence of nesting has not been obtained.

Bay Point Area: Nesting was not reported in 1975-77 or 1991. In 2007, 1 bird was observed on the water off SC 1 at 10:19 h on 24 April. Little if any nesting habitat is available at this subcolony. Definitive evidence of nesting has not been obtained.

Other 2007 Observations: On 24 April at 08:20 h, 1 bird in breeding plumage was noted near reefs between Cuyler Harbor and Prince Island.

Tufted Puffin

Prince Island: In 1975-77, Tufted Puffins did not breed at Prince Island. Prior breeding had occurred in the late 1800s and early 1900s, last noted in 1912. In 1991, a maximum of 4 birds were observed at the north cliffs area on 8 and 10 June. During intense El Niño conditions, none were seen at nest site entrances but one bird in breeding plumage was noted flying near the island on 5 May 1992 (Ingram and Carter 1997) and none were noted on 15 July 1993 (P. Martin, unpubl. data). In 1994, a maximum of 3 birds was noted on 13 July (H.R. Carter, unpubl. data). Strong evidence of nesting was obtained in 1991 and 1994: a) at least 3 potential nest crevices were attended or entered; b) birds displayed and carried nesting material; and c) suspected Tufted Puffin eggshell fragments were observed in a crevice after the 1991 breeding season (Carter et al. 1992; McChesney et al. 1995). On 5 May 1995 at 08:12 h, 4 birds were seen on the north cliffs (H.R. Carter, unpubl. data). On 24 April 1996 at 08:53 h, 1 bird was seen on the north cliffs (H.R. Carter, unpubl. data). On 16-17 April 1997 and in May 1997, 1 bird in breeding plumage was noted outside the same crevice on the north cliffs; this bird was not seen on 14 July 1997 (P. Martin, unpubl. data; McChesney and Carter 2008). In 1998, none were seen (Hebshi and Sydeman 1999). In 1999, none were seen on checks of the north cliffs in March-May (H.R. Carter, A. Hebshi, and W.J. Sydeman, unpubl. data). In 2004, none were noted on 29 March (16:26 h), 21 May (09:00 h), or 26 May (14:00 h; D. Whitworth, unpubl. data). In 2007, no birds were observed in April-June. Tufted Puffins appear to no longer breed at Prince Island, although small numbers may again recolonize under better conditions.

On 24 May 2007 at 07:52-08:09 h, a subadult Horned Puffin (*F. corniculata*) was observed on the water off the north cliffs. The smaller body size, white underparts, pale brown back, white patch on the side of the head, and highly curved, dark orange bill were quite distinguishable from subadult Tufted Puffins. Several Horned Puffins also were reported along the central California coast in spring 2007 (J. Adams, unpubl. data).

DISCUSSION

Population Sizes and Trends

Population sizes and trends of breeding seabirds are summarized for each species in the SMI group in 1975-77, 1991, and 2007 (Table 1-1; Figure 1-14a,b). Below, we briefly summarize available information on trends and anthropogenic impacts for all breeding seabird species at the SMI group. We limited discussion of certain anthropogenic impacts for several reasons: a) possible effects of prey changes are difficult to interpret with available data for most seabird species; b) increases in nesting and non-nesting avian predators have occurred since the 1970s, particularly the Peregrine Falcon (at least 6 nesting pairs in 2007 compared to none during the 1980s; Van Riper et al. 1988; B. Latta, unpubl. data; Appendix 1) and Barn Owl (*Tyto alba*; in November 2001, a count of 29 Barn Owls on eastern SMI proper was 3 times higher than any previous count [C. Drost, pers. comm.]). This increase in known predators almost certainly has led to increased seabird predation near colonies and at sea but more work is needed to assess populations of avian predators, the degree and type of increased predation, and any population effects; c) some anthropogenic impacts (e.g., oil spills) during the non-breeding season outside of Southern California are difficult to interpret because of imperfect knowledge of the degree of winter residency and areas where birds from the SMI group disperse to or winter; and d) immigration from other colonies or emigration to other colonies are difficult to assess because most birds are not banded or marked. To indicate the approximate importance of the SMI group for each species, we roughly estimated what proportion the SMI group constituted within the SCB population which included all breeding areas between Point Conception, California, and San Jeronimo Island, Baja California. The SCB area represents a geographical area exposed to similar oceanographic conditions at the southern end of the California Current, with greater seabird movements between colonies expected within the SCB. Joint management, conservation planning, monitoring, and research for seabirds by U.S., California, and Mexican agencies has been developing for the SCB (Kushlan et al. 2002, Burkett et al. 2003, Gress et al. 2005, USFWS 2005). Species accounts follow:

***Leach's Storm-Petrel*:** About 114 breeding birds have been estimated and trends are not known but more work is needed to collate and analyze mistnetting data at Prince Island from 1994-2007. Main anthropogenic factors affecting Leach's Storm-Petrels at the SMI group appear to be organochlorine pollution, loss of nesting habitats due to guano mining and bombing at Prince Island, and possibly increased plastic ingestion (Spear et al. 1995). Prevention of impacts from light pollution is important (see Ashy Storm-Petrel below). Breeding in the SMI group in 1991 roughly constituted between 20% and 30% of the SCB, assuming 200 breeding birds for northwestern Baja California (Everett and Anderson 2001, Carter et al. 1992, 2006).

***Ashy Storm-Petrel*:** In 1991, higher numbers were estimated than in 1975-77. This change likely reflected differences in estimation techniques. More work is needed to collate and analyze mistnetting data at Prince Island from 1994-2007. Main anthropogenic factors affecting Ashy Storm-Petrels at the SMI group appear to be organochlorine pollution,

predation by introduced rats on SMI proper, loss of nesting habitats due to guano mining and bombing at Prince Island, and possibly increased plastic ingestion (Spear et al. 1995). Prevention of impacts from light pollution is important. In the late 1990s, squid light boats (with lights on but without associated trawlers) were first noted on a few occasions in the Cuyler Harbor area (I. Williams, pers. comm.). On 17 June 1998, a squid light boat (with lights on from 20:00 to 21:15 h about 400 m east of the island) casted bright light onto island habitats (A. Hebshi and W.J. Sydeman, unpubl. data). On 28 August 2008, about 4 squid boats (with lights on during the day) were anchored in Cuyler Harbor (R. McMorran, unpubl. data). Since 1992, overall squid fishing has rarely occurred near the SMI group (Maxwell et al. 2004; I. Williams, pers. comm.). Prince Island is currently located in a marine reserve where squid fishing is not allowed. Future more intensive squid fishing just outside of marine reserves (especially near Prince Island and Castle Rock) could lead to heavy impacts on breeding seabirds, especially nocturnal storm-petrels and alcids. Efforts must be taken to prevent squid fishing and other bright lights from vessels near the SMI group in the future. In particular, boats should not anchor off the lee (south) side of Prince Island because even limited lighting can result in birds landing onboard. Breeding in the SMI group in 1991 roughly constitutes about 30% of the SCB population, assuming about 4,135 breeding birds in the Channel Islands (i.e., adding 1,000 breeding birds to 1991 estimates based on 1994-96 surveys; H.R. Carter, unpubl. data) and 500 breeding birds for northwestern Baja California (Everett and Anderson 2001, Carter et al. 1992, 2006, unpubl. data).

***Black Storm-Petrel*:** Breeding has not yet been determined and trends are not known but more work is needed to collate and analyze mistnetting data at Prince Island from 1994-2007 to best assess presence and absence. Prince Island is the northernmost location where Black Storm-Petrels have been recorded on land and may breed. If breeding occurred in 1991, it constituted <1% of the SCB population, assuming <20 breeding birds in the SMI group and about 1,000 breeding birds for northwestern Baja California (Everett and Anderson 2001, Carter et al. 1992, 2006).

***Brown Pelican*:** Breeding in 2006 (but not 2007) likely reflected continuing recovery of this species and regular breeding by small numbers may again occur in the future. In 2006, breeding occurred on the south end of the top of Prince Island (associated with Double-crested Cormorants) where they are not disturbed by boats. Main anthropogenic factors affecting pelicans at the SMI group appear to be organochlorine and oil pollution (mainly along mainland coasts away from colonies), past overfishing of key prey species, and human disturbance of the Prince Island colony (mainly in the past but little direct evidence available) and roosts in the SMI group and along mainland coasts. The SMI group was the north end of the current breeding range in 2006-07 but previous breeding occurred as far north as Bird Island (Point Lobos) in central California. Breeding in the SMI group in 2006 constituted <1% of the SCB population (Carter et al. 1992; Gress 1995; Gress et al. 2005; Anderson et al. 2007).

***Double-crested Cormorant*:** Numbers in 2006 were similar to 1991 (Figure 1-14a), but higher than in 1975-77. More work is needed to collate and analyze aerial survey data from 1991-2007. This colony appears to have stabilized at the current population size

(although fluctuations can occur during intense El Niño conditions) and birds currently nest in a traditional area on the south end of the top of Prince Island near cactus (*Opuntia* sp.) patches where they are not disturbed by boats. Main anthropogenic factors affecting Double-crested Cormorants at the SMI group appear to be organochlorine and oil pollution (mainly along mainland coasts away from colonies) and human disturbance of the Prince Island colony (mainly in the past but little direct evidence available) and roosts in the SMI group and along mainland coasts. Breeding in the SMI group in 1991 constituted about 10-20% of the SCB population, assuming about 2,000 breeding birds in northwestern Baja California (Carter et al. 1992, Gress et al. 2005).

***Brandt's Cormorant*:** Numbers of nests increased from 1975-77 to 1991 and then declined since 1991 (partly related to intense El Niño conditions in 1992-93 and 1998), although 2007 numbers appeared to have been affected by poor marine conditions (Capitolo et al. 2008a) and were not directly comparable to 1991 (Figure 1-14a). More work is needed to collate and analyze aerial survey data from 1991-2007. In addition, numbers in 1991 may have reflected unusually good conditions. El Niño conditions in 1992-93 and 1998 were related to reductions in population size (Carter et al. 1996a; unpubl. data). Unfortunately, aerial survey data were not collected between 1977 and 1991 to better assess population levels at this time. A major change in population size may have occurred with the long-term loss of the large Bay Point colony apparently due to human disturbance in 1992. This colony comprised 36% of estimated numbers in 1991 although prior nesting was not documented in 1975-77. Without more information, it is difficult to determine if: a) this colony formed by smaller numbers of birds and grew to a relatively large size over several years (after 1977 and prior to 1991); or b) highly unusual conditions in 1991 somehow promoted a single large-scale mass breeding event at this location. Given that 1991 oceanographic conditions were not highly unusual, colonies usually form with much smaller numbers of birds (than the 2,548 nests recorded at Bay Point in 1991), and no other large-scale mass breeding event has been documented at any other location in California, the former explanation is much more likely but we also cannot fully rule out the latter explanation. Numbers at Prince Island in 2006 were only slightly lower than 1991; substantial numbers continue to nest on coastal habitats near the southeast and northwest shorelines where they flush due to disturbance from boats that are over 100 m from shore (H.R. Carter, pers. obs.). Similarly, birds nesting on the east island at Castle Rock occur near the water and flush due to disturbance from boats at distances over 100 m. Numbers at Bay Point Area, Point Bennett, and Crook Point-Tyler Bight reflected human disturbance and possibly impacts from mammalian predators. Main anthropogenic factors affecting Brandt's Cormorants at the SMI group appear to be organochlorine and oil pollution (mainly at mainland locations away from colonies) and human disturbance of many SMI colonies (see above). Breeding in the SMI group in 1991 constituted roughly about 50% of the SCB population, assuming about 800 breeding birds for northwestern Baja California (Carter et al. 1992, Gress et al. 2005).

***Pelagic Cormorant*:** Numbers of nests were lower in 2007 than in 1991 at 2 colonies (Harris Point-Cuyler Harbor, Castle Rock) but were similar at other colonies in the SMI group (Figure 1-14a), likely reflecting poor marine conditions. Given relatively high annual variation (Boekelheide et al. 1990), large changes without unusual conditions are

required to indicate trends. Numbers appeared to increase between 1975-77 and 1991 and then decrease between 1991 and 2007. The main anthropogenic factor affecting Pelagic Cormorants at the SMI group appears to be human disturbance, but little direct evidence is available. Breeding in the SMI group in 1991 constituted roughly about 20% to 30% of the SCB population, assuming about 50 breeding birds for northwestern Baja California (Carter et al. 1992, Gress et al. 2005).

***Black Oystercatcher*:** In 1991 and 2007, numbers in the SMI group were similar, apparently showing little change (Figure 1-14a). Numbers in 1975-77 were not directly comparable but suggested similar numbers. The main anthropogenic factor affecting Black Oystercatchers in the SMI group appears to be human disturbance, but little direct evidence is available. Breeding in the SMI group in 1991 constituted roughly between 10% and 15% of the SCB population, assuming about 100 birds for northwestern Baja California (Carter et al. 1992, unpubl. data).

***Western Gull*:** In 2007, relatively large increases in nest numbers were noted since 1991 on SMI proper at Harris Point-Cuyler Harbor, Bay Point Area, Simonton Cove Area colonies, possibly related in part to island fox decline. From 1991 to 1998, numbers grew only slightly at Point Bennett (P. Martin, unpubl. data). Western Gulls also increased at Prince Island since 1975-77 and 1991, apparently reflecting continued colony recovery with increased prey resources at the SMI group (e.g., increased marine mammals) and along the mainland, and perhaps greater immigration from other large and increasing nearby colonies at Anacapa Island and Santa Barbara Island (Carter et al. 1992, Capitolo et al. 2008b). Main anthropogenic factors affecting Western Gulls at the SMI group appear to be human disturbance and enhanced prey resources from human sources in the SCB, but little direct evidence is available. Breeding in the SMI group in 1991 constituted roughly about 5% of the SCB population, assuming 10,000 breeding birds for northwestern Baja California (Everett and Anderson 1991; Carter et al. 1992, unpubl. data; Capitolo et al. 2008b).

***Common Murre*:** In 2007, increased numbers attended Prince Island (compared to 1975-77 and 1991; Figure 1-14b), and indicated substantial potential for recolonization and regular breeding in the future. Main anthropogenic factors affecting Common Murres at the SMI group appear to be historic egg collecting, past gill-net fishing mortality and oil pollution (especially north of Point Conception [Carter et al. 2001]), possible redistribution of northern anchovy, and low emigration from colonies in central California due to greatly reduced numbers in the past. Natural factors include low emigration from colonies in central California due to small breeding population size and population decline from the late 19th century to the 1960s (Carter et al. 2001). Past breeding at Prince Island (documented in 1885 to 1912) was the only known breeding in the SCB (Hunt et al. 1979, 1980; Carter et al. 1992, 2001).

Table 1-1. Estimates of seabird population sizes (in total breeding birds) and trends at the SMI group in 1975-77, 1991 and 2005-07. Codes: ND, no data available; P, presence; +, incomplete estimate). Although not documented to breed in these years, Black Storm-Petrel and Common Murre also are included as potential breeding species.

Species	Estimation Method	1975-77	1991	2005-07	Trend (1975-1991)	Trend (1991- 2007)
Leach's Storm-Petrel	Mistnet	4+	114	P	Unknown (few present)	Unknown
Ashy Storm-Petrel	Mistnet/ Site Count	400	1,354	P	Unknown	Unknown
Black Storm-Petrel	Mistnet	0	P[2]	0	Unknown (few present)	Unknown
Brown Pelican	Nest Count	0	0	204[2]	Not Breeding (roosting)	Breeding (recolonized 2006)
Double-crested[3] Cormorant	Nest Count	150	460[5]	322	Increase	Stable
Brandt's Cormorant[3]	Nest Count	2,632	14,314[5]	3,296	Increase or Stable	Decrease or Stable
Pelagic Cormorant	Nest/Site Count	320	586[5]	260	Increase or Stable	Decrease or Stable
Black Oystercatcher	Bird Count	60	55	48	Stable	Stable
Western Gull[3,4]	Nest/Site Count	1,182	1,892[5]	2,770-3,070	Increase	Increase
Common Murre	Bird Count	1	2	70	Not Breeding (few present)	Not Breeding (increase)
Pigeon Guillemot	Bird Count	900	583[5]	731	Stable	Stable
Xantus's Murrelet	Bird Count	150	100-600	20-100	Unknown	Decrease (few present)
Cassin's Auklet	Site Count	21,800	11,582	P	Decrease	Decrease
Rhinoceros Auklet	Bird Count	0	19	10	Colonized (few present)	Stable (few present)
Tufted Puffin	Bird Count	0	4[5]	0	Recolonized (few present)	Abandoned 1998
Total		27,599	31,315	ND		

[1] Presence noted in 1991 but breeding not certain and no estimate available.
[2] Nesting in 2006 only; no nesting otherwise since the 1960s.
[3] Average counts were used for 1975-77 and 2005-07 colony estimates when possible.
[4] Incomplete count for 2007 but included 1991 value for Castle Rock and 1998 value for Point Bennett.
[5] Estimates reflect raw counts and differ from corrected values in Carter et al. (1992).

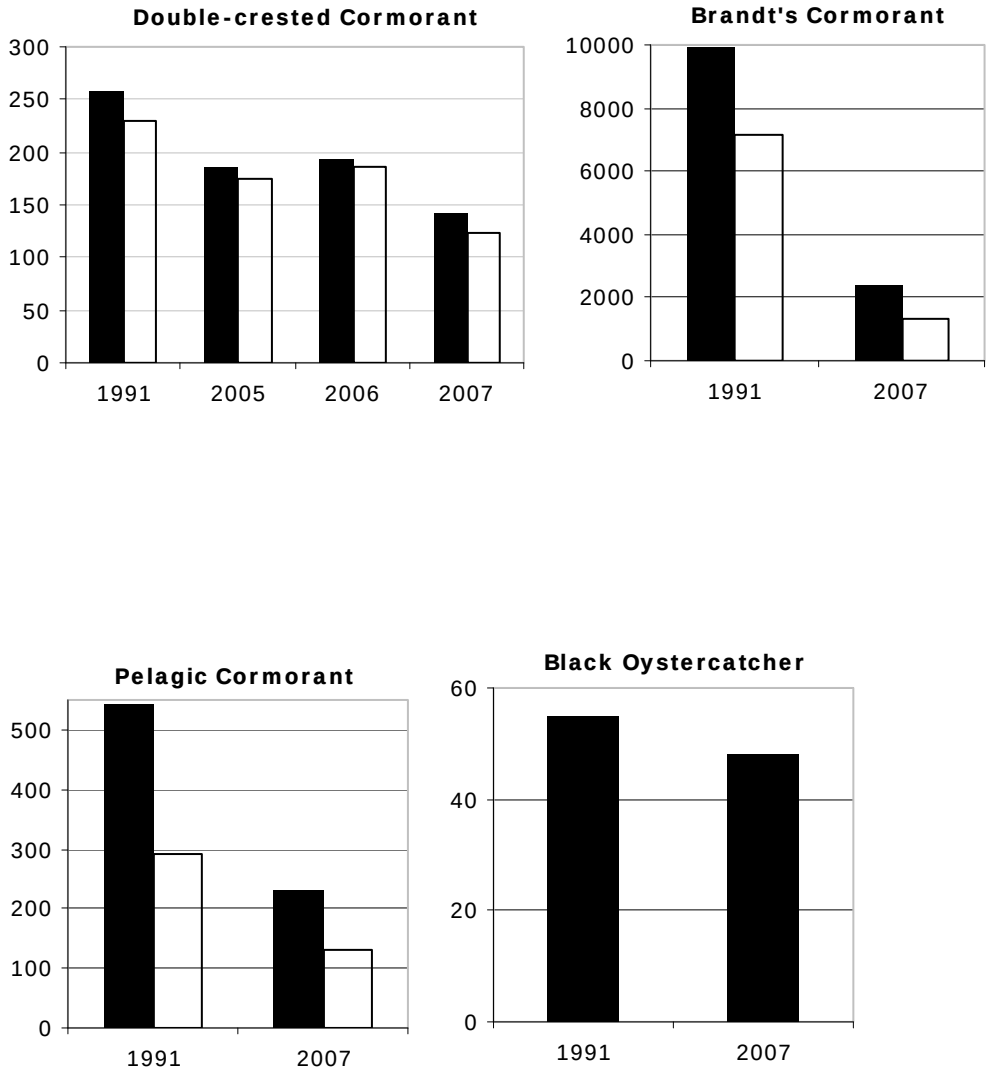


Figure 1-14a. Comparison of total counts of cormorants and oystercatchers at San Miguel Island in 1991 and 2005-07. For Black Oystercatchers, Point Bennett is excluded for 1991 as no data were available for 2007. Less comparable data for 1975-77 are not included.

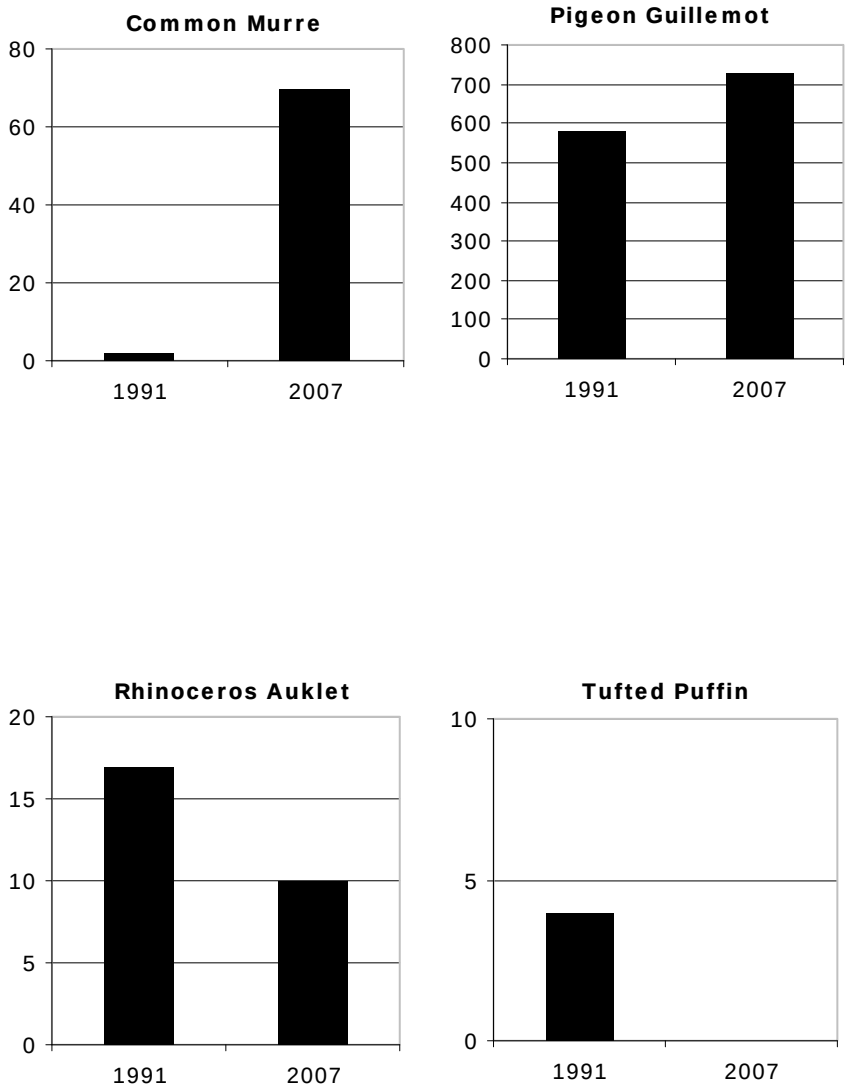


Figure 1-14b. Comparison of total counts of four species of alcid at San Miguel Island in 1991 and 2007. Less comparable data for 1975-77 are not included.

***Pigeon Guillemot*:** In 1991 and 2007, numbers in the SMI group were similar (Figure 1-14b), apparently showing little change. Numbers in 1975-77 were not directly comparable but still suggested similar numbers. No major anthropogenic factors appear to be affecting Pigeon Guillemots at the SMI group. Carcasses of guillemots have been recorded from fox dens on SMI proper (Hunt et al. 1980). Breeding in the SMI group in 1991 constituted roughly between 30% and 40% of the SCB population (Carter et al. 1992). None breed in northwestern Baja California.

Xantus's Murrelet: In 1991-96, 50-300 breeding pairs were estimated. While higher than numbers estimated in 1975-77, estimates were not directly comparable. In 2007, only 20-100 breeding birds were estimated. While numbers are again not directly comparable, a decline is suspected (see Chapter 2 for more details). The main anthropogenic factors affecting Xantus's Murrelets at the SMI group appear to be black rats, increased avian predation, loss of nesting habitats due to guano mining and bombing at Prince Island, possible prey changes, and other at-sea impacts. Prevention of impacts from rats and light pollution is important (see Ashy Storm-Petrel above). Breeding in the SMI group in 1991-2007 constituted <1% of the SCB population (Carter et al. 1992, 2005, unpubl. data; Burkett et al. 2003; Karnovsky et al. 2005).

***Cassin's Auklet*:** In 1991, lower numbers were estimated at Prince Island than in 1975-77. This change likely reflected differences in estimation techniques, as well as decline related to changes in prey resources and increased avian predation. Prior to 1975-77, loss of nesting habitats on Prince Island also occurred due to guano mining and bombing. Decline appears to have continued after 1991, based on reduced occupancy of monitored nest sites in 1995-2005. No new data on population size were obtained in 2007 but a lack of breeding in 2006-07 likely reflected continued decline from prey changes and increased predation. Apparent foraging in kelp beds off the north side of SMI proper in 2007 likely indicated poor foraging conditions farther from shore. However, kelp beds often host substantial populations of small fish which can act as an alternate food source for some individuals. To better assess trends, more work is needed to collate and analyze nest monitoring data at Prince Island from 1986 to 2007. The main anthropogenic factor affecting auklets on SMI proper is predation by introduced rats. Prevention of impacts from light pollution also is important (see Ashy Storm-Petrel above). Breeding in the SMI group in 1991 roughly constituted between 50% and 70% of the SCB population, assuming 5,000 breeding birds for northwestern Baja California (Carter et al. 1992, unpubl. data; Everett and Anderson 1991).

***Rhinoceros Auklet*:** In 2007, numbers were slightly lower than in 1991, but diurnal breeding behaviors (e.g., birds landing, carrying fish, or courtship displays) were not observed indicating little or no active breeding. Colonization occurred between 1975-77 and 1991. The main anthropogenic factors threatening Rhinoceros Auklets at the SMI group appear to be historic oil pollution and introduced rats on SMI proper. Past natural factors included no emigration from colonies in central California to Oregon due to apparent range contraction from the 1860s to 1960s (McChesney et al. 1995). The SMI group was the southern end of the breeding range in 1991 and 2007. Breeding in the SMI

group in 1991-2007 represents the only known breeding in the SCB (Carter et al. 1992, McChesney et al. 1995).

Historic breeding also may have occurred in the SMI group, given disappearance of Rhinoceros Auklets from the Farallon Islands, central California, by 1862 and recolonization in 1972 (Grinnell 1926, Ainley and Lewis 1974; Ainley and Boekelheide 1990; McChesney et al. 1995). For more than a century, a range contraction appeared to occur as far north as Washington. Since 1968, Rhinoceros Auklets have bred at many locations from Oregon to central California (Scott et al. 1974, Osborne 1972, Carter et al. 1992, McChesney et al. 1995). It is possible that: a) breeding occurred in the past at the SMI group and more widely in the Channel Islands; and b) breeding in small numbers currently occurs more widely in the SCB, given observations of a few individuals on the water near potential breeding habitats at Anacapa, Santa Barbara, and Coronado Islands during the breeding season (Carter et al. 1992, 2006; McChesney et al. 1995).

***Tufted Puffin*:** In 2007, none were observed, indicating no active breeding. Recolonization by small numbers occurred at Prince Island between 1975-77 and 1991. Abandonment occurred after 1997, when puffins were last noted at the island. However, abandonment may only be temporary and recolonization may again occur. Main anthropogenic factors affecting Tufted Puffins at the SMI group appear to be historic egg collecting, oil pollution, and possible overfishing of prey resources (Ainley and Lewis 1974, Hunt et al. 1979). Natural factors include low emigration from colonies in central California due to small breeding population size, population decline, and colony losses (McChesney et al. 1995). The southern terminus of the breeding range of the Tufted Puffin occurred at the SMI group in 1991 but, by 2007, the southern terminus had shifted northward, perhaps to the South Farallon Islands where continued breeding occurs. Prior to 1991, breeding also had been documented at Prince Island from 1886 to 1912, and possibly in the 1960s and 1970s (Streator 1886, 1888; Hunt et al. 1979, 1980; McChesney et al. 1995). Breeding in the SMI group in 1991-97 represents the only known recent breeding in the SCB, although small numbers also bred at Santa Cruz, Anacapa, and Santa Barbara Islands prior to 1912 (Hunt et al. 1979, 1980; Carter et al. 1992, McChesney et al. 1995, McChesney and Carter 2008).

Seabird Impacts from Black Rats

In 2007, evidence of rats was found on the east side of SMI proper, in areas that are difficult to access (see Chapter 2). Since 1989, rats apparently have spread from the north side of SMI proper and Point Bennett area to the east side, although numbers of rats in newly-used areas still may be relatively low (C. Drost, unpubl. data). Rat abundance likely still is much greater at Point Bennett and along the north side of the island where rats were recorded in 1987-89 and likely were introduced by shipwreck (Collins 1979, Erickson and Halvorson 1990). At least 4 ships grounded and then broke apart on the west end of SMI proper in the early 1900s (Roberts 1991), including: a) schooner *J. M. Coleman* at Point Bennett in 1905; b) schooner *Comet* at Simonton Cove in 1911; c) schooner *Watson A. West* at Point Bennett in 1923; and d) steamer *Cuba* at Point Bennett in 1923. Island fox may have previously restricted rats to the west end of the island (Erickson and Halvorson

1990) and rats were not reported at SMI proper by Sumner and Bond (1939). Loss of foxes may have led to expansion of rats in some coastal habitats on SMI proper (C. Drost, pers. comm.). However, expansion also may have been occurring slowly since their introduction for various other reasons. Some cliff and steep slope areas likely are still rat free, especially along parts of Harris Point-Cuyler Harbor, Hoffman Point, and Bay Point where steep cliffs and slopes occur. To better assess possible seabird impacts, an updated study of rat distribution, abundance, and diet is clearly needed especially in all shoreline areas, with special attention to examining upper slope areas in the Harris Point-Cuyler Harbor area, Hoffman Point Area, and Bay Point Area where several burrow- and crevice-nesting seabirds (Ashy Storm-Petrels, Xantus's Murrelets, and Cassin's Auklets) breed or appear to breed. Impacts to breeding Xantus's Murrelets in these areas were documented in 2007 (see Chapter 2).

No evidence of impacts of rats on Brandt's Cormorants, Pelagic Cormorants, Black Oystercatchers, Western Gulls, or Pigeon Guillemots was obtained through comparing 2007, 1991, and 1975-77 surveys at SMI proper. These 5 species comprised over 95% of breeding seabirds of the west and north sides of SMI proper, potentially leading to greater rat interaction compared to less numerous breeding seabird species. However, all 2007 surveys of these species were conducted from boats or aircraft. Ground surveys, nest searches, and nest monitoring have much greater potential to detect rat-depredated broken eggshells or carcasses, as well as detect rat sign. For Xantus's Murrelets, evidence of such rat impacts was found at Bay Point Area but extensive nest searches were required to obtain this information (see Chapter 2). Rat feces and a partly-mummified, severed head of a Rhinoceros Auklet also was found in a cave at Harris Point-Cuyler Harbor which may have indicated adult depredation by rats or gnawing by rats on an old carcass. However, we could not exclude possible Barn Owl predation. The killing of this adult by a rat would have been facilitated by Rhinoceros Auklet use of shallow crevices for nesting within small caves at this colony (McChesney et al. 1995) where adults could be trapped in nest sites and unable to ward off rat attacks. These caves also are very difficult to access by researchers, making it difficult or impossible to obtain evidence of depredated eggs or chicks. Ground surveys are not feasible at most Brandt's Cormorant and Pelagic Cormorant colonies because major disturbances by researchers would cause nest abandonments. Pigeon Guillemots nest entirely on coastal cliffs and bluffs, making ground surveys and nest finding dangerous, difficult, or impossible. Black Oystercatchers nest non-colonially and their nests also are difficult to find. Ground surveys of Western Gull colonies could be conducted to search for evidence of rat predation, if disturbances to other seabirds and marine mammals were avoided. However, gulls probably are the most capable of all breeding seabirds at SMI proper to ward off rats, based on their relatively large size and aggressive individual and colonial nest defense behavior.

Only small numbers of burrow-nesting Cassin's Auklets (and possibly Rhinoceros Auklets) have bred or attempted to breed at Point Bennett. In 1991, 12 potential Cassin's Auklet burrows were reported on Cormorant Rock and 1 burrow was found on the main point (Carter et al. 1992). In addition, 6 large alcid burrows were noted on the north side of the colony. Similarly, 8-10 auklet burrows between Point Bennett and Adams Cove plus 1 burrow on Point Bennett were found in 1977 (Hunt et al. 1979). In 2007, 2 burrows

were noted on Cormorant Rock and at least 5-10 burrows were noted on Point Bennett. Poor burrowing substrates or natural predation from island fox at Point Bennett likely limit development of a large colony. However, rat predation also may contribute to the lack of colony development over time.

In addition to Xantus's Murrelets (see Chapter 2), Ashy Storm-Petrels and Cassin's Auklets appear to breed in small numbers on the east side of SMI proper within the Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area colonies. These small seabirds are very susceptible to egg and adult depredation by rats. Recent expansion of rats into these habitats may result in the extirpation of these species from SMI proper. It is unclear how many birds of these species historically have bred or currently breed in this colony. Very steep and difficult habitats have prevented the discovery of nests and mist netting to determine estimates of abundance and examine distribution. A special project is needed to better assess: a) numbers and distribution of Ashy Storm-Petrels, Cassin's Auklets, and Xantus's Murrelets, and any other burrow-nesting and crevice-nesting seabirds at the Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area colonies; and b) search for rat sign and any evidence of rat impacts in these areas.

Seabird Colony Protection

To ensure continued recovery of seabird populations at the SMI group, various forms of seabird colony protection need to be considered:

● Human disturbance in seabird nesting areas can occur through close approach of seabird nesting areas by humans (on foot, swimming, boats, jet skis, and aircraft). Long-term plans in the SMI group for recreational use (hiking, diving, kayaking, wildlife viewing, etc.), commercial and recreational fishing, and research activities (e.g., seabird, marine mammal, island fox, plant, and intertidal monitoring) should record and monitor disturbances, plus address the need for greater protection of seabird breeding colonies. Except for certain research, monitoring, and emergency situations, current CINP policies of no landing on Prince Island and Castle Rock should be continued and extended to include closures to boats within 200 m of shore to prevent flushing of nesting Brandt's Cormorants and Common Murres. Except for island landings and certain research and monitoring purposes, current CINMS policies of not allowing over flights below 1000 feet should be continued. No vessels should anchor off the lee (south) side of Prince Island to prevent potential light impacts.

● Military and aerospace activities also can cause disturbance of seabird breeding colonies and possible impacts to nesting habitats when explosions or sonic booms occur near or at colonies. Continued efforts to prevent such impacts are needed.

● Commercial and recreational fishing activities can directly impact seabirds, especially when birds are injured or killed by fishing gear (e.g., gill-nets, hooking) or when bright lights from vessels illuminate colonies. Squid fishing uses very bright lights which have great potential to impact colonies through increasing predation or causing nest abandonment (see Ashy Storm-Petrel discussion). Although squid fishing is not allowed within marine reserves, squid lights outside marine reserves near the SMI group may

affect seabirds at colonies, including Prince Island and Castle Rock. If squid fishing does occur, potential impacts to seabirds should be investigated. Light levels from all types of boats also should be monitored in Cuyler Harbor and at Prince Island.

● For oil spills, shipwrecks, or other disasters, a well-developed plan is needed to minimize disturbance to seabird colonies and to minimize destruction of seabird breeding habitats during response activities.

Seabird Research and Monitoring

To ensure adequate tracking of seabird population status and impacts at the SMI group, various research and monitoring activities are needed. Primary needs that have arisen from this review of the status of breeding seabirds in the SMI group include:

● Annual monitoring of Cassin's Auklets (California species of special concern) at Prince Island for reproductive success, nest occupancy, and diet is imperative to understand changes in prey resources and annual variation in prey availability for seabirds at the SMI group. With annual banding of adults and chicks, adult survival and recruitment also can be examined over time. Much greater effort is needed to ensure adequate data for long-term monitoring purposes.

● Annual monitoring of Brandt's Cormorants, Double-crested Cormorants, and Brown Pelicans (U.S. and California endangered species; expected to be removed from listed status in the near future) is imperative to best track changes in breeding population size in response to annual marine conditions and potential impacts from oil spills. Aerial surveys are an effective method for this monitoring and should be continued.

● Additional baseline surveys and periodic monitoring for Xantus's Murrelets (California threatened species and U.S. candidate species), using spotlight surveys and nest searches, are needed to carefully track this state-threatened species which occurs in small numbers and appears to be declining (see Chapter 2). Spotlight surveys are an effective method for this monitoring.

● Additional baseline surveys and periodic monitoring for Ashy Storm-Petrels (petitioned in 2008 for U.S. listing), using mistnet captures and banding, are needed to carefully track this rare California species of special concern and federal species of management concern. Leach's Storm-Petrels and Black Storm-Petrels (California species of special concern) also can be monitored using mist nets.

● Periodic surveys, at least once per decade, of population size of all species of breeding seabirds is imperative to track changes in breeding population size and distribution. Tufted Puffins also are a California species of special concern.

● A detailed study of burrow-nesting and crevice-nesting seabirds is needed at Castle Rock to better assess the status of Leach's Storm-Petrels, Ashy Storm-Petrels, Xantus's Murrelets, Cassin's Auklets, and Rhinoceros Auklets.

● Studies of black rat and avian predator populations and predation on seabirds is needed to develop baseline data to measure future changes.

● A detailed study is needed to assess damages to nesting habitats from guano harvesting, bombing, and sonic booms at Prince Island (and possibly Castle Rock) plus assess the potential to restore nesting habitats for Xantus's Murrelets and other burrow-nesting and crevice-nesting seabirds at Prince Island.

● A long-term monitoring program is needed for examining effects of organochlorine and other pollutants over time.

Chapter 2

Breeding status of the Xantus's Murrelet

INTRODUCTION

The breeding range of the Xantus's Murrelet is restricted to 12 island groups off southern California and northwestern Baja California (Hunt et al. 1979, 1980; Carter et al. 1992, 2005, unpubl. data; Drost and Lewis 1995; Keitt 2005). The SMI group is the northernmost known breeding location. The SMI group is exposed to strong winds and open ocean conditions to a greater degree than the other Channel Islands. Harsh environmental conditions, relatively low population size, largely inaccessible breeding habitats, and nocturnal nest exchanges have greatly limited the ability to document and study murrelet populations at the SMI group. While murrelets were first documented breeding at nearby Anacapa Island and Santa Cruz Island in 1911 and 1928, respectively (Hunt et al. 1979; Carter et al. 2005), early ornithological visits to Prince Island, Castle Rock, and SMI proper from 1886 to 1939 (summary in Hunt et al. 1979) failed to record murrelets, although visits usually occurred after most or all chicks had departed and little or no time was spent on Prince Island or Castle Rock at night. A single murrelet was first recorded at sea about a quarter of a mile north of Prince Island between 17 and 19 April 1939 (Sumner and Bond 1939). Firm evidence of breeding at Prince Island (eggshells and a live downy chick, without definite nest sites) was first found during seabird surveys by the Smithsonian Institution (Pacific Ocean Biological Survey Program) in May-June 1968 (Crossin and Brownell 1968, Huber 1968). Given that murrelets rarely occur in nearshore waters during the day and it is very difficult to find nests at Prince Island, a small murrelet population probably was not detected for many decades without nest searches aided by flashlights during the breeding season. Archeological remains dating back 1000-3000 years also indicated Xantus's Murrelets have long inhabited the SMI group (Guthrie 1980).

From 1968 to 1991, only 2 studies were conducted that better determined the status of Xantus's Murrelets at the SMI group. In 1975-77, the University of California Irvine conducted a major study of seabird breeding population size, reproductive success, and diet at the SMI group and other Channel Islands (Hunt et al. 1979, 1980). In 1991, Humboldt State University (HSU; Carter, McChesney, Whitworth, and others) conducted a follow-up survey of breeding population size for seabirds at the SMI group and other Channel Islands (Carter et al. 1992). Five murrelet nests were found on Prince Island in 1975-77 and 2 more in 1991, but little effort was expended to assess population size at SMI proper and at Castle Rock. Based on nests found and captures of up to 60 murrelets in 1 night on a boat near Prince Island, a breeding population of 75 breeding pairs was estimated in 1975-77 (Hunt et al. 1979; R.L. Pitman, pers. comm.).

In 1994-96, HSU (Carter, Whitworth, McIver, McChesney, Ochikubo Chan, and others) and MMS (Pierson) conducted the first specific surveys for Xantus's Murrelets to better determine breeding distribution in the Southern California Bight (Carter et al. 1996b,

1997, unpubl. data; Burkett et al. 2003). In addition to nest searches, a newly-developed survey technique for murrelets was developed using vocalization rates of birds within nocturnal at-sea congregations beside potential breeding habitats. This technique was used to determine distribution and relative size of murrelet populations at all 8 Channel Islands, including the SMI group. Based on vocal detection surveys and historical estimates, 50-300 breeding pairs were roughly estimated for the SMI group.

In 2001-04, HSU and the California Institute of Environmental Studies (CIES; Whitworth, Carter, Koepke and others) employed another newly-developed survey technique for murrelets, nocturnal spotlight surveys of murrelets attending nocturnal at-sea congregations. This technique was used to better assess murrelet distribution and relative population size at 6 Channel Islands, including the SMI group in 2004 (Whitworth et al. 2003a, 2005a). Few murrelets were seen but surveys may have been insufficient to document actual population size.

In 2007, the Montrose Trustee Council (MTC) sponsored CIES (Whitworth and Koepke) and Carter Biological Consulting (CBC; Carter and Hébert) to conduct additional spotlight surveys, nest searches, and at-sea captures to better assess the status of the Xantus's Murrelet at the SMI group and to develop future monitoring approaches. Spotlight surveys were focused on the east side of SMI proper and Prince Island, where past work has found most evidence of murrelet breeding and suspected breeding, and where spotlight surveys can be conducted under a much wider range of environmental conditions in spring. Nest search efforts were focused on Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area where murrelet nesting was suspected during past studies and impacts from introduced black rats might be occurring (see Chapter 1). At-sea captures were focused near Cuyler Harbor where the support vessel could be safely anchored under all weather conditions.

The MTC will use this information to better assess the potential impacts of rats on Xantus's Murrelets at SMI proper and better evaluate potential benefits of rat eradication at SMI proper to the murrelet population in the SMI group. If rat eradication occurs, data gathered in 2007 will contribute to baseline data for measuring potential population increase over time, as conducted at Anacapa Island before and after rat eradication (Whitworth et al. 2003a,b, 2005b, 2008). If rat eradication does not occur, 2007 data are valuable for long-term monitoring purposes and baseline data for assessing future potential oil spill impacts (Carter et al. 2000).

In Chapter 2, the breeding status of Xantus's Murrelets at the SMI group in 2007 is assessed and compared with historical data. Various natural and anthropogenic factors potentially affecting murrelets at the SMI group are also discussed.

METHODS

Field Logistics

Field trips to the SMI group to assess breeding status of Xantus's Murrelets were scheduled mainly in late April to late May, based on 3 major considerations: a) spotlight surveys should be the main technique for assessing population sizes and breeding distribution and should be conducted 2 or 3 times during the peak-incubation period (normally late April to late May) to obtain peak or near-peak numbers; b) breeding status of other species also should be assessed during pre-breeding or incubation (generally late April to late May [Carter et al. 1992]; see Chapter 1); and c) personnel and support boat availability was limited.

The research vessel *Shearwater* (operated by CINMS) and the private charter vessel *Miss Devin* (operated by Ocean Sports Private Charters) were used for transportation from Santa Barbara to the SMI group and accommodations while at the group. All field work was conducted by Whitworth, Koepke, Carter, and Hébert, with assistance from volunteers from CINMS and the Channel Islands Naturalist Corps. A 3.8 m Zodiac® inflatable craft powered by a 15-25 hp Mercury outboard engine was used for nocturnal spotlight surveys, at-sea captures, and shoreline landings for nest searches in potential breeding habitats. Boats and personnel were supplied with all required safety equipment.

Spotlight Surveys

The nocturnal spotlight survey protocol used at the SMI group (Figure 2-1) in 2007 was first developed at Anacapa Island in 2001, with modification in 2004 (Whitworth et al. 2003a,b; 2005a). Surveys were conducted on transects located 150-250 m from shore along the northeast and east sides of the SMI group (Figure 2-2) from Harris Point to Cardwell Point (10.96 km) on SMI proper and around Prince Island (3.19 km). Surveys were not conducted at Castle Rock because of suboptimal conditions on all potential survey nights. Surveys were conducted over 3 nights with adequate but not optimal conditions on 1-2 May (NW winds 15-20 kn), 2-3 May (NW winds 10-15 kn), and 22-23 May (mist, NW winds <5 kn). On 2-3 May, only a partial survey (east side only) was conducted at Prince Island due to high swells. Surveys were started each night between 23:00 and 00:15 h (PDT) and completed between 01:30 and 02:15 h. Surveys were not conducted on nights with winds gusting over 20-25 kn (23-24 April, 24-25 April, 30 April-1 May, and 3-4 May) or with thick mist/fog (23-24 May).

The three-person survey crew included a boat driver, spotlight observer, and data recorder. The driver guided the inflatable craft at low speeds along transect lines by navigating between predetermined waypoints (Figure 2-2) using a hand-held Garmin GPSmap 76CS Global Positioning System (GPS) receiver. Using a high-intensity spotlight (1 million candlepower), the observer slowly passed the spotlight beam along

Figure 2-1. Satellite image of the SMI group, showing SMI proper, offshore islets Prince Island and Castle Rock, and place names mentioned in the text.

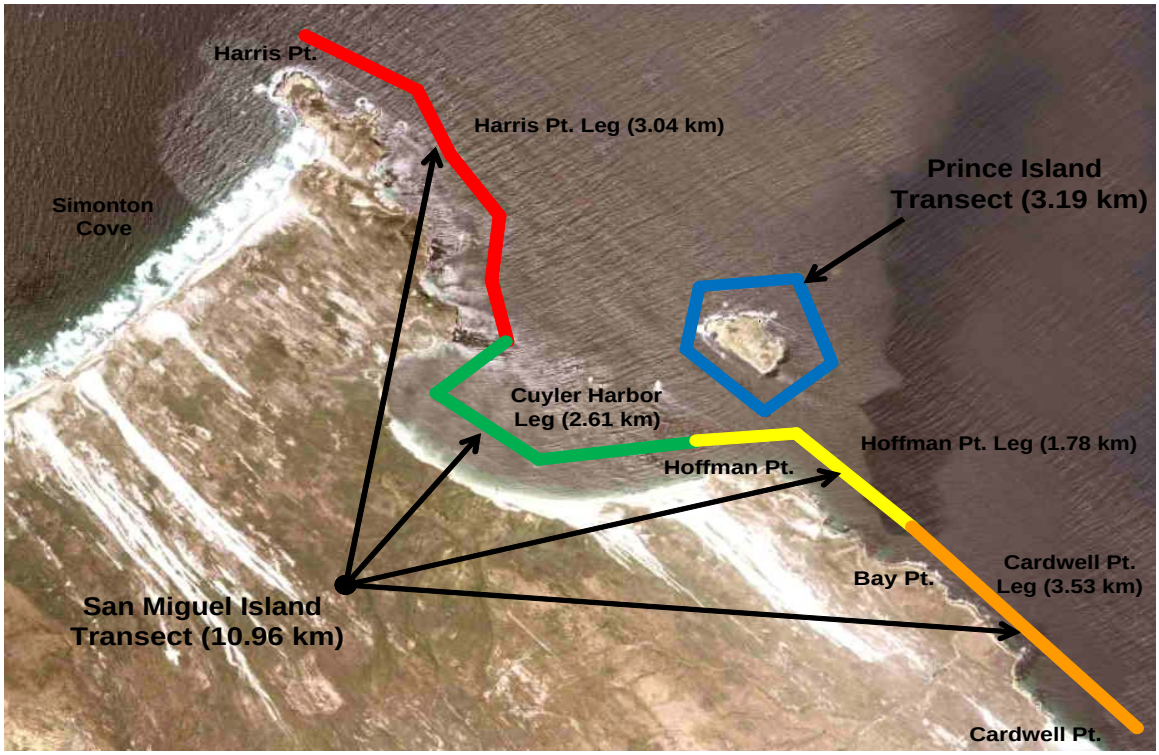


Figure 2-2. At-sea transects used during Xantus's Murrelet spotlight surveys at SMI proper and Prince Island in 2007. Legs of the SMI transect are color coded.

the water across a 90° arc on each side of the bow. The observer called off all murrelets observed to the data recorder who recorded observations in a field notebook. Data recorded included: 1) total number of murrelets seen during each 90° scan; and 2) bird behavior (i.e., total sitting on water, flying, or flushed per scan). The data recorder also entered a GPS waypoint at the end of each scan. Date, time, location, and conditions (i.e., wind, Beaufort sea state, cloud cover, and moon) were recorded for each survey.

Numbers of murrelets counted during each survey were used to examine spatial patterns in at-sea congregation attendance. All murrelets observed were included in survey totals, regardless of behavior or distance from the vessel. Murrelet encounter rates (murrelets km^{-1}) were calculated for each of 5 segments: 1) Harris Point to Cuyler Harbor (3.04 km); 2) within Cuyler Harbor (2.61 km); 3) Cuyler Harbor to Bay Point (1.78 km); 4) Bay Point to Cardwell Point (3.53 km); and 5) Prince Island (3.19 km).

Nest Searches

Small hand-held flashlights were used to search suitable crevices, sea caves, shrubs and other sheltered sites for evidence of past or current murrelet breeding (e.g., incubating or brooding adult, whole unattended eggs, broken or hatched eggshell fragments, eggshell membranes, or chicks). We recorded all observations in field notebooks. All sites containing evidence of murrelet breeding were photographed and location coordinates were recorded on a hand-held Garmin GPSmap 76CS Global Positioning System (GPS) receiver.

Nest searches were conducted in coastal habitats (see Figures 2-3 to 2-11) accessible with an inflatable boat along the northeast and east sides of the SMI group (see Appendix 3, Maps 3 and 4 for subcolony [SC] numbers), including:

1) Harris Point-Cuyler Harbor (~2.90 km – see Figures 2-3 and 2-5 to 2-8) including SC 4, 5 [including Nifty Rock], 6, 10 [Hare Rock], 14 and 15 on 23 April, 1 May, 3 May, and 22 May;

2) Hoffman Point-Bay Point (~1.50 km – see Figures 2-4, 2-9, and 2-11) including Hoffman Point SC 1, 2 and 3, and Bay Point SC 1 on 24 April, 2 May and 22 May;

3) Harris Point-Simonton Cove (~0.40 km – see Figures 2-3 and 2-10) including SC 2 on 1 May; and

4) Prince Island east shoreline (~0.25 km – see Figure 2-4) on 24 April.

Where habitat permitted (i.e., most of Hoffman Point Area, Bay Point Area SC 1, and Harris Point-Cuyler Harbor SC 2, 4, and 14-15), we walked or climbed along the shoreline to search for potential nest sites. In other areas, particularly much of the Harris Point-Cuyler Harbor area, patchy accessible habitats were accessed by dropping off personnel from the inflatable craft.

Figure 2-3. Shoreline areas surveyed during nest searches for Xantus's Murrelets on Harris Point, SMI proper, in 2007.

With limited available time, the east shoreline of Prince Island was selected for nest searches because it was not searched during the breeding season in 1991, 1994 or 1995 due to nesting Brandt's Cormorants. In 2007, Brandt's Cormorants were not nesting in this area (see Chapter 1), allowing nest searches without disturbance. Nest searches were not conducted on Castle Rock due to concern about disturbance to Brandt's Cormorants and sea lions.

At-Sea Captures

To help assess breeding status, Xantus's Murrelets were captured using the "night-lighting" capture technique (Whitworth et al. 1997) within at-sea congregations in the northwest corner of Cuyler Harbor (Figures 2-1 and 2-4) on the nights of 24-25 April and 3-4 May. Capture efforts were conducted on windy nights when spotlight surveys were not possible, preventing any possible impacts from capture efforts on survey numbers or distribution on capture nights.

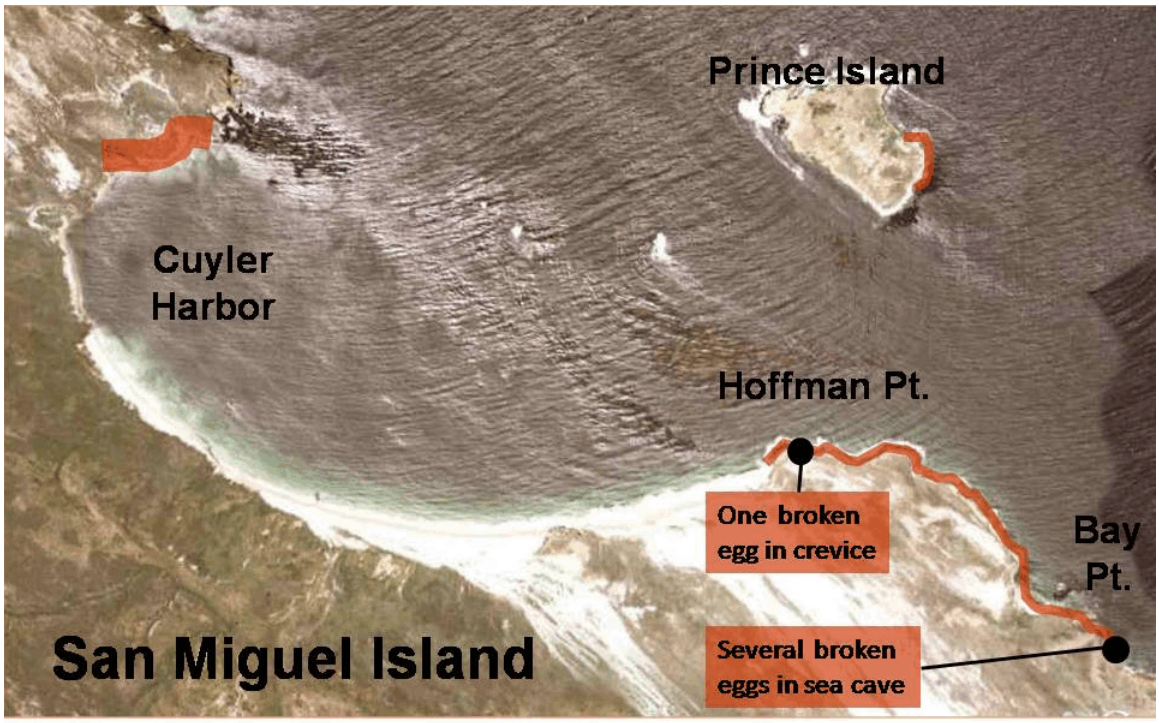


Figure 2-4. Shoreline areas surveyed during nest searches for Xantus's Murrelets from Cuyler Harbor to Bay Point at SMI proper and at Prince Island in 2007.

Three-person crews consisting of a boat driver, spotlight operator, and dip net handler searched near shore waters in an inflatable Zodiac® craft. Waters around the craft were scanned with a high-intensity spotlight (1 million candlepower) for murrelets sitting on the water surface. Murrelets within at-sea congregations are usually observed alone or in pairs, although a few larger groups are seen on occasion. We approached murrelets at moderate speeds and attempted to net birds within the spotlight beam as they either remained on the water surface, made shallow escape dives, or made short flights. Many birds were captured on the first attempt, but multiple attempts were used if the bird remained within spotlight range. Pursuit was ended after a few failed attempts to prevent undue stress to murrelets (Newman et al. 2005).

Due to extremely windy conditions (persistent 25-30 kn NW winds) on the night of 24-25 April and thick mist/fog conditions on the night of 3-4 May, our search efforts were conducted within 500-750 m of the support vessel at anchor in the northwest corner of Cuyler Harbor. Captured murrelets were transported to the support vessel where each bird was examined for subspecies plumage characteristics and bilateral brood patches, and photographs were taken. A blood sample was collected for genetic analyses from each individual captured by making a small puncture of the brachial vein with a sanitized

Figure 2-5. Southern end of Harris Point-Cuyler Harbor colony, SMI proper, 23 April 2007 (Photo by Percy Hébert). SC 14 at right and SC 15 to left. Nest searches in 2007 found little murrelet nesting habitat. In 1976, 3 Ashy Storm-Petrels were captured in mist nets here. This area is composed of a large landslide that occurred in 1940-42.

Figure 2-6. Harris Point-Cuyler Harbor (SC 5), SMI proper, 23 April 2007 (Photo by Percy Hébert). Nest searches in 2007 found no evidence of murrelet nesting.

Figure 2-7. Harris Point-Cuyler Harbor colony (SC 10, Hare Rock), SMI proper, 23 April 2007 (Photo by Percy Hébert). Nest searches in 2007 found no evidence of murrelet nesting. Cassin's Auklet nests were found in 1991 and 1994.

Figure 2-8. Potential nesting habitat of Xantus's Murrelets at Harris Point-Cuyler Harbor (SC 4), SMI proper, 1 May 2007 (Photo by Percy Hébert).

Figure 2-9. Potential nesting habitat of Xantus's Murrelets at Hoffman Point Area (between SC 1 and 2), SMI proper, 1 May 2007 (Photo by Percy Hébert). Little nesting habitat and no evidence of murrelet nesting were found.

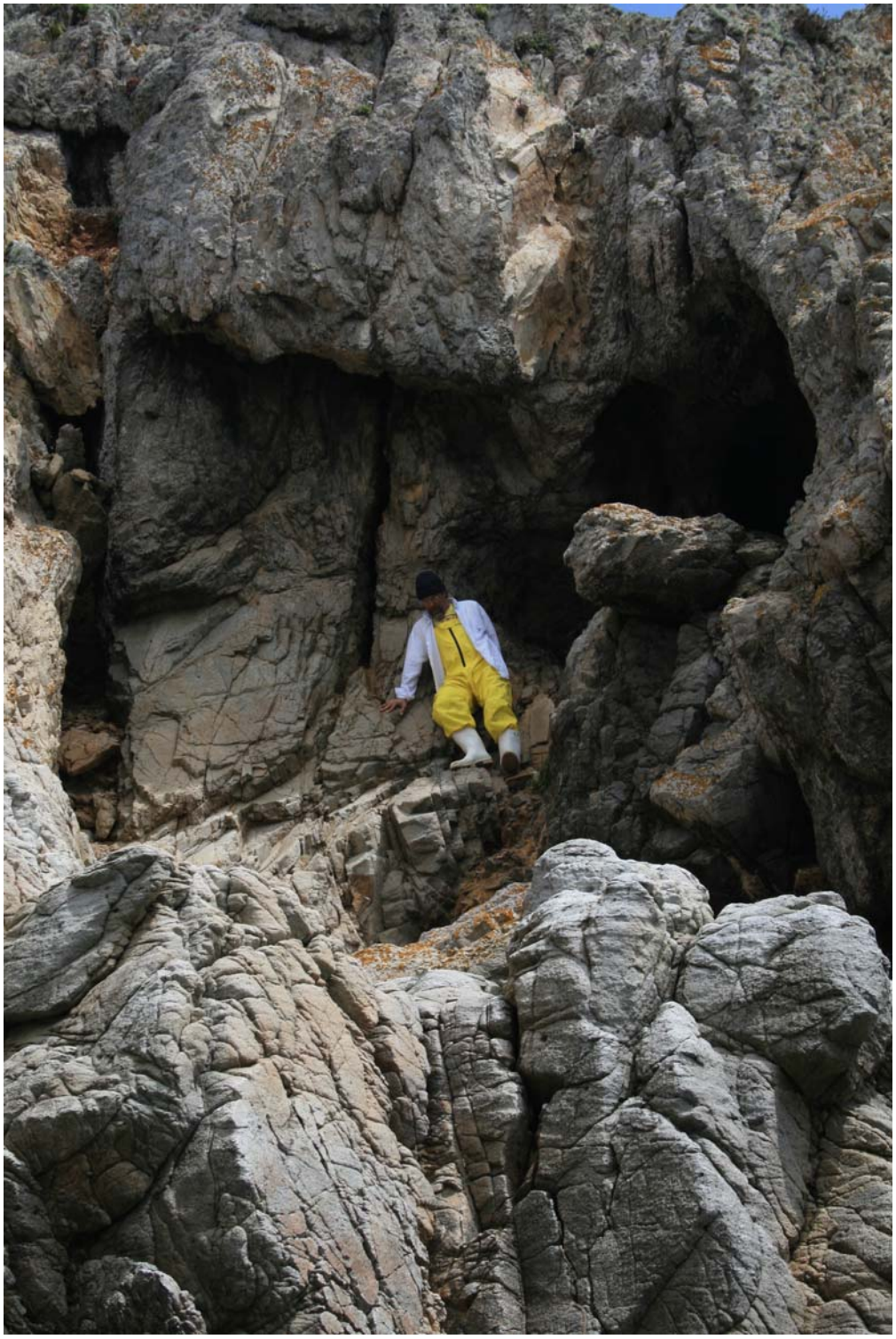


Figure 2-10. Potential nesting habitat of Xantus's Murrelets at Harris Point-Cuyler Harbor (SC 2), SMI proper, 1 May 2007 (photo by Harry Carter). Much nesting habitat but no evidence of murrelet nesting were found.

Figure 2-11. Potential nesting habitats of Xantus's Murrelets at Hoffman Point Area (SC 1), SMI proper, 2 May 2007 (Photo by Percy Hébert).

needle and absorbing a few drops of blood onto Whatman No. 1 tissue paper (H.R. Carter and D.L. Whitworth, unpubl. data). We banded 5 murrelets with U.S. Fish and Wildlife Service #2 bands. Five other birds were temporarily marked by clipping a small piece at the tip of a secondary feather (S2) to identify any recaptures.

RESULTS

2007 Spotlight Surveys

A mean of 19 (± 5 sd) Xantus's Murrelets per spotlight survey was recorded during 3 surveys at the SMI group in 2007 (Table 2-1). Counts were similar between consecutive surveys on the nights of 1-2 May (21 murrelets) and 2-3 May (23 murrelets), but were lower on 22-23 May (13 murrelets). Most murrelets (67-92% of survey totals; 14, 18 and 12 murrelets per survey, respectively) were observed along the coasts of SMI proper rather than Prince Island (8-33% of survey totals; 7, 5, and 1 [east side only] murrelets per survey, respectively). Counts were highest along the Harris Point to Cuyler Harbor segment (10 ± 7 murrelets) and similar between Prince Island (4 ± 3 murrelets), Cuyler Harbor (2 ± 1 murrelets), and Cuyler Harbor to Bay Point segments (3 ± 3 murrelets). No

Table 2-1. Counts and encounter rates (km^{-1}) of Xantus's Murrelets from spotlight surveys at the San Miguel Island group in 2007.

Transect Segment (Length; km)	1-2 May	2-3 May	22-23 May	Mean ± sd
Harris Pt. (3.04 km)	10 3.29 km^{-1}	16 5.26 km^{-1}	3 0.99 km^{-1}	10 ± 7 3.18 ± 2.14 km^{-1}
Cuyler Harbor (2.61 km)	3 1.15 km^{-1}	1 0.38 km^{-1}	2 0.77 km^{-1}	2 ± 1 0.77 ± 0.39 km^{-1}
Hoffman Pt. (1.78 km)	1 0.56 km^{-1}	1 0.56 km^{-1}	7 3.93 km^{-1}	3 ± 3 1.68 ± 1.95 km^{-1}
Cardwell Pt. (3.53 km)	0	0	0	0
SMI Sub-total (10.96 km)	14 1.28 km^{-1}	18 1.64 km^{-1}	12 1.09 km^{-1}	15 ± 3 1.34 ± 0.28 km^{-1}
Prince Island (3.19 km)	7 2.19 km^{-1}	5 1.57 km^{-1}	1 0.31 km^{-1}	4 ± 3 1.36 ± 0.96 km^{-1}
Survey Total (14.15 km)	21 1.48 km^{-1}	23 1.63 km^{-1}	13 0.92 km^{-1}	19 ± 5 1.34 ± 0.37 km^{-1}

murrelets were seen along the Bay Point to Cardwell Point segment during any of these 3 surveys.

Murrelet encounter rates (km^{-1}) exhibited similar patterns with highest encounter rates at Harris Point to Cuyler Harbor (3.18 ± 2.14 km^{-1}), followed by Cuyler Harbor to Bay Point (1.68 ± 1.95 km^{-1}), Prince Island (1.36 ± 0.96 km^{-1}), and Cuyler Harbor (0.77 ± 0.39 km^{-1}).

A shift in murrelet distribution seemed to occur among SMI proper segments over May. Most murrelets were observed on the Harris Point to Cuyler Harbor segment on both 1-2 May (71%) and 2-3 May (89%). However, a higher proportion (58%) was observed on the Cuyler Harbor to Bay Point segment on 22-23 May. This shift may have been influenced to some degree by a relaxation of high winds by 22-23 May. Most of the Harris Point to Cuyler Harbor segment (i.e., SC 5-13) is partly protected from high winds and swells whereas the Cuyler Harbor to Bay Point segment is more exposed. In addition, this shift may not have actually occurred and may have simply reflected small sample sizes or reduced numbers in late May. Low murrelet numbers (6-21%) occurred on the Cuyler Harbor segment on all 3 surveys.

2007 Nest Searches

No active Xantus's Murrelet nests were found at SMI proper or Prince Island in 2007, but evidence of recent murrelet nesting was found in 3 nest sites along the shoreline of SMI proper (Table 2-2). These findings were the first direct pieces of evidence of murrelet nesting found on SMI proper. Evidence of recent nesting included: 1) aged broken eggshell fragments found in a crevice site about 10 m above the shoreline near Hoffman Point on 24 April (see Figure 2-4); 2) 2 intact fresh eggs found in a crevice along a rock wall south of Harris Point on 1 May and again on 22 May that apparently had been abandoned (see Figures 2-3, 2-12, and 2-13); and 3) a rat-depredated murrelet eggshell (i.e., longitudinal half of an eggshell with rat bite marks along the margin) and several other unreachable broken eggshell fragments in a low sea cave near Bay Point on 2 May and again on 22 May (see Figures 2-4, 2-14, and 2-15). All eggshells were collected and delivered to CINP.

Considerable breeding habitat with numerous potential nest sites was found at SMI proper, especially in sea caves and rocky scree between Harris Point and Cuyler Harbor. Undoubtedly, more habitat also exists in inaccessible areas not searched. Unfortunately, evidence of rats, including midden sites and feces, also was found in these breeding habitats, notably in and around sea caves near Harris Point SC 4. The single nest found near Harris Point was located in an isolated and fairly shallow crevice on a sheer but relatively low north-facing rock wall that probably was inaccessible to rats, mice, or island fox. Although both eggs were abandoned, they were intact and appeared to have been laid in 2007. No nests were found on Hare Rock (see Figure 2-7) on 23 April although small numbers of potential crevices exist there that have been used in past years by Cassin's Auklets (see Chapter 1). Nifty Rock was searched on 23 April but no suitable crevices were found.

Table 2-2. Summary of nest search effort and evidence of Xantus's Murrelet breeding found at the San Miguel Island group in 2007. See Figures 2-3 and 2-4 for locations of specific search areas.

Date	Area	Evidence of Murrelet Nesting
23 April	N. Cuyler Harbor (Area A)	None
	Hare Rock	None
	E. Harris Pt. (Area D)	None
	E. Harris Pt. (Area E1)	None
24 April	Prince Island (East)	None; 13 Cassin's Auklet carcasses and 2 broken Cassin's Auklet eggs
	Bay Pt. (Area F)	None
	Hoffman Pt.	1 broken murrelet eggshell fragment
1 May	W. Harris Pt. (Area E2-E5)	None
	E. Harris Pt. (Area E1)	None; Pigeon Guillemot eggshell fragment; rat midden and feces
	E. Harris Pt. (Area E7)	None
	E. Harris Pt. (Area E9)	2 abandoned murrelet eggs in crevice site on rock wall
	E. Harris Pt. (Area E8)	None
	E. Harris Pt. (Area E10)	None
2 May	Hoffman Pt. (Area G)	None; long shoreline area from Cuyler Harbor to near Bay Pt.
	Bay Pt. (Area H)	Several broken murrelet eggshells in low cave
22 May	Bay Pt. (Area H)	Broken murrelet eggshell in same cave as 2 May
	Hoffman Pt. (Area G)	None
	E. Harris Pt. (Area E1)	None

Figure 2-12. Xantus's Murrelet nest with 2 eggs found at Harris Point-Cuyler Harbor (SC 4), SMI proper, 1 May 2007 (Photo by Percy Hébert).

Figure 2-13. Xantus's Murrelet egg (briefly removed from nest for photographs) at Harris Point-Cuyler Harbor (SC 4), SMI proper, 1 May 2007 (Photo by Percy Hébert). Egg surfaces were soiled (note orange coloration), indicating abandonment.

Figure 2-14. Xantus's Murrelet eggshell from egg eaten by black rats at Bay Point Area (SC 1), SMI proper, 2 May 2007 (Photo by Percy Hébert). Large bite marks along the shell edge indicate rat predation rather than mouse predation.

Figure 2-15. Xantus's Murrelet nest site found at Bay Point Area (SC 1), SMI proper,2 May 2007 (Photo by Percy Hébert). A rat-depredated egg was found on the sandy floor of this grotto (see above).

Nesting habitats were patchily distributed in other areas searched on foot, especially Cuyler Harbor to Hoffman Point, the west side of Harris Point, the north end of Cuyler Harbor, and the east side of Prince Island. The nest site found at Hoffman Point was an isolated crevice in a small rocky outcrop atop a low bluff about 10 m above the shoreline (see Figure 2-11). In contrast, nest sites at Bay Point were found in a low narrow cave less than 2 meters above the high tide line. Although this cave appeared to be difficult to access by rats, all eggshell fragments observed in this cave had apparently been moved by rats from nest sites located in deep inaccessible crevices and eggshell fragments did not appear to have fallen from sites further upslope. The single retrieved eggshell fragment appeared to have been depredated by rats. Other sea caves along this section of coastline were more easily accessible to rats or inundated at high tides.

Nesting habitat along the west side of Harris Point was limited to several crevices sites in a large rockfall. Sea caves along this shoreline were shallow and mostly inundated at high tide. Isolated potential nest sites in rocky outcrops at the north end of Cuyler Harbor may have been less suitable as nest sites due to their greater distance from shore (about 100 m) and dense brush which might lengthen time from the nest to the ocean for departing chicks, making them more susceptible to predation. However, chicks can travel even greater distances to sea through brushy areas from certain nest sites on Santa Barbara Island (C. Drost, pers. comm.). Several potential crevice sites were found under boulders on the east shoreline of Prince Island, but no active nests of Xantus's Murrelets, Cassin's Auklets or Ashy Storm-Petrels were discovered. However, Ashy Storm-Petrels rarely lay eggs as early as late April (Ainley 1995, McIver 2002).

2007 At-Sea Captures

In 2007, 10 murrelets were captured on 2 nights of effort at Cuyler Harbor at SMI proper (Table 2-3). We captured 6 murrelets on 24-25 April during capture efforts from about 22:00-01:18 h, with a break in captures from 23:36-00:20 h. Considerable numbers of murrelets (as many as 10 birds during each pass around the support vessel) were seen, but none were found from about 00:48 to 01:08 h, prior to ending capture efforts for the night. On 3-4 May, we captured 4 murrelets (including both members of 1 pair) during capture efforts from 10:20- 00:51 h, with a break in captures from 23:30-00:30 h. Less murrelets were seen in Cuyler Harbor during capture search efforts on 3-4 May compared to 24-25 April.

None of the captured sample had brood patches or was previously banded. The first 5 murrelets captured on 24-25 April were banded (#1052-26786 to #1052-26790), but no further birds were banded in 2007 after our limited supply of bands was exhausted. Facial plumage patterns indicated that all belonged to the *S. h. scrippsi* subspecies. Blood samples for genetic analyses were collected from all 10 murrelets (H.R. Carter and D.L. Whitworth, unpubl. data).

Table 2-3. Summary of Xantus's Murrelets captured in at-sea congregations in Cuyler Harbor, SMI proper, in 2007.

Date	Number Captured	Brood Patches	Recaptures
24-25 April	6	0	0
3-4 May	4	0	0
Total	10	0	0

Other 2007 Xantus's Murrelet Observations

Xantus's Murrelets typically are not seen on the water near breeding colonies during the day. However, on 23 April at 13:10 h, 2 birds were observed mid channel between Harris Point and Prince Island during boat surveys for other seabirds (Chapter 1).

DISCUSSION

Evidence of Breeding, Population Size, and Breeding Phenology in 2007

Prior to 2007, Xantus's Murrelets at the SMI group had been documented nesting on Prince Island and suspected of nesting on Castle Rock and SMI proper (Harris Point-Cuyler Harbor and Hoffman Point Area (see Appendix 2). Nest searches in 2007 uncovered: a) the first nests on SMI proper at Harris Point, Hoffman Point, and Bay Point; b) the first nests anywhere in the SMI group since 1999; and c) the only nests other than on Prince Island. Spotlight surveys in 2007 confirmed: a) the presence of small numbers of murrelets attending at-sea congregations and apparently nesting in adjacent coastal habitats (patchy, mostly inaccessible) along the shoreline of SMI proper, as well as Prince Island; b) similar low numbers as found during spotlight surveys in 2004; and c) apparently lower levels of overall murrelet activity than found in 1994-96 vocal detection surveys (Figure 2-16; Appendix 2).

Overall survey results from the SMI group must be considered in the context of Xantus's Murrelet nesting phenology in 2007. With available funding, the 2007 survey plan was designed to conduct nest searches and spotlight surveys during the center of the incubation period (generally late April to late May) when peak or near-peak murrelet numbers usually occur. Two or 3 spotlight surveys were planned to account for some variation in breeding phenology and generally windy and difficult survey conditions at the SMI group. This plan also seemed to account for possible late nesting, as long as most birds still attended at-sea congregations prior to breeding. However, murrelets at Anacapa Island (the nearest monitored colony) exhibited quite unusual breeding phenology in 2007, with the latest mean lay date (20 May) and widest range of lay dates (18 March to 8 July) reported since monitoring began there in 2000 (Whitworth et al. 2008). If similar nesting

phenology occurred at the SMI group in 2007, it undoubtedly affected our nest searches which would have been conducted before mean egg laying. Thus, nest searches may have only documented early breeding activity and more egg laying may have occurred in late May to early July. On the other hand, spotlight surveys (1-23 May) may still have measured approximate numbers of murrelets in at-sea congregations, depending on whether or not most of the murrelet population had begun attending the colony by late April to late May. The similarity of 2004 and 2007 numbers could reflect either low approximate numbers or underrepresented numbers in both years (see below).

Insufficient data were obtained in 2007 to determine if: a) many murrelets abandoned early nests and departed from the SMI group for the season prior to late April; b) many murrelets left but returned to attend at-sea congregations and commence breeding after late May; and c) if most murrelets did not begin attending at-sea congregations and commence breeding until after late May. If spotlight survey data were representative (maximum count 23 birds), only a small breeding population of 10-50 breeding pairs appear to be currently nesting at the SMI group. However, several factors can affect assessments of breeding population size based on spotlight survey counts: 1) at least 1 bird of an actively-incubating pair usually is not in an at-sea congregation; 2) not all birds attending congregations on a specific night are counted (especially under suboptimal survey conditions); 3) some non-incubating birds probably do not attend congregations each night; and 4) both breeding adults and non-breeding subadults may attend at-sea congregations. With available data, it was not possible to determine if: a) only a very small population (e.g., 10-50 breeding pairs) exists at the SMI group as documented in 2007; or b) a substantially larger breeding population existed but was not detected in 2007. Additional surveys are needed in the near future to resolve this problem.

At-Sea Congregations and Nesting Distribution

Although little direct evidence is available on the current nesting distribution of the small murrelet population at the SMI group, a general relationship apparently existed between their attendance of at-sea congregations and nesting distribution. With the exception of the Cuyler Harbor segment, evidence of murrelet nesting was found in all shoreline areas with suitable breeding habitats adjacent to coastal waters with at-sea congregations, including: a) Harris Point to Cuyler Harbor; b) Cuyler Harbor to Bay Point; and c) Prince Island. In contrast, no evidence of nesting and no murrelets in at-sea congregations were found in coastal areas without suitable nesting habitat between Bay Point and Cardwell Point and most of Cuyler Harbor. A very similar relationship on the east side of SMI proper and at Prince Island was found using vocal detection surveys in 1995-96 (Carter et al. 1997, unpubl. data; see Figure 2-16).

All murrelets observed in Cuyler Harbor during 2007 spotlight surveys and at-sea captures were in the far northwest portion of the cove, in protected waters near the vessel anchorage. Nest searches in the marginal nesting habitat on brushy slopes above the anchorage failed to discover any sign of murrelet nesting and few suitable sites (see Figure 2-5). Although isolated nests may occur there in some years, most of the habitat may be unsuitable for breeding due to its distance from shore (> 100 m) and dense brush

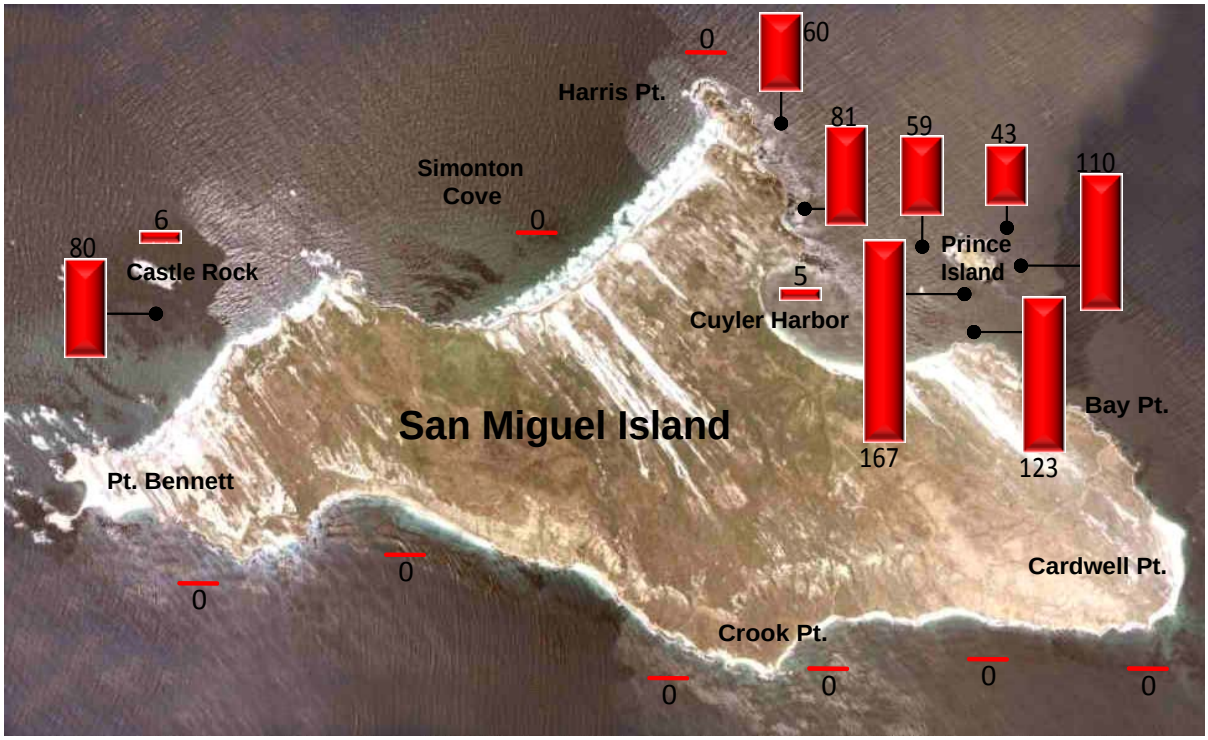


Figure 2-16. Number of vocal detections of Xantus's Murrelets heard within a 15-minute period at stations around the SMI group in April and May 1995-96 (Carter et al. 1997, unpubl. data).

which might impede departing chicks from reaching the shoreline. In addition, this area is very accessible to terrestrial predators such as island fox and introduced black rats (see below). Two theories may explain why relatively large numbers of murrelets occurred in northern Cuyler Harbor near the anchored support vessel despite little if any adjacent nesting habitat:

a) Under very windy conditions, murrelets may seek more protected waters that facilitate visual and vocal interactions in at-sea congregations. Strong winds blew at the SMI group on the capture nights of 24-25 April and 3-4 May, when relatively high numbers (about 10-20 birds) were noted around the support vessel. In contrast, fewer or no murrelets were found in this area during spotlight surveys on nights with less windy conditions on 1-2 May, 2-3 May, and 22-23 May. Under less windy conditions, these birds may have stayed in at-sea congregations closer to potential nesting areas farther north from Bat Rock to Harris Point; or

b) Lights on anchored vessels in Cuyler Harbor may have attracted murrelets to land on the water nearby. Lights on our support vessel were muted and large deck lights were turned off, except for safety when personnel were departing or returning on the inflatable craft. A few other fishing boats were also anchored in this harbor on these nights but had only very small anchor lights. Given known attraction to boat lights by murrelets (Whitworth et al. 1997, Carter et al. 2000), some attraction to greater night lights from our support vessels seems plausible but would not fully explain why more

birds were present during windy capture nights, although deck lights may have remained on for longer periods of time under these conditions.

Although no nests were found on the east side of Prince Island in 2007, nests were found on Prince Island during earlier studies in 1975, 1977, 1991 and 1999 (see Appendix 2). Previous studies suggested that the bulk of the murrelet population in the SMI group bred at Prince Island (Hunt et al. 1979; Carter et al. 1992, unpubl. data; Whitworth et al. 2005a). Failure to find nests on Prince Island in 2007 could have resulted from lower numbers of nests, timing of nest searches in relation to breeding phenology, or the limited amount and location of potential nesting habitats searched. Murrelets within nocturnal at-sea congregations were observed primarily along the north and west sides of the islet on 1-2 May near known breeding habitats that were not searched. On 2-3 May, a partial spotlight survey was conducted on the east side of Prince Island adjacent to areas searched on 24 April and 1 bird was seen but this date was about 1 month after the nest search. In any case, it was remarkable that most murrelets during 2007 spotlight surveys were observed off SMI proper rather than Prince Island. The majority of the small remaining population may now breed on SMI proper.

Historical Population Size and Breeding Distribution (1968-2004)

Prior to 1968, insufficient data were available on Xantus's Murrelets at the SMI group for assessment of population size or trends. From 1968 to 2007, information gathered on the status of Xantus's Murrelets was severely limited due to the small size of the breeding population, inadequate survey techniques, limited research effort, and difficult logistics of working at the SMI group. Without standardized data and study techniques over a substantial period of time, trends in population size for Xantus's Murrelets in the SMI group have been impossible to determine. However, it is valuable to review available information on population sizes and breeding distribution to explain differences between data obtained and point out any possible trends that may exist. A detailed summary of studies conducted at SMI group from 1968 to 2004 is presented in Appendix 2. A brief summary follows here:

First evidence of breeding by Xantus's Murrelets at the SMI group was obtained in 1968 by members of the Pacific Ocean Biological Survey Program conducted by the Smithsonian Institution. At Castle Rock, an adult with bare brood patches was captured by hand in a potential nest crevice but no evidence of eggs or chicks was found (Crossin and Brownell 1968; Appendix 2). At Prince Island, 6 eggshell fragments, 1 chick departing from the island, and 12 adults were found but nest sites were not reported (Huber 1968, Appendix 2). Eggshell fragments were not reported to have been found in nest sites. While firm evidence of breeding was obtained at Prince Island and suggestive evidence of breeding was obtained at Castle Rock, the discovery of the first active nest site at the SMI group did not occur. The size of the overall population was not estimated.

The first major studies of seabird population sizes, reproductive biology, diet, and foraging areas at the SMI group were conducted in 1975-77 by the University of California Irvine (Hunt et al. 1979). A survey to assess any changes in population sizes

since 1975-77 was conducted by Humboldt State University in 1991 (Carter et al. 1992). For the most part, information on murrelets was gathered opportunistically within both studies which involved work at both the SMI group and other Channel Islands. Nest searches, nest monitoring, and mist-netting were used to obtain data for all nocturnal species such as Cassin's Auklets, Ashy Storm-Petrels, Leach's Storm-Petrels, and Xantus's Murrelets (see Chapter 1). Almost all efforts were concentrated at the largest and most accessible breeding area for nocturnal seabirds within the SMI group at Prince Island where 1 nest was found in 1975 (first definite nest) and 4 nests were found in 1977. In 1975 and 1977, highest capture totals on a boat near the island in 1 night each year was 25 and 60 murrelets, respectively. Using available data, 75 breeding pairs were estimated for the SMI group, concentrated primarily on Prince Island, but small numbers also were thought to still persist on Castle Rock (although limited searches failed to find nests in 1976-77) and breeding was suspected at the north end of Cuyler Harbor (based on murrelet vocalizing at night in 1976-77). In 1991, Carter et al. (1992) recorded murrelet vocalizing during mist-netting for storm-petrels on the southeast end of Prince Island and 2 crevice sites with eggshell fragments were found during post-breeding season nest searches (Appendix 2). Never more than a few birds were calling at a time and only small numbers were suspected to breed there. No evidence of nesting at Castle Rock was obtained. The continued existence of a small breeding population at Prince Island was confirmed in 1991 but the 1975-77 breeding distribution and population size estimate were not improved upon. Trends in population size between 1968 and 1991 could not be determined.

In 1994-96, specific surveys for Xantus's Murrelets were first conducted to better determine breeding population sizes and distribution in the Southern California Bight (Carter et al. 1996b, 1997, unpubl. data). These surveys included nocturnal vocal detection surveys at 18 at-sea stations around the SMI group in 1995-96 and on land at 1 station at Prince Island in 1994-95, as well as nest searches at Prince Island and Harris Point-Cuyler Harbor in 1994-95 (Appendix 2). Vocal detection surveys focused on developing a relative index of murrelet activity (i.e., the number of "vocal detections" [each detection was defined as 1 or more calls from a certain direction separated by at least 5 seconds without calls from that direction] heard within a 15-minute period) at a station within nocturnal at-sea congregations off potential nesting areas. Stations were spaced along coastlines to provide wide coverage and placed close to potential nesting habitats on offshore islets, cliffs, and steep slopes. Relatively high levels of vocal detections were recorded from several at-sea stations around the SMI group in 1995-96, with highest activity around Prince Island, Castle Rock, Harris Point-Cuyler Harbor, and Hoffman Point Area (Figure 2-16). These surveys confirmed previous suspicions that Prince Island appeared to host most breeding birds within the SMI group but also that substantial breeding likely was occurring on SMI proper (Harris Point-Cuyler Harbor and Hoffman Point Area) and at Castle Rock. These coastal areas have similar recent volcanic rock types (Miocene andesites; Bremner 1933) which form cliffs and clearly develop suitable crevice nesting habitats over time. No vocal detections were noted on the south side of SMI proper, at the north tip of Harris Point, or in Simonton Cove. These coastal areas have older rock types (Eocene sandstones and mudstones; Bremner 1933) which appear to have little or no crevice development. Xantus's Murrelets likely have not nested along

other parts of the coasts of SMI proper in the past. Limited breeding distribution on SMI proper is related to a great extent to availability of suitable nesting habitats. Limited nest searches at Prince Island in 1994-95 and at Harris Point-Cuyler Harbor in 1994-96 were unsuccessful. Nest searches were not conducted at Castle Rock, Hoffman Point Area, and Bay Point Area. Vocalizing murrelets continued to be heard during storm-petrel mistnetting at Prince Island.

An estimate of 50-300 breeding pairs was determined by HSU, based mainly on 1995-96 vocal detection surveys and historical estimates (Burkett et al. 2003). The upper end of this estimate was higher than previous estimates, reflecting a higher potential population size depending on interpretation of vocal detection surveys and not an increase in population size. The wide range of this estimate reflected uncertainty in the relationship between numbers of vocal detections found on single surveys and numbers of breeding birds present in sampled areas as well as potential problems with extrapolating survey data to nearby unsurveyed areas. Based mainly on a comparison of relative levels of activity between Santa Barbara Island group (where population size is better known for portions of the main island) and the SMI group, a narrower estimate of 68-156 breeding pairs could be determined, with 32-63 at Prince Island, 6-12 at Castle Rock, and 30-81 on SMI proper (D. Whitworth and H. Carter, unpubl. data). Given difficulties with data interpretation, population estimates based on vocal detection surveys are very rough. While useful for broad-scale surveys for discovering breeding areas and making rough assessments of population size, vocal detection data should not be used for trend monitoring without much greater sample sizes.

In 2004, spotlight surveys of murrelets in at-sea congregations were first conducted at the SMI group to refine earlier population estimates and initiate development of baseline data for measuring trends in population size (Whitworth et al. 2005a). However, these surveys yielded unexpectedly low counts, given relatively high vocal detection counts in 1994-96 compared to some other Channel Islands. Using the same transects as in 2007, just 9 birds were counted on 29-30 March and on 26-27 May. A separate transect also was conducted in 2004 along the south side of SMI proper but no murrelets were seen. Similarly, no murrelets were found with vocal detection surveys in these areas in 1995-96 and breeding is not suspected on the south side of SMI proper. Low counts in 2004 may have been due to: a) poor marine conditions that caused reduced and late breeding at Anacapa Island and Santa Barbara Island; or b) poor timing of only 2 surveys in relation to breeding phenology under poor conditions. Given low survey effort at the SMI group in 2004, we may not have conducted surveys on nights of peak attendance, or low numbers may have attended the colony throughout the breeding season.

Given consistently low counts in March and May 2004 (maximum of 9 murrelets per survey) and May 2007 (maximum of 23 murrelets per survey), spotlight survey counts may indeed have been fairly representative of a very small murrelet population in both years. Spotlight surveys can detect a large percentage of birds in at-sea congregations on a particular night (Whitworth et al. 2003a,b) and, in both years, surveys covered most suitable nesting habitats on the east end of the SMI group, but excluded Castle Rock. If 2004 and 2007 spotlight counts are directly representative of the murrelet population in

the SMI group, population size could be as low as 0-10 breeding pairs (or 0-20 breeding individuals) if all birds were not breeding or all breeding birds were counted. If numbers of murrelets counted in at-sea congregations under-represented numbers of breeding birds (i.e., some birds occurred farther from shore or at Castle Rock and not all breeding birds attended at-sea congregations on survey nights), we tentatively estimate that as many as 50 breeding pairs (or 100 breeding individuals) could still breed at the SMI group. With low sample sizes of surveys and unusual conditions in 2004 and 2007, insufficient data were available to determine trends in population size between 2004 and 2007. While not directly comparable, higher levels of murrelet activity and higher population estimates were documented in 1995-96, possibly indicating decline between 1996 and 2004. Comparison of spotlight survey data and vocal detection survey data will require a special effort to study comparability in the same year. However, this study should be conducted at Anacapa Island where weather conditions are not as severe and murrelet populations are larger and more widespread.

Future Monitoring

Spotlight surveys in 2007 provided important baseline data for assessing population size and future population trends at SMI proper and Prince Island. Based on 2007 nest searches (if representative), adequate samples of nests may not be available for monitoring, and baseline spotlight surveys will be the most important technique for assessing population size and future trends, particularly at this apparently small colony where almost all birds may nest at sites that are inaccessible to humans (e.g., cliffs). Spotlight surveys provide direct and repeatable counts of individuals and can be conducted under calm to moderately windy conditions on the east side of the SMI group. Vocal detection surveys provide indirect measurement of vocal activity, likely have much greater interobserver variation, and require relatively calm conditions (which rarely occur at the SMI group). To form a more solid baseline for measuring future murrelet population trends at the SMI group, greater spotlight survey effort (e.g., 15 surveys per year) would be required in at least 1 year (if not 2-3 years) without unusual conditions. After a solid baseline is developed, periodic standardized monitoring (perhaps every 3-5 years) with adequate survey effort and without unusual conditions would be needed to detect trends.

Additional nest searches on SMI proper (especially in Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area) are needed in future years to attempt to find more nests to more directly examine effects of rat depredation and rat eradication. In 2007, nest searches were limited by available time, boat-accessible areas, and a lack of climbing equipment and expertise. Future work should aim to examine a greater proportion of potential nesting habitats on SMI proper in years without unusual marine conditions.

Anthropogenic Impacts

Island Fox: In the past, island fox likely prevented nesting by Xantus's Murrelets on many parts of SMI proper which fox have inhabited for the last 16,000 years (Streator 1887; Wayne et al. 1991). While island fox have not been documented as specific

predators of Xantus's Murrelets, fox species in general are formidable predators of ground nesting birds. Red fox (*Vulpes vulpes*) and arctic fox (*Alopex lagopus*) have been responsible for seabird population reductions and extirpations on many islands in the northeast Pacific (Bailey and Kaiser 1993). Xantus's Murrelets nest in steep coastal areas (e.g., cliffs and sea caves) which are inaccessible to island fox at Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area. Almost all remaining coastlines of SMI proper are accessible to fox. In the 1990s, the island fox population declined precipitously due to predation by Golden Eagles (*Aquila chrysaetos*) and other factors (see Chapter 1). The few remaining fox were temporarily taken into captivity, as part of an endangered species recovery program, but recently released back onto SMI proper. Currently, island fox numbers are low and likely have little or no direct impact on Xantus's Murrelets (but see black rat below).

Black Rats: Until recently, island fox probably restricted introduced black rats to isolated beaches on the west end of SMI proper which may have been near the introduction site (Erickson and Halvorson 1990, McChesney and Tershy 1998; see Chapter 1). However, drastic declines in fox numbers and their subsequent captivity may have allowed recent expansion of rats throughout coastal habitats on SMI proper. The rat-depredated murrelet egg at found at Bay Point Area in 2007 provided direct evidence of impacts from rats on Xantus's Murrelets on SMI proper. Evidence of rats was also found in prime seabird breeding habitat in the Harris Point area, suggesting that rats likely have been impacting seabirds there. In 1994-95, rats were not noted in sea caves within SC 4 where Rhinoceros Auklets were studied (McChesney et al. 1995), although rat sign may have been overlooked. No Rhinoceros Auklets were found nesting in this area in 2007 but a severed head appeared to be the work of rats (see Chapter 1). The overall extent of rat impacts on Xantus's Murrelets on SMI proper cannot be determined with available data.

A seabird restoration program for the SMI group, including the eradication of introduced rats at SMI proper, is being considered by CINP and the Montrose Trustee Council (MSRP 2005; see Chapter 1). A similar restoration project was initiated at Anacapa Island in 2000, with rat eradication completed in December 2002 (Howald et al. 2005). Xantus's Murrelet was identified as the breeding seabird species that would most benefit from rat eradication at Anacapa Island, thus a special monitoring program was developed to monitor murrelet breeding success and population levels pre- and post-eradication. Several rat-depredated murrelet nests were found in sea caves during baseline data collection from 2000 to 2002 (Whitworth et al. 2003b) that further justified the removal of rats from Anacapa Island (Whitworth et al. 2005b). With continued post-eradication monitoring in 2003-08, increased hatching success and considerable expansion of the Xantus's Murrelet colony has been documented (Whitworth et al. 2005b, 2008).

Although data demonstrating the degree of detrimental effects of rats on Xantus's Murrelets and other seabirds on SMI proper are not readily available, the discovery of 2 depredated murrelet nests in 2007 suggested that rat eradication would have substantial benefits for small numbers of Xantus's Murrelets still breeding on SMI proper. Potential benefits include: a) preventing extirpation by rats of this small murrelet population which may currently occur primarily on SMI proper; and b) improving reproductive success and

increasing population size to prevent extirpation by other factors (e.g., oil spills or prey changes). Loss of this colony would be a significant impact to the U.S. and world population because: a) the SMI group hosts the only murrelet population that occurs close to the upwelling center off Point Conception where many murrelets likely feed primarily on upwelled prey; and b) the already restricted breeding range would be reduced by about 50 km, with loss of use of a relatively large amount of potential nesting habitat, and Santa Cruz Island would become the new northern limit of breeding. Another important benefit to consider is that removal of rats from SMI proper would help prevent future potential introduction of rats from SMI proper to Prince Island which: a) has historically hosted most Xantus's Murrelets in the SMI group; and b) hosts regionally important populations of other vulnerable crevice or burrow nesting species (i.e., Leach's Storm-Petrel, Ashy Storm-Petrel, and Cassin's Auklet). Accidental rat introduction to Prince Island by humans also might result in the extirpation of Xantus's Murrelets from the SMI group.

***Avian Predators*:** Peregrine Falcons, Barn Owls, and Bald Eagles are significant predators of small alcids at breeding colonies. Substantial populations of falcons and owls occur at the SMI group with many nesting areas associated with breeding areas of murrelets and other nocturnal seabirds, especially at Prince Island (see Appendix 1). At the SMI group, falcons and owls undoubtedly take considerable numbers of storm-petrels, Xantus's Murrelets, and Cassin's Auklets. In the 1940s, the Peregrine Falcon population disappeared, likely due to organochlorine pollution (Kiff 1980); however, by the early 1980s, falcons were again seen regularly at the SMI group in autumn and winter (Stewart and DeLong 1984). By 2007, at least 6 nests existed (B. Latta, unpubl. data; see Chapter 1, Appendix 1). Numbers of Barn Owls increased at SMI proper after the loss of foxes in the late 1990s, probably reflecting increased mouse populations (C. Drost, pers. comm.; see Chapter 1). Two sets of wings and sternum of Cassin's Auklets were found at a Barn Owl roost in Nidever Canyon on SMI proper in 2005 which possibly reflected increased Barn Owl numbers and greater use of seabird prey than in the past (C. Drost, pers. comm.).

Bald Eagles have been absent from the northern Channel Islands since the mid 1950s after decades of human persecution and impacts from organochlorine pollution. Recent efforts by the MTC and CINP have attempted to reintroduce Bald Eagles to the northern Channel Islands (see Chapter 1). In addition to reintroduction, highly territorial Bald Eagles should prevent relocated Golden Eagles, which preyed heavily on island fox, from returning to the Channel Islands. If this reintroduction is successful, the return of Bald Eagles to the northern Channel Islands may lead to increased predation pressure on Xantus's Murrelets. However, while Xantus's Murrelets have been recorded as occasional prey of Bald Eagles at Santa Catalina Island (Valoppi et al. 2000), it is not clear to what extent they will prey on murrelets once they reoccur at the SMI group. With higher murrelet population sizes in the past, loss of some murrelets to predation by eagles could be considered to be natural and not a problem at a population level. However, with currently reduced and recovering murrelet populations in the Channel Islands, eagle predation may contribute to relatively high predation along with other raptors which might contribute to loss of small colonies or slow growth at recovering colonies (i.e., Anacapa and possibly SMI proper in the future). To better assess the degree of predation by various raptors on nocturnal seabirds, a low-

effort method of improving knowledge of raptor predation would be to conduct annual counts of seabird carcasses at raptor nest and roost sites.

Western Gulls and Common Ravens (*Corvus corax*) are both known to prey upon small alcids (e.g., Oades 1974, Nelson 1989, Thayer et al. 1999) and both gulls and ravens are widespread and abundant in coastal habitats at the SMI group (see Appendix 1). About 500-1,000 breeding pairs of Western Gulls breed on Prince Island (see Chapter 1) and prey on Cassin's Auklets (Hebshi and Sydeman 1999). Predation by Western Gulls may have played an important role in the apparent decline of the Cassin's Auklet population, although changes in prey resources may have been the chief cause (Chapter 1). Gull predation also may have significant effects on the murrelet population at Prince Island, particularly at the current low murrelet population level. Greater assessment of the effects of murrelet predation by gulls and ravens is desirable but would be difficult without high effort.

***Nest-site Competition*:** At Prince Island and Castle Rock, Xantus's Murrelets must compete for nest sites with other crevice or burrow nesting alcids, including Pigeon Guillemots, Cassin's Auklets, and Rhinoceros Auklets. Cassin's Auklets are the most abundant competitor at Prince Island, with an estimated 10,000 breeding pairs in 1975-77 (see Chapter 1). Hunt et al. (1979) noted that murrelets "may be out competed for nest space by the ubiquitous Cassin's Auklet on Prince Island". Although little is known about competitive interactions between these species, this supposition seems plausible when auklets occur in large numbers because: a) auklets breed extensively in burrows where any soil habitat exists but also nest widely in rock crevices that appear to be suitable for murrelets; and b) auklets are much more aggressive than murrelets when handled by humans. The Prince Island auklet colony has been long-established (although first reported in 1886 by Streator [1888]) and large numbers of auklets have probably contributed to small numbers of murrelets breeding on Prince Island. However, only 4,500 breeding pairs of Cassin's Auklets were estimated in 1991 (Carter et al. 1992) and numbers appear to have declined greatly since then with no successful breeding in 2006-07 (J. Adams, unpubl. data). At present, auklet competition probably is not affecting murrelet nesting at Prince Island and, on the contrary, empty burrows may have created much available nesting habitat for murrelets. Pigeon Guillemots and Rhinoceros Auklets breed in lower numbers mainly in crevices along the north cliffs of Prince Island and may not overlap extensively with Xantus's Murrelets. Similar conditions and breeding species exist on Castle Rock although breeding habitats are more limited there.

Changes in Prey Resources: Possible population decline of Xantus's Murrelets in the SMI group since the mid 1990s may be linked to long-term changes in the marine environment. Recent warming trends in ocean temperatures have been linked to decreased upwelling and reduced current flow in the California Current, resulting in low primary productivity that has important implications through the food chain (Roemmich and McGowan 1995). Warming trends in the northeast Pacific have been associated with changes in species composition and abundance of plankton, fish and seabirds in the California Current System (Veit et al. 1996, Field et al. 2006). Changes in prey resources may have led to reduced prey availability during the breeding season, resulting in poor

reproductive success and population decline. In the absence of other impacts, it is not clear if changes in prey resources would alone lead to extirpation of the murrelet population from the SMI group, even though this colony occurs at the northern edge of the breeding range. An almost complete lack of egg laying of Cassin's Auklets occurred in 2006-07 at Prince Island, apparently due largely to changes in prey resources (J. Adams, unpubl. data). However, prey resources likely differ between these 2 alcid species (Adams et al. 2004, Hamilton et al. 2004). Regardless, similar factors may be depressing the murrelet population. Unlike Santa Barbara Island and Anacapa Island, nothing is known of the diet of Xantus's Murrelets at the SMI group, or foraging areas used by murrelets from the SMI group during the breeding season (Hunt et al. 1979, Whitworth et al. 2000, Hamilton et al. 2004, Hamilton 2005). Thus, it is difficult to assess how prey changes may be affecting Xantus's Murrelets. We suspect at a minimum that such changes have occurred and have reduced reproductive success, contributing to possible population decline. In addition, small numbers of dead murrelets were found on SMI and Santa Rosa Island beaches during the 1998 El Niño event (Appendix 2). Heightened mortality of adults or subadults also may have occurred during this event.

Guano Harvesting: Extensive guano harvesting on Prince Island in the late 1800s likely affected nesting habitats of Xantus's Murrelets, Cassin's Auklets, and other burrow and crevice-nesting species at Prince Island (see Chapter 1). Initial guano harvesting was documented at two islands in Cuyler Harbor (Prince Island and possibly Hare Rock) in 1895 when ten tons of guano were carted off the island in sacks on the shoulders of sailors and loaded aboard the schooner *Glen* and taken to San Diego (SFC 1895; Doran 1980). In addition, eight tons of guano were harvested at "San Miguel Island" (probably Prince Island) and brought to San Diego aboard the schooner *Ellen* on 21 October 1895 (SDU 1895). Some harvesting likely occurred before 1895 and some may have continued afterward. Removal of this large amount of guano significantly affected breeding habitats for burrow-nesting and crevice-nesting seabirds. In areas with thick layers of guano, Cassin's Auklets can burrow directly into the guano layer (H.R. Carter, pers. obs.). When guano is removed from an area, not only is burrow-nesting habitat lost but small boulders and loose rocks within these areas also are altered or moved, removing potential crevice-nesting habitat for Xantus's Murrelets and storm-petrels. Remaining soil can be washed away by rain often leaving bare rock without suitable nesting crevices. Most harvesting probably occurred on the top and south end of the island because these areas were most accessible. Rubble fields and boulder piles on the southeast side may reflect displacement of larger rocks during guano harvesting. However, damages from bombing impacts also may be involved (see below). Creeping soil on steep slopes at the northeast end of the island also may suggest attempted limited harvesting or bombing in this area. Further assessment of guano mining impacts is needed.

Bombing Impacts: The use of the SMI group as a military bombing range in the 1940s to 1960s undoubtedly affected nesting habitats of the Xantus's Murrelet in limited crevice- and burrow-nesting habitats on Prince Island (see Chapter 1). The top of Prince Island is composed of bare rock and soil creep is occurring in certain areas, particularly at the northeast end. While guano harvesting likely was responsible for much reduction in breeding habitats (see above), some loss of soil and crevice-nesting habitats also likely

occurred due to bombing, but explosions also may have created nesting habitat in rubble field and boulder piles on the southeast side of the island. Little direct evidence of bomb craters or debris is available at Prince Island. Little or no bombing may have occurred on Castle Rock and Point Bennett because of well-known marine mammal populations (see Chapter 1).At Castle Rock, 2 large crater-like sinkholes above sea caves may have been created by a large earthquake in 1895 (Johnson 1972, Doran 1980). Further assessment of impacts of bombing at Prince Island (and possibly at Castle Rock) is needed.

***At-sea Impacts*:** Carter et al. (2000) reviewed at-sea conservation issues for Xantus's Murrelets in the SCB, including mortality due to oil pollution, organochlorine pollution, gill-net fishing, bright lights, and military weapons testing far at sea. Without recovery of carcasses of banded individuals from the SMI group and with little documentation of such issues near the SMI group, it is very difficult to evaluate the degree of these threats on the small murrelet population at the SMI group over time. However, it is important to acknowledge that these issues have occurred and continue to occur, likely contributing to small population size and potential decline at the SMI group. Oil spills have potential to contribute to the extirpation of the small murrelet population in the SMI group, along with impacts from introduced rats (see above). Measures should be put in place to prevent the use of bright lights on boats around the SMI group, especially in the main anchorage in Cuyler Harbor. In particular, squid fishing with bright lights should be prevented near Prince Island, Castle Rock, Harris Point-Cuyler Harbor, Hoffman Point Area, and Bay Point Area from February to November, a period that encompasses the breeding season of Xantus's Murrelets and other seabirds (see Chapter 1).

Natural Changes to Breeding Habitats

Significant natural erosion and landslides have occurred at certain coastal areas of SMI proper but most seabird breeding habitats appear to have been little affected, except for a major landslide on the north side of Cuyler Harbor in 1940-42 (Johnson 1972) which may have removed some breeding habitat for Xantus's Murrelets, although also perhaps created some breeding habitat for Ashy Storm-Petrels (see Chapter 1). On Prince Island, erosion appears enhanced by guano harvesting and bombing (see above). At Castle Rock, 2 large sinkholes above sea caves may have been created by an earthquake in 1895 (Johnson 1972) and led to some loss of some breeding habitat for Xantus's Murrelets.

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Appendix 1. Avian predators in the San Miguel Island group, 1968-2007

Although not the focus of seabird surveys and monitoring, various observations of avian predators have been recorded in the SMI group during seabird work. Although observations were not standardized and few observations were made in the interior of SMI proper, an increase in avian predator populations seems to have occurred between 1991 and 2007. More work is needed to assess potential changes in seabird predation. While we have not collated all possible observations, especially those of raptor and landbird researchers, available observations during seabird work are presented for each research group and year below:

Smithsonian Institution: 1968 (Huber 1968)

SMI proper: During a survey trip on 28 May to 7 June 1968, 2 adult and 1 immature Red-tailed Hawk (*Buteo jamaicensis*) were observed at various times, most commonly in the upper interior behind Cuyler Harbor. Several American Kestrels (*Falco sparverius*) were noted, mostly scattered along outer cliffs. A pair of Barn Owls was found in a small cave in the back of a steep, wind-blown barranca in the upper interior of the island. A partial egg shell, probably of this species, was found below the cave. No signs of nesting at this time were observed. Approximately 20 pellets were opened and found to contain over 95 percent *Peromyscus* with the remainder small birds, apparently House Finches (*Carpodacus mexicanus*).

Prince Island: Between 28 May and 7 June 1968 (see Appendix 2), a few pellets, Barn Owl size, were found on the rocks on the southeast side of the islet. They were all composed of mouse hair with a few pieces of small crab exoskeleton.

Humboldt State University: 1991 (Carter et al. 1992, unpubl. data)

Prince Island: During ground surveys and storm-petrel mistnetting on 8-9 January, 1 Peregrine Falcon was seen during the day (and a falcon also was found roosting on the west side at midnight) and 1 owl (possibly Burrowing Owl *Athene cunicularia*) was heard at night. During nest searches and storm-petrel mistnetting on 4-5 April, 1 Peregrine Falcon (brownish – possibly immature) flew in and landed in gap in cliff on the southeast side at 17:20 h. During storm-petrel mistnetting on 8-9 June, 1 Barn Owl was heard calling at 23:38 h. During daytime burrow and crevice counts on 22-23 October, 2 Barn Owls were seen flying over the island on 22 October. On 23 October, 3 Barn Owls were seen together, with one being chased by the others and much accompanying vocalization. The owl being chased landed briefly on south side. No avian predators were recorded on several other dates when the island was visited in April to July.

Harris Point-Cuyler Harbor: During a boat survey on 11 May, 1 Peregrine Falcon was seen flying and landing at a potential eyrie site in SC 5. On other boat surveys on 7 June and 12 July, none were recorded.

Castle Rock: During boat surveys on 3 April, 11 May, 10 June, none were recorded. During a ground survey on 21-22 October, 3 old Bald Eagle nests were noted, with 1 nest on the middle peak and 2 nests on the west peak. Nests were composed of very large sticks with some pinniped bones.

Channel Islands National Park: 1993 (P. Martin, unpubl. data)

Prince Island: On 15 July, 1 Osprey (*Pandion haliaetus*) was seen flying high overhead.

Humboldt State University: 1994 (H.R. Carter, unpubl. data)

***Prince Island*:** On 9 April at 08:30 h, 1 probable immature Red-tailed Hawk flying over island, landed on ledge on southeast cliffs, and then was chased by gulls, causing 200 Brandt's Cormorants to flush off the southeast corner. On 10 April, 1 old dead Western Gull with cleaned sternum found, possibly a Peregrine Falcon kill. On 11 April, 1 Red-tailed Hawk was seen at the west end at 08:38 h and a juvenile appeared along the northeast ridge and flushed about 100 Western Gulls. During mistnetting on the night of 11-12 April at net site #1, Barn Owls were heard at 20:25-20:30 h (3 times) and 20:45 h (netting from 20:20-04:03 h). On 12 April, 3 Common Ravens arrived at the island at sunrise from the south. During mistnetting on the night of 12-13 April at net site #1, Barn Owls were heard at 20:28 h and 23:50 h (circling overhead) (netting from 20:00-04:00 h). On 4 May at 15:30 h, 1 Red-tailed Hawk flew over and disturbed gulls and cormorants. During mistnetting on the night of 5-6 May, a possible Peregrine Falcon chick was heard "clicking" above net site #1 at 20:43 h and Barn Owls were seen or heard and recorded only at 22:45 h (netting from 20:23-04:04 h). During mistnetting on the night of 12-13 July, a Barn Owl was heard and recorded only at 22:23 h (netting from 21:01-04:00 h). During mistnetting on the night of 6-7 August at net site #2, Barn Owls were heard at 22:50 h and 01:30 h (netting from 20:45-04:45 h). On 7 August (09:51 h), an adult female Peregrine Falcon flew in and perched on the north cliffs and a pile of 20 carcasses of Pigeon Guillemots (mainly adults but at least 2 juveniles) was found below this perch location at the entrance to a cave. During mistnetting on the night of 7-8 August at net site #2, a Barn Owl was heard and recorded only at 21:12 h (netting from 20:15-02:30 h).

Harris Point-Cuyler Harbor: On 5 May, an adult male Peregrine Falcon was seen flying and then returning to a perch in SC 5 (Nifty Rock area) at 09:18 h and was still perched there at 10:18 h. At 10:43 h, it was no longer at the perch but responded to "kacking" by J. Gilardi and flew in from west, perches about 20 m above a cavity, flies out and returns to perch above cavity, and then flew down into another east facing cavity. Also on 5 May at 10:52 h, a different adult male was seen soaring low over the cliff at SC 12-14 (Bat Rock) and perching high above the cliff. On 12 July, 2 Peregrine Falcons flew overhead at SC 14-15 where several carcasses of Cassin's Auklets and Ashy Storm-Petrels were found. On 13 July, 1 Peregrine Falcon was seen flying at SC 4 and one flying pair and 1 perched immature were seen at SC 12 (Bat Rock). On 8 August, 1 adult was seen flying around cliffs at SC 12 (Bat Rock).

Cuyler Harbor: On 8 April, 2 Peregrine Falcons flew by the cliffs on the west side of the harbor. Common Ravens were seen several times above the anchorage on 7-12 April. On 12 July, 2 Peregrine Falcons flew overhead on our arrival at

Humboldt State University: 1995 (H.R. Carter, unpubl. data)

Prince Island: During mistnetting on the night of 3-4 May Barn Owls were heard and recorded calling at 20:35 h, 21:28 h, and 23:42 h at net site #1 (netting from 20:46-04:00 h) and at 20:33 h and 21:53 h at net site #2 (netting from 20:33-23:15 h).

Humboldt State University: 1996 (H.R. Carter, unpubl. data)

Prince Island: 1 Red-tailed Hawk seen above the cactus at the southeast peak on 23 April. On 29 April, a Barn Owl roost was found in an upper cave on the southwest side with Cassin's Auklet remains and pellet.

Harris Point-Cuyler Harbor: During nest searches in SC 13 and 14 on 29 April, 2 dead adult Barn Owls were found in a cave.

Point Reyes Bird Observatory: 1998 (A. Hebshi and W.J. Sydeman, unpubl. data)

Prince Island: On 18 March, 2 or 3 Peregrine Falcons were present. On 24 March, 1 Peregrine Falcon was observed on the north side. This bird called, flew over, and hovered overhead for a few seconds when Hebshi walked along the high slope. In April, Barn Owl predation was noted. A small cave on the eastern spine of Prince Island was littered with 5 fresh auklet carcasses and a dozen pellets, with 3 pellets containing whole auklet skulls with bills. About 6 more sets of wings were seen around the southeast end. In May, only 1 new carcass was observed during 7 visits to the same areas in May (including the cave mentioned above). On 31 May, a Red-tailed Hawk was seen clutching a Western Gull chick in its talons. In June, Barn Owls were heard almost every night spent on the island (but no new carcasses were found) and the Red-tailed Hawk nest fledged 3 chicks.

Hoffman Point Area: The Peregrine Falcon nest at SC 2 fledged 1 chick.

Harris Point-Cuyler Harbor: The Peregrine Falcon nest at Bat Rock (SC 12-13) fledged 1 chick.

Channel Islands National Park: 1998 (P. Martin, unpubl. data)

Simonton Cove: During a Snowy Plover (*Charadrius alexandrinus*) survey (19-22 May), a dead Rhinoceros Auklet was found that may been killed by a Peregrine Falcon or a Barn Owl. At another location, a dead Cassin's Auklet and a dead Xantus's Murrelet were found close together and may have been killed by a Peregrine Falcon or Barn Owl. A Common Raven nest was found at Charcoal Beach.

Point Reyes Bird Observatory: 1999 (A. Hebshi and W.J. Sydeman, unpubl. data)

Prince Island: In April, Barn Owls were heard each night worked at the island. Up to 3 have been observed at once. On 23 April, a Barn Owl roost was discovered on the south face in a rocky outcrop. The area was littered with pellets, consisting exclusively of Cassin's Auklet remains. A Western Gull that specialized on Cassin's Auklets was routinely seen pecking at its catch in the mornings on the southeast side.

Cuyler Harbor: On 6 June, about 50 Common Ravens were observed in the Nidever drainage. Common Ravens have been observed congregating in massive flocks around SMI proper.

Carter Biological Consulting & California Institute of Environmental Studies 2007 (This study)

Prince Island: During nest searches on 24 April, several observations were made: a) 1 Red-tailed Hawk was seen flying overhead; b) a Barn Owl primary feather and 8 carcasses of Cassin's Auklets were found in a ravine on the east side of the island; and c) 3 other Cassin's Auklet carcasses were found on the east side. During a boat survey on 25 April, 1 Red-tailed Hawk was seen at 07:00 h at the top of the south end; and at 08:15 h, 1 Red-tailed Hawk was chased by 1 Peregrine Falcon at the south end. During a boat survey on 19 June at 14:07-14:17 h, 1 Peregrine Falcon was heard calling and seen flying over the north cliffs and possibly another falcon called from the cliff area itself but was not seen.

Harris Point-Cuyler Harbor: During a boat survey on 24 April, Common Ravens were seen flying off SC 1 (n = 6), SC 9 (n = 3), and SC 11 (n = 2). On 1 May at 11:55 h (observations from the anchored support vessel), 15 Common Ravens circled the north end of Cuyler Harbor and 1 Peregrine Falcon flew by the north end of the harbor. During nest searches on 1 May, 1 Red-tailed Hawk, 1 Peregrine Falcon, and 1 Common Raven were seen at 13:40 h at SC 4 where owl pellets also were found in a large crevice and a large hatched eggshell membrane from an owl or large alcid was found in a long crevice with a dirt floor. During nest searches on 3 May, the skeleton of an owl (probably a Barn Owl) was found above SC 14-15 at the north end of Cuyler Harbor. During a boat survey on 22 May, 1 Peregrine Falcon was heard calling and seen landing high on the cliffs in SC 6. During a boat survey on 24 May, 2 Peregrine Falcons were heard calling at SC 12 (Bat Rock).

Hoffman Point Area: During nest searches on 24 April, 1 Peregrine Falcon was seen landing about three quarters of the way up the cliff at a potential nest ledge. During a boat survey on 24 April, 2 Common Ravens were seen flying off SC 2. During a boat survey on 22 May, 1 Common Raven was observed on a nest above the area where the Xantus's Murrelet eggshell was found in SC 2 and 2 Peregrine Falcons landed at different areas high up on Hoffman Point (SC 2).

Bay Point Area: During nest searches on 24 April, 1 Peregrine Falcon was noted and 1 Common Raven made repeated landings at a potential nest site in a large cave in the

center of the point. During nest searches on 22 May at 13:30 h, 1 Peregrine Falcon was heard calling as it flew above.

***Castle Rock*:** On 23 May at 07:45-08:06 h, 2 Peregrine Falcons were heard calling and observed landing on the south-facing top of the east peak. Later on the same day (12:50-13:30 h), 2 Peregrine Falcons and 1 Common Raven were noted at the rock.

Point Bennett: On 23 May, 2 Common Ravens were noted at SC 8 (08:40-08:47 h) and 2 more Common Ravens were noted at SC 9 (08:47-08:54 h).

Anubis Point (Northwest San Miguel Island): On 23 May at 09:07-09:08 h, 1 Common Raven was noted at SC 1.

***Tyler Bight-Adams Cove*:** On 23 May at 15:03-15:10 h, 3 Common Ravens were noted at SC 4.

U.S. Geological Survey: 2000-07 (J. Adams, unpubl. data)

Prince Island: On 27 April 2002, a huge pile of auklet carcasses was found along the southeast spine, another 11 carcasses were found on the southeast end and along part of the south side, and 1 Peregrine Falcon was observed at the west end. Since 2000, avian predators have been observed consistently: a) a pair of Red-tailed Hawks has nested and produced chicks at the crest of the southeast slope in several years; b) Barn Owls were consistently observed during night work; and c) at least 1 Peregrine Falcon occurs regularly at the southeast side (J. Adams, unpubl. data).

Santa Cruz Predatory Bird Group: 2007 (B. Latta, unpubl. data)

Eight Peregrine Falcon territories (6 active) were recorded at SMI proper in 2007, including: Bat Rock, Carbon Point, Cardwell Point, Crook Point, Hoffman Point, Rat Trap, Salvador Point, and Science Point. [CBC and CIES confirmed activity at Bat Rock and Hoffman Point, did not have activity at Cardwell Point and Crook Point but we are not familiar with other locations named (i.e., Carbon Point, Rat Trap, Salvador Point and Science Point)].

Appendix 2: Historical summary of Xantus's Murrelets at San Miguel Island, 1968-2004

Below, available evidence of breeding by Xantus's Murrelets and efforts to document breeding at the SMI group from 1968 to 2004 are summarized in some detail:

Smithsonian Institution, Pacific Ocean Biological Survey Program: 1968 (Crossin and Brownell 1968, Huber 1968)

● At Castle Rock, R.S. Crossin and R.L. Brownell found an adult murrelet with bare brood patches in a rock crevice without eggs or chicks and collected on the night of 14-15 May (Crossin and Brownell (1968). No mention of murrelet presence or nesting was found during a brief visit to Prince Island from 18:00-23:00 h on 15 May 1968.

● Between 28 May and 7 June 1968, L. Huber and J.T. Lewis found 6 broken eggshells at Prince Island, and 12 adults and 1 chick were captured and collected on the rocky slopes at the east and southeast ends (Huber 1968). A rough estimate of 45 $\pm$ 5 individuals was determined, without details. Castle Rock was not landed upon during this trip.

● In November 2000, the Smithsonian Museum (which houses the U.S. National Museum [USNM]) was visited and details recorded on specimen tags were recorded (H.R. Carter, unpubl. data). In January 2008, Smithsonian staff C. Angle and R. Clapp further clarified and confirmed many details. Key information on these specimens (except for certain measurements, empty stomachs, and fat level) is provided below:

● Castle Rock Adult: USNM 544041 (POBSP 140384; 14 May 1968, male, 166.5 g, bare brood patches, collectors R.S. Crossin and R.L. Brownell, prepared by T.J. Lewis. No eggs or eggshell fragments from Castle Rock were found in the U.S. National Museum.

● Prince Island Chick: USNM 544888 (POBSP 140178; 4 June 1968, male, 18.5 g, "coll by hand – rocky slope", collector L. Huber, prepared by T.J. Lewis). In addition, an archived museum data card reported that this chick had been "caught on its way to its calling parent offshore", as reported by Huber (1968).

● Prince Island Eggshell Fragments: No eggs or eggshell fragments from Prince Island were found in the U.S. National Museum.

● Prince Island Adults:

1) USNM 544885 (POBSP 140493; 4 June 1968, male, 152 g, refeathering brood patches, "coll by hand on rocky slope", collected and prepared by T.J. Lewis).
2) USNM 544886 (POBSP 140490; 4 June 1968, female, 185 g, bare brood patches, "coll: rocky slope by hand", collector L. Huber, prepared by T.J. Lewis).
3) USNM 544887 (POBSP 140469; 31 May 1968, female, 161 g, bare brood patches, "coll by hand – rocky slope", collected and prepared by L. Huber).
4) USNM 544889 (POBSP 140492; 4 June 1968, male, 162 g, no brood patches, "coll by hand on rocky slope", collected and prepared by T.J. Lewis).

5) USNM 544890 (POBSP 140468; 31 May 1968, female, 159 g, brood patches refeathering, "coll by hand – rocky slope", collector L. Huber, prepared by J.T. Lewis).
6) USNM 544891 (POBSP 140740; 31 May 1968, male, 150 g, bare brood patches, "coll by hand", collected and prepared by T.J. Lewis).
7) USNM 544892 (POBSP 140489; 4 June 1968, female, 179 g, bare brood patches, "coll by hand on rocky slope", collected and prepared by T.J. Lewis).
8) USNM 544893 (POBSP 140491; 4 June 1968, female, 173 g, bare brood patches, "coll by hand – rocky slope", collector L. Huber, prepared by T.J. Lewis).
9) USNM 544894 (POBSP 140494; 4 June 1968, male, 174 g, refeathering brood patches, "coll by hand on rocky slope", collector L. Huber, prepared by T.J. Lewis).
10) USNM 544895 (POBSP 140466; 31 May 1968, female, 174 g, refeathering brood patches, "coll by hand – rocky slope", collector L. Huber, prepared by T.J. Lewis).
11) USNM 544896 (POBSP 140471; 31 May 1968, female, 165 g, bare brood patches, "coll: rocky slope by hand", collector L. Huber, prepared by T.J. Lewis).
12) USNM 544897 (POBSP 140467; 31 May 1968, male, 178 g, bare brood patches, "coll by hand – rocky slope", collector L. Huber, prepared by T.J. Lewis).

● J.T. Lewis (pers. comm.) confirmed that no nests were found at Prince Island and Castle Rock in 1968. At Prince Island, work was conducted on the night of 4-5 June, the night Robert F. Kennedy was assassinated. They used headlamps with focused beams to work at night which may have attracted murrelets to land near them. On approach to the SMI group, they also saw more murrelets within a few miles of shore than expected.

● At SMI proper, Hare Rock was examined on 15 May 1968 but no murrelets or other nesting seabirds were recorded (Crossin and Brownell 1968). Between 28 May and 7 June, no studies were conducted on SMI proper because the U.S. Navy would not give permission to work there (Huber 1968; J.T. Lewis, pers. comm.). However, Huber (1968) noted that the presence of Xantus's Murrelets at SMI proper was nearly impossible to determine and they may be found in selected localities, such as the rock slope directly south of Prince Island (i.e., Hoffman Point Area).

University of California Irvine: 1975-77 (Hunt et al. 1978, 1979, unpubl. data)

● At Castle Rock, no evidence of murrelet nesting was found during brief landings on 8 June 1976 and 4 June 1977.

● For Prince Island, only a brief summary of 1975-77 findings about Xantus's Murrelets was presented. In 1975, a single nest was found and a "high count" (i.e., defined as "the greatest number of birds captured on or near the island on any one night" of 25 murrelets occurred on 13 May. R.L. Pitman (pers. comm.) clarified that captures of large numbers of murrelets occurred on a boat anchored near the island. In 1976, no nests were found and 10 birds were banded. In 1977, 4 nests were found, 8 birds were banded, and a high count

of 60 birds occurred on 20 March. Despite extensive nest searches, few nests were found at Prince Island, all of which were found along the southeast end of the islet.

● At SMI proper, murrelets were heard vocalizing on the water near a rocky cliff just north of Cuyler Harbor within the Harris Point-Cuyler Harbor colony on 21 May 1976. In 1976 and 1977, murrelets also were heard vocalizing in Cuyler Harbor and a few flew on board the anchored boat there. No landings occurred in the Hoffman Point Area.

● During shipboard at-sea surveys in 1975-76, Xantus's Murrelets were noted within 10-minute latitude by 10-minute longitude blocks near the SMI group in: a) May 1975 (northwest and south sides); b) July 1975 (northwest side); c) September 1975 (south side); and d) mid March 1976 (northeast side). Aerial surveys in 1975-76 did not sample waters close to the SMI group.

● On 15 February 1977, 2 adult *scrippsi* males were collected by G.L. Hunt, Jr., 5 miles [11 km] north of Harris Point (34° 02' N; 120° 20' W; LACM 88020, 90223)

● An estimate of 75 breeding pairs was stated for the SMI group but how this estimate was determined was not described. Raw data for 1975-77 studies were not available.

Humboldt State University: 1991 (Carter et al. 1992, unpubl. data)

● Castle Rock was not landed upon during the breeding season. No evidence of nesting was obtained on a whole-island burrow and crevice count on 21-22 October.

● At Prince Island, murrelets vocalized on the water and flying over the southeast end at night during storm-petrel mistnetting on the nights of 4-5 April, 5-6 April, 7-8 June, 8-9 June, and 9-10 July. Vocalizing was greater in April than in June; most were gone by July. No calls were heard on the nights of 8-9 January, 8-9 July, 10-11 July, 12-13 July, and 13-14 July. No nests were found and no birds were seen on land during nocturnal nest searches on the southeast end. During the whole-island burrow and crevice count on 22-23 October, 1 crevice with a murrelet eggshell fragment was found at the southeast end and 1 crevice with a possible murrelet eggshell fragment was found at the north end.

● On 11 May, 2 murrelets were seen about 0.5 miles north of Prince Island.

● At SMI proper, no evidence of nesting was found at Harris Point-Cuyler Harbor during brief nest searches at subcolony (SC) 10 (Hare Rock; see Appendix 3 for maps of subcolony locations) on 11 May and 7 June, and at SC 12 (south of Bat Rock) on 11 May.

● No landings occurred at Hoffman Point Area or Bay Point Area.

● Insufficient data were gathered in 1991 to improve upon the 1975-77 breeding distribution and population size estimate.

Humboldt State University: 1994-96 (Carter et al. 1996b, 1997, unpubl. data)

● No landings occurred at Castle Rock in 1994-96.

● At Prince Island in 1994, murrelets were reported vocalizing on the water and flying over the southeast end at night during storm-petrel mistnetting on nights of 8-9 April, 11-12 April, 12-13 April, 2-3 May, 4-5 May, 5-6 May, 8-9 June (some calling from cliffs above net site), 12-13 July (1 bird possibly heard at net site), and 13-14 July (1 call only). Vocalizing was greater in April and May than in June, with few in July. None vocalized on the nights of 11-12 July, 13-14 July, 6-7 August, and 7-8 August. No nests were found and no birds were seen on land during nocturnal nest searches on the southeast end. No nests were found during a brief nest search at north cliffs on 7 August. On 10 April at 07:40 h, 1 bird was observed departing from the north side, and at 08:00 h, 2 birds were seen between Prince Island and Hoffman Point Area.

• On 12 July at 13:15 h, 1 bird was seen on the water about 1 mile northeast of Prince Island.

• At Prince Island in 1995, murrelets were reported vocalizing on the water and flying over the southeast end at night during storm-petrel mistnetting on the nights of 3-4 May and 4-5 May. No nests were found and no birds were seen on land during nocturnal nest searches on the southeast end. At Prince Island in 1994 and 1995, specific 15-minute vocalization surveys were conducted through the night (as early as 21:00 h and as late as 05:00 h) at a shore-based station on the south side of the islet. Forty surveys were conducted over 5 nights on 8-9 April, 11-12, April, 12-13 April, and 5-6 May 1994, and on 4-5 May 1995. Call count means for shore-based surveys were very low (mean = 14 ± 10 calls survey^{-1}; range = 0- 42 calls). Vocal activity at shore-based stations did not appear to differ between 1994 (mean = 14 ± 11 calls survey^{-1}; n = 31 surveys) and 1995 (mean = 15 ± 6 calls survey^{-1}; n = 9 surveys).

● At SMI proper in 1994, no evidence of nesting was found at Harris Point-Cuyler Harbor during brief nest searches at SC 4 on 5 May, 12 July, and 13 July, and at SC 10 (Hare Rock) on 11 April.

● At SMI proper in 1995, Harris Point-Cuyler Harbor was visited only once for brief nest searches at SC 4 and SC 10 (Hare Rock) on 4 May and 12 July but no evidence of nesting was found. On 5 May at 00:05 h, murrelets were heard vocalizing from a boat anchored in Cuyler Harbor.

● At SMI proper in 1996, Harris Point-Cuyler Harbor was visited only once for a brief nest search at SC 12 on 29 April and no evidence of murrelet nesting was found.

● At SMI proper, no landings occurred at Hoffman Point Area and Bay Point Area in 1994-96.

● Specific 15-minute vocalization surveys were conducted from inflatable boats at 18 at-sea stations around the SMI group (including Prince Island and Castle Rock; see Figure 2-5) on 4 May 1995 and 28-29 April 1996. Overall vocal activity at at-sea stations was low (mean 41 ± 53 calls survey^{-1}; range 0-167 detections; n = 18 surveys). Vocal activity was variable around the SMI group. At SMI proper, activity occurred at Hoffman Point (123 detections), Bat Rock (81 detections), Nifty Rock (60 detections), and Cuyler Harbor (5 calls). Activity also occurred at 4 stations around Prince Island (range 43-167 detections) and 2 stations at Castle Rock (6 and 80 detections). Activity did not occur at 6 stations on the south side of SMI proper, nor at Harris Point or Simonton Cove.

● A rough breeding population estimate of 50-300 breeding pairs was determined for the SMI group, based on 1991-96 data with emphasis on vocalization surveys (see Burkett et al. 2003). Details of how this estimate was determined were not provided. Key factors considered were: a) the number of murrelet vocalizations heard in a 15-minute period; and b) amount of suitable nesting habitat in adjacent areas.

● At-sea sightings occurred near land on a few occasions. On 10 April 1994, 1 bird was seen flying off the north side of Prince Island at 07:40 h and 2 birds were seen on the water midway between Prince Island and the easternmost beach at Cuyler Harbor at 08:00 h. On 12 July 1994, 2 birds were seen about 1 mile northeast of Prince Island.

Channel Islands National Park: 1998 (P. Martin, unpubl. data)

● During a beached bird survey in Simonton Cove (19-22 May), 2 dead murrelets were found on the beach. Another 1-2 dead murrelets also were collected at Soledad Beach at Santa Rosa Island on 26-30 May.

Humboldt State University and U.S. Geological Survey: 1999-2001 (Mason et al. 2007; D. Whitworth, unpubl. data)

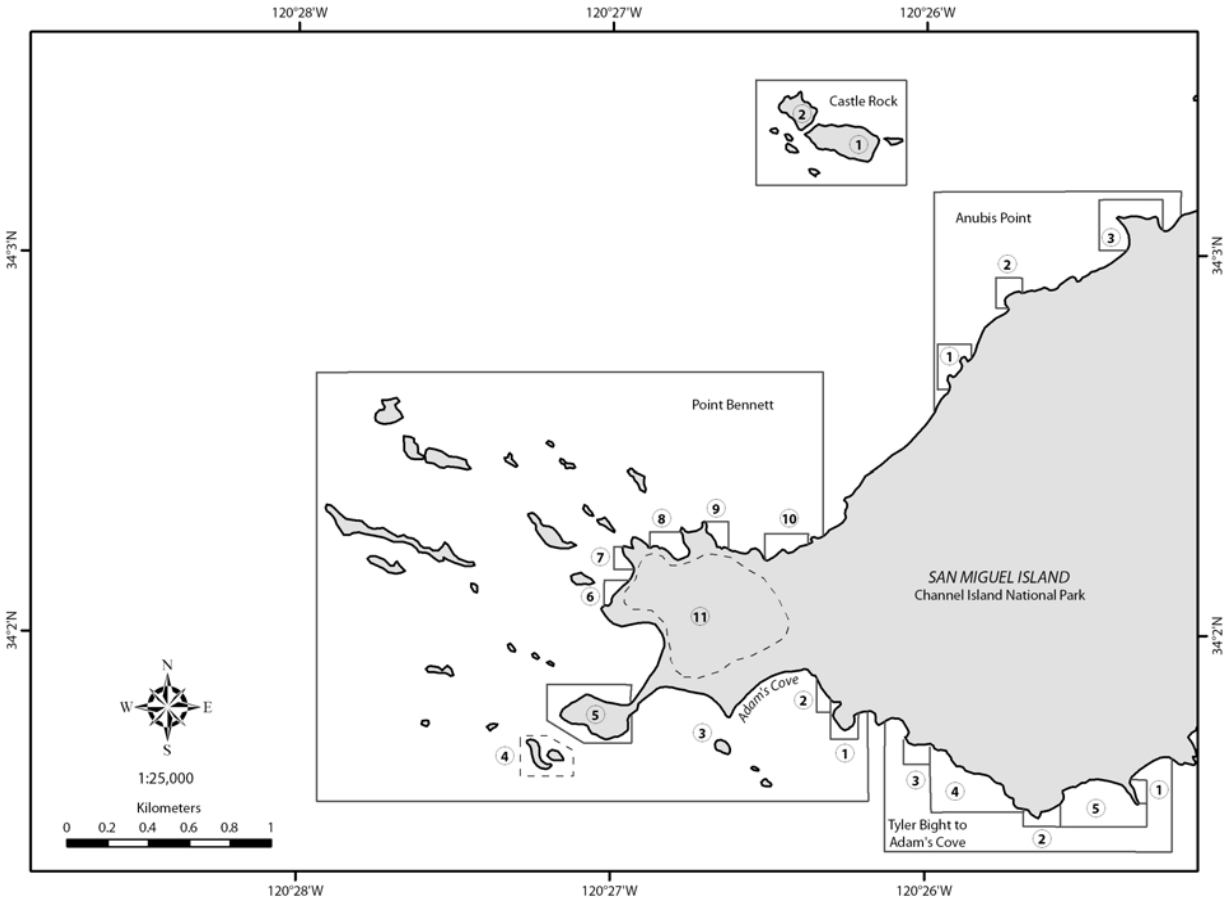
• During Cassin's Auklet research at Prince Island in May 1999, a murrelet nest containing 1 chick was found in a crevice site along the shoreline on the west side (D. Whitworth , unpubl. data). Overnight video footage recorded the chick departing from the nest site, a pair of adult murrelets visiting and copulating in the site, and a deer mouse exploring the crevice (A. Hebshi and W.J. Sydeman, unpubl. data).

• During aerial at-sea surveys in May 1999-2001, September 1999-2001, and January 2000-2002 (Mason et al. 2007), no Xantus's Murrelets were noted within 5-minute latitude by 5-minute longitude blocks nearest the SMI group. However, murrelets were found farther from the SMI group in ten-minute by ten-minute blocks in January and May.

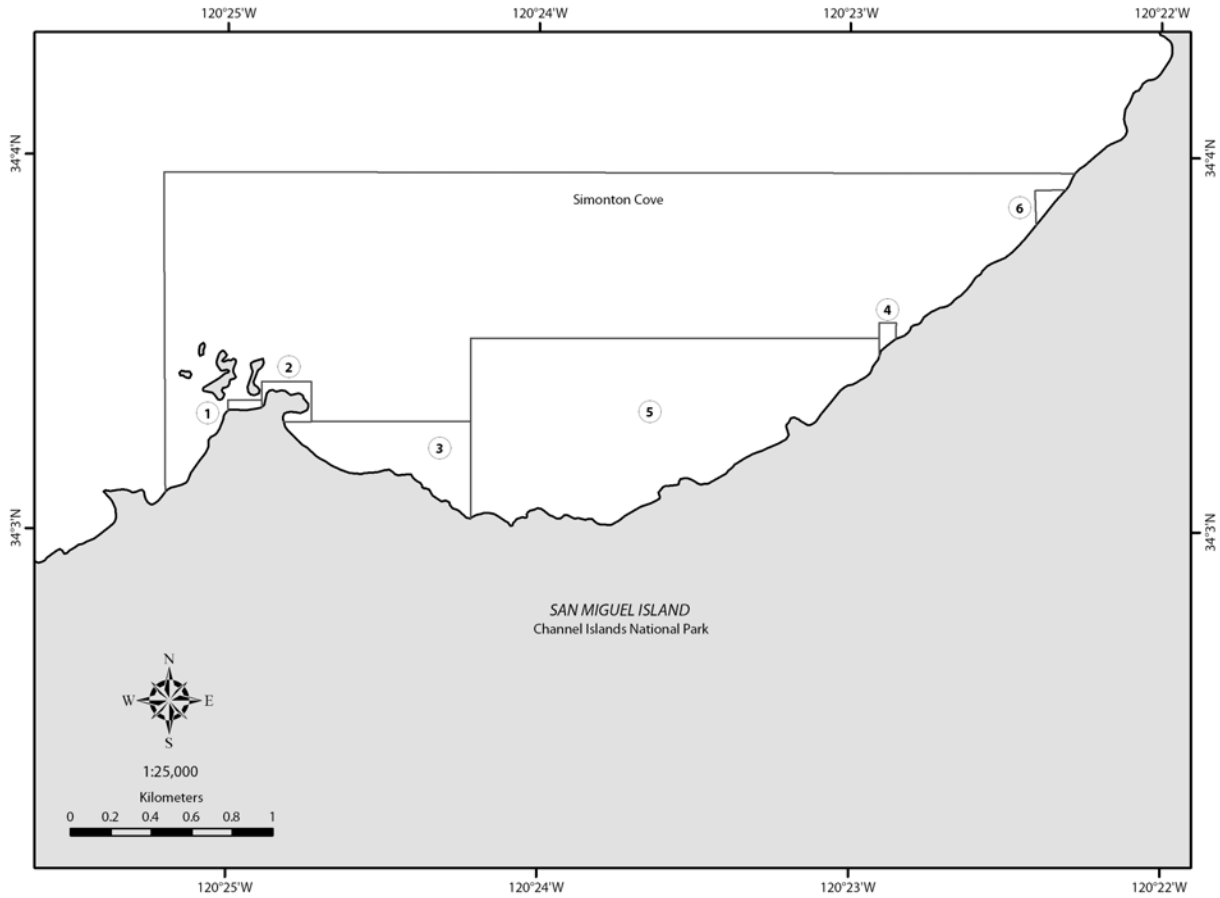
California Institute of Environmental Studies: 2004 (Whitworth et al. 2005a)

- In 2004, nocturnal spotlight surveys were conducted: a) on 29-30 March, from Harris Point to Cardwell Point and around Prince Island; b) on 26-27 April, along the south side of SMI proper from Tyler Bight to Cardwell Point; and c) on 26-27 May, from Harris Point to Hoffman Point and around Prince Island. Nine murrelets were observed on both surveys along the east side of the SMI group: a) March: 5 birds off SMI proper and 4 birds at Prince Island; and b) May: 7 birds off SMI proper and 2 birds at Prince Island. No murrelets were seen along the south side of SMI proper in April.

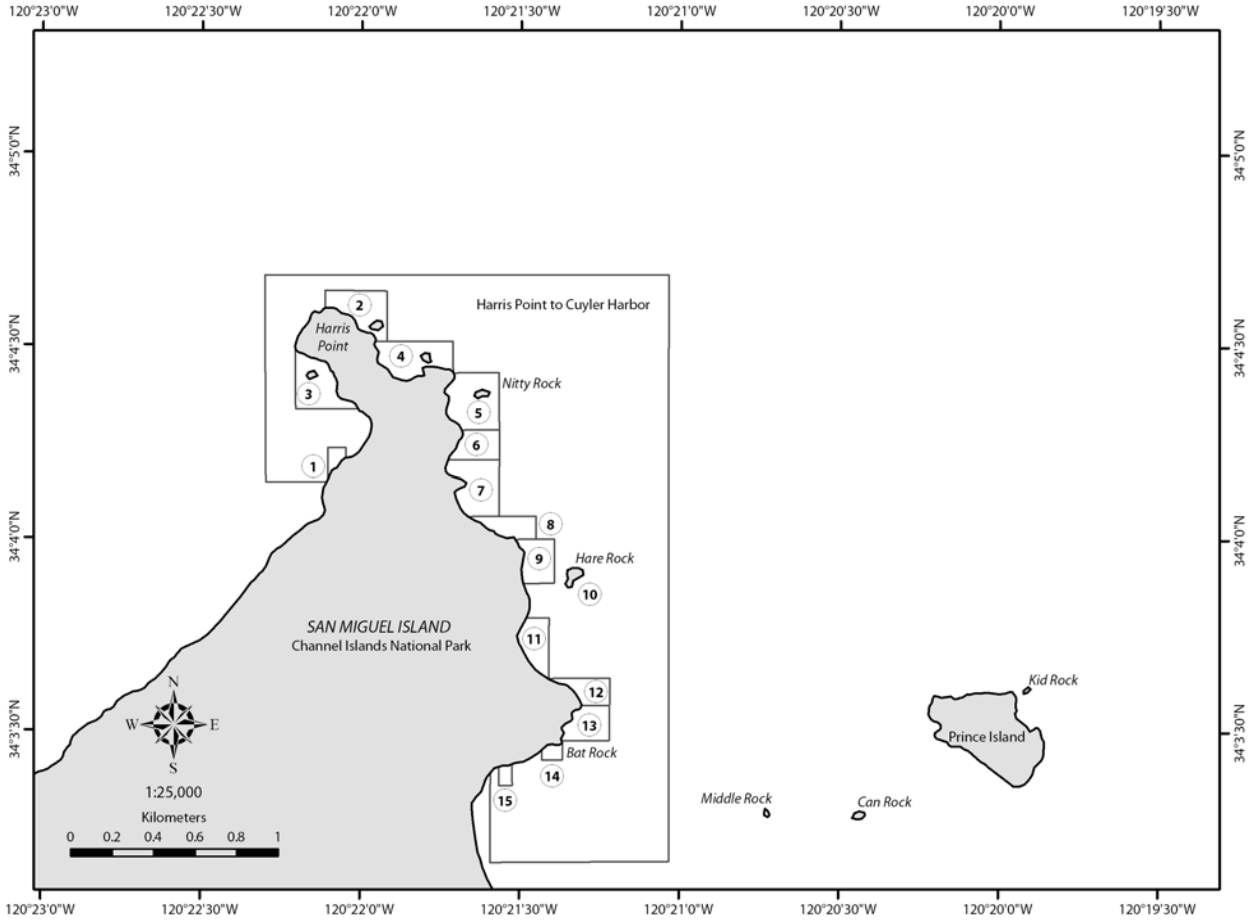
Appendix 3. Locations of seabird breeding colonies at San Miguel Island, Prince Island, and Castle Rock. Maps were recreated from original maps provided in Carter et al. (1992). Original subcolonies designated in 1991 retained their original numbers and locations. New subcolonies designated in 2007 were assigned new numbers and locations. The location of Richardson Rock is indicated in Figure 1-1. A summary of 2007 data obtained for each boat survey by species and subcolony number is provided in Appendix 4.



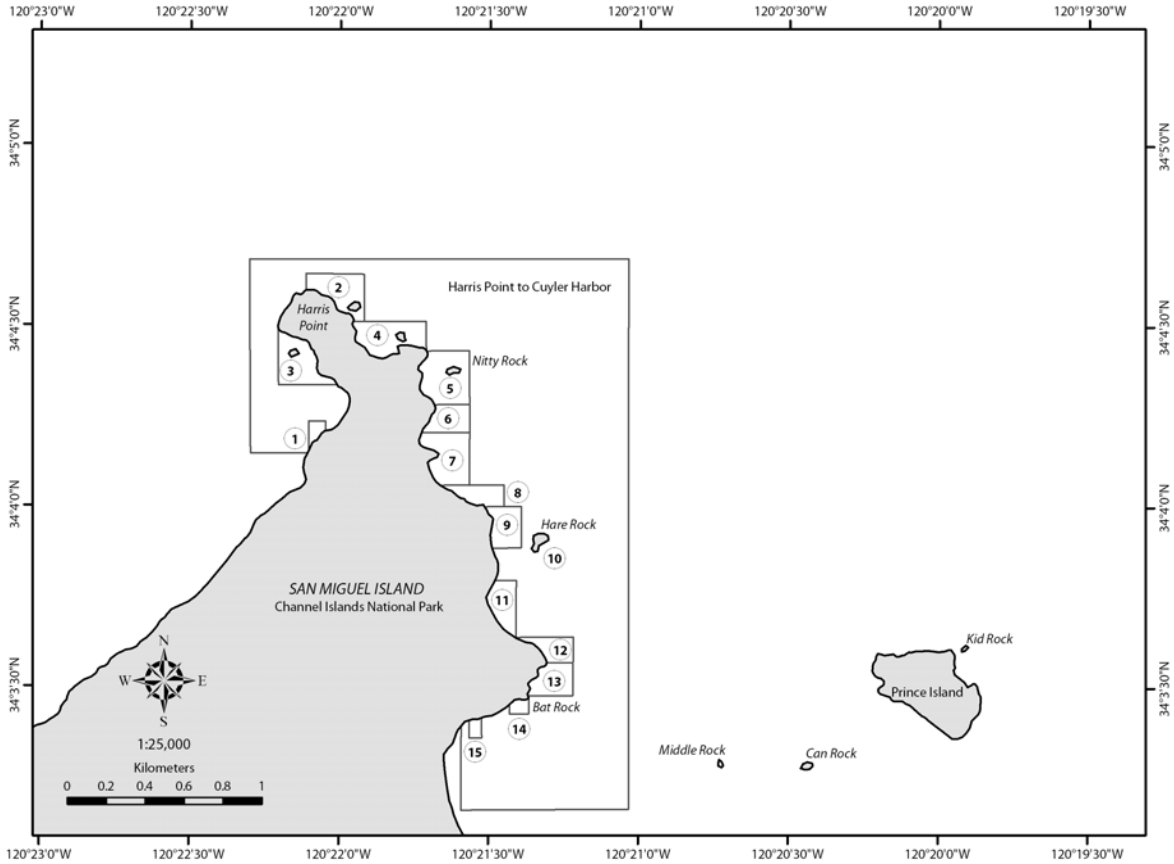
Appendix 3 – Map 1. West portion of the SMI group, showing seabird colonies on SMI proper (Point Bennett, Anubis Point, and Tyler Bight to Adams Cove) and Castle Rock. Subcolonies are numbered within each colony.



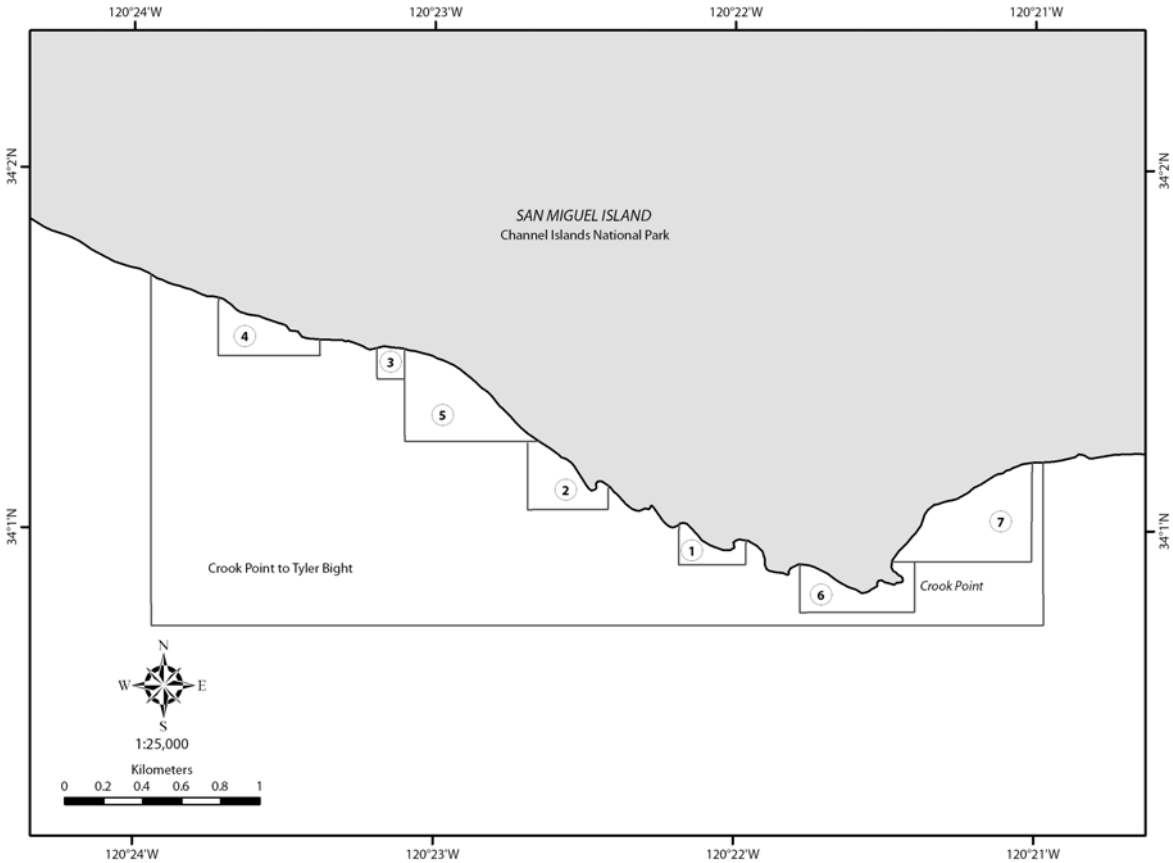
Appendix 3 – Map 2. North-central portion of the SMI group, showing seabird colonies on SMI proper (Simonton Cove). Subcolonies are numbered.



Appendix 3 – Map 3. Northeast portion of the SMI group, showing seabird colonies on SMI proper (Harris Point-Cuyler Harbor) and Prince Island. Subcolonies are numbered with each colony.



Appendix 3 – Map 4. East portion of the SMI group, showing seabird colonies on SMI proper (Hoffman Point Area, Bay Point Area, and Cardwell Point West).



Appendix 3 – Map 5. South-central portion of the SMI group, showing seabird colonies on SMI proper (Crook Point-Tyler Bight). Subcolonies are numbered.

Appendix 4. Breeding seabird data by subcolony and date from 2007 boat surveys at San Miguel Island, Prince Island, Castle Rock, and Richardson Rock.

Database fields were defined as follows:

Colony Name: Names follow Carter et al. (1992), except that Northwest San Miguel Island was renamed Anubis Point for greater clarity about colony location.
Date: Month, day, year.
Time: 24-hour system (Pacific Daylight Time).
Observer: Different groups of observers were numbered as follows: 1 (Carter, Hébert); 2 (Carter, Hébert, Whitworth, Koepke); 3 (Carter); 4 (Carter, Hébert, Koepke); 5 (Carter, Gorton); 6 (Carter, Koepke); 7 (Whitworth, Koepke).
Subcolony Number: Numbering follows Carter et al. (1992), with added subcolonies in 2007 (see Appendix 3 for locations). Number 99 denotes no subcolonies defined at this colony.
Species: Breeding species are coded as: Double-crested Cormorant (DCCO), Brandt's Cormorant (BRCO), Pelagic Cormorant (PECO), Black Oystercatcher (BLOY), Western Gull (WEGU), Common Murre (COMU), Pigeon Guillemot (PIGU), Cassin's Auklet (CAAU), Rhinoceros Auklet (RHAU), and Tufted Puffin (TUPU). When no breeding seabirds were noted, species was coded as ZERO.
Nests: Total number of nests counted, where nest material could be seen.
Birds: Total number of birds observed, including birds attending nests, sites, or roosting.
Sites: Total number of sites counted, including: a) possible nests attended by birds but nest material could not be seen; and b) potential nest sites attended by adults without nest material.
Best: Following Carter et al. (1992), if data were used for estimates of population size at colonies in 2007, they were assigned a "Y" for yes. If not, they were assigned a "N" for no. In cases when data from different dates resulted in the same population estimate, an "A" for alternate was assigned but the date selected for Y was considered better for representing the 2007 estimate.

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Anubis Pt	05/23/07	09:15-09:16	1	3	BLOY	0	1	0	Y
Anubis Pt	05/23/07	09:07-09:08	1	1	PECO	5	8	0	Y
Anubis Pt	05/23/07	09:12-09:13	1	2	PECO	16	20	0	Y
Anubis Pt	05/23/07	09:15-09:16	1	3	PECO	3	3	0	Y
Anubis Pt	05/23/07	09:07-09:08	1	1	WEGU	0	3	0	Y
Anubis Pt	05/23/07	09:12-09:13	1	2	WEGU	0	4	0	Y
Anubis Pt	05/23/07	09:15-09:16	1	3	WEGU	2	7	0	Y
Bay Pt Area	04/24/07	10:29	1	2	BRCO	0	1	0	N
Bay Pt Area	05/22/07	13:45	4	2	BRCO	0	25	0	N
Bay Pt Area	04/24/07	10:29	1	3	BRCO	0	28	0	N
Bay Pt Area	05/22/07	13:35-13:39	4	1	PECO	1	1	0	Y
Bay Pt Area	04/24/07	10:29	1	2	PECO	0	2	0	N
Bay Pt Area	04/24/07	10:29	1	3	PECO	0	2	0	N
Bay Pt Area	05/22/07	13:51	4	3	PECO	0	3	0	Y
Bay Pt Area	04/24/07	10:19	1	1	PIGU	0	20	0	Y
Bay Pt Area	05/03/07	10:05-10:16	1	1	PIGU	0	15	0	N
Bay Pt Area	05/22/07	13:35-13:39	4	1	PIGU	0	1	0	N
Bay Pt Area	04/24/07	10:19	1	1	RHAU	0	1	0	Y
Bay Pt Area	04/24/07	10:19	1	1	WEGU	0	1	0	N
Bay Pt Area	05/22/07	13:35-13:39	4	1	WEGU	0	1	0	Y
Bay Pt Area	04/24/07	10:29	1	2	WEGU	0	12	0	N
Bay Pt Area	05/22/07	13:45	4	2	WEGU	0	40	30	Y
Bay Pt Area	04/24/07	10:29	1	3	WEGU	0	6	0	N
Bay Pt Area	05/22/07	13:51	4	3	WEGU	1	11	3	Y
Cardwell Pt West	05/23/07	15:42-16:12	6	99	ZERO	0	0	0	Y
Castle Rock	05/23/07	07:20-07:35	1	99	BLOY	0	2	0	Y
Castle Rock	05/23/07	07:20-07:35	1	99	BRCO	50	300	0	Y
Castle Rock	05/23/07	07:20-07:35	1	99	CAAU	0	1	0	N
Castle Rock	05/23/07	12:50-13:30	6	99	CAAU	0	25	0	Y
Castle Rock	05/23/07	07:20-07:35	1	99	PECO	21	35	0	Y
Castle Rock	05/23/07	07:20-07:35	1	99	PIGU	0	97	0	Y
Crook Pt-Tyler Bight	05/23/07	15:38	6	1	BLOY	0	6	0	Y

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Crook Pt-Tyler Bight	05/23/07	15:40	6	6	BLOY	0	1	0	Y
Crook Pt-Tyler Bight	05/23/07	15:38	6	1	BRCO	0	50	0	Y
Crook Pt-Tyler Bight	05/23/07	15:31	6	2	BRCO	10	85	0	Y
Crook Pt-Tyler Bight	05/23/07	15:40	6	6	BRCO	0	20	0	Y
Crook Pt-Tyler Bight	05/23/07	15:42	6	7	BRCO	20	110	0	Y
Crook Pt-Tyler Bight	05/23/07	15:38	6	1	WEGU	0	70	0	Y
Crook Pt-Tyler Bight	05/23/07	15:31	6	2	WEGU	0	2	0	Y
Crook Pt-Tyler Bight	05/23/07	15:20	6	4	WEGU	0	5	0	Y
Crook Pt-Tyler Bight	05/23/07	15:23	6	5	WEGU	0	6	0	Y
Crook Pt-Tyler Bight	05/23/07	15:40	6	6	WEGU	0	20	0	Y
Crook Pt-Tyler Bight	05/23/07	15:42	6	7	WEGU	0	20	20	Y
Harris Pt-Cuyler Hbr	05/24/07	06:30-06:31	1	1	BLOY	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:02-10:12	1	2	BLOY	0	4	0	Y
Harris Pt-Cuyler Hbr	05/23/07	09:53-09:56	1	2	BLOY	0	5	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:32-06:40	1	2	BLOY	0	6	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:12-10:19	1	3	BLOY	0	2	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:01	1	4	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:19-10:35	1	4	BLOY	0	7	0	Y
Harris Pt-Cuyler Hbr	05/23/07	10:01-10:06	1	4	BLOY	0	4	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:43-06:47	1	4	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:35-10:40	1	5	BLOY	0	2	0	Y
Harris Pt-Cuyler Hbr	05/23/07	10:06-10:10	1	5	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:47-06:51	1	5	BLOY	0	3	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:20	1	6	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:10-10:12	1	6	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	BLOY	0	4	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:12-10:15	1	7	BLOY	0	1	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:56-06:58	1	7	BLOY	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:33	1	8	BLOY	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:55-11:04	1	8	BLOY	0	2	0	Y
Harris Pt-Cuyler Hbr	05/23/07	10:15-10:18	1	8	BLOY	0	3	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:58-07:01	1	8	BLOY	0	1	0	N

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Harris Pt-Cuyler Hbr	04/24/07	8:45	1	9	BLOY	0	6	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:01-07:07	1	9	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:04-11:09	1	10	BLOY	0	2	0	Y
Harris Pt-Cuyler Hbr	05/24/07	07:09-07:10	1	10	BLOY	0	2	1	N
Harris Pt-Cuyler Hbr	04/24/07	9:07	1	13	BLOY	0	2	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:32-11:44	1	13	BLOY	0	1	0	Y
Harris Pt-Cuyler Hbr	05/24/07	07:18-07:21	1	13	BLOY	0	2	1	N
Harris Pt-Cuyler Hbr	04/24/07	7:29	1	2	BRCO	0	35	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:32-06:40	1	2	BRCO	1	0	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:59	1	3	BRCO	0	24	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:19-10:35	1	4	BRCO	0	25	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:35-10:40	1	5	BRCO	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	BRCO	0	3	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:33	1	8	BRCO	0	3	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:55-11:04	1	8	BRCO	0	1	0	N
Harris Pt-Cuyler Hbr	04/23/07	13:08	1	10	BRCO	0	2	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:46	1	10	BRCO	0	26	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:04-11:09	1	10	BRCO	0	19	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:26-11:32	1	12	BRCO	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	9:07	1	13	BRCO	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:12-10:19	1	3	CAAU	0	1	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:40-06:43	1	3	CAAU	0	2	0	N
Harris Pt-Cuyler Hbr	04/23/07	14:52	1	5	CAAU	0	1	0	N
Harris Pt-Cuyler Hbr	06/19/07	11:55	5	3	COMU	0	3	0	N
Harris Pt-Cuyler Hbr	06/20/07	07:47-07:53	5	4	COMU	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:01	1	4	DCCO	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:46	1	10	DCCO	0	3	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:39	1	1	PECO	0	2	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:29	1	2	PECO	0	7	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:02-10:12	1	2	PECO	3	1	0	Y
Harris Pt-Cuyler Hbr	05/23/07	09:53-09:56	1	2	PECO	1	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:59	1	3	PECO	0	6	2	N

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Harris Pt-Cuyler Hbr	05/22/07	10:12-10:19	1	3	PECO	0	3	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:01	1	4	PECO	0	4	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:19-10:35	1	4	PECO	0	2	0	Y
Harris Pt-Cuyler Hbr	04/23/07	13:25	1	5	PECO	0	6	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:11	1	5	PECO	0	7	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:35-10:40	1	5	PECO	0	2	0	Y
Harris Pt-Cuyler Hbr	05/23/07	10:10-10:12	1	6	PECO	1	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	PECO	0	2	0	N
Harris Pt-Cuyler Hbr	05/03/07	09:15-09:20	1	7	PECO	1	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:33	1	8	PECO	0	9	1	N
Harris Pt-Cuyler Hbr	05/22/07	10:55-11:04	1	8	PECO	3	9	5	Y
Harris Pt-Cuyler Hbr	04/24/07	8:45	1	9	PECO	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:09-11:22	1	9	PECO	3	3	0	Y
Harris Pt-Cuyler Hbr	05/22/07	11:04-11:09	1	10	PECO	0	3	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:58	1	12	PECO	5	8	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:26-11:32	1	12	PECO	9	11	0	Y
Harris Pt-Cuyler Hbr	04/24/07	9:07	1	13	PECO	0	5	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:32-11:44	1	13	PECO	2	5	0	Y
Harris Pt-Cuyler Hbr	04/23/07	12:08	1	14	PECO	0	2	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:44-11:48	1	14	PECO	0	5	0	Y
Harris Pt-Cuyler Hbr	04/24/07	7:29	1	2	PIGU	0	10	0	Y
Harris Pt-Cuyler Hbr	05/22/07	10:02-10:12	1	2	PIGU	0	3	0	N
Harris Pt-Cuyler Hbr	05/23/07	09:53-09:56	1	2	PIGU	0	7	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:32-06:40	1	2	PIGU	0	10	0	A
Harris Pt-Cuyler Hbr	05/22/07	10:12-10:19	1	3	PIGU	0	1	0	N
Harris Pt-Cuyler Hbr	05/23/07	09:56-10:01	1	3	PIGU	0	1	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:40-06:43	1	3	PIGU	0	2	0	A
Harris Pt-Cuyler Hbr	04/23/07	14:25-14:50	1	4	PIGU	0	2	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:01	1	4	PIGU	0	36	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:00-09:05	1	4	PIGU	0	15	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:19-10:35	1	4	PIGU	0	69	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:01-10:06	1	4	PIGU	0	28	0	N

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Harris Pt-Cuyler Hbr	05/24/07	06:43-06:47	1	4	PIGU	0	33	0	A
Harris Pt-Cuyler Hbr	04/24/07	8:11	1	5	PIGU	0	34	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:10-09:12	1	5	PIGU	0	26	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:35-10:40	1	5	PIGU	0	14	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:06-10:10	1	5	PIGU	0	26	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:47-06:51	1	5	PIGU	0	39	0	A
Harris Pt-Cuyler Hbr	04/24/07	8:20	1	6	PIGU	0	25	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:12-09:14	1	6	PIGU	0	7	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:40-10:44	1	6	PIGU	0	11	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:10-10:12	1	6	PIGU	0	2	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:51-06:55	1	6	PIGU	0	13	0	A
Harris Pt-Cuyler Hbr	04/23/07	13:20	1	7	PIGU	0	5	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	PIGU	0	11	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:15-09:20	1	7	PIGU	0	19	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:44-10:49	1	7	PIGU	0	8	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:12-10:15	1	7	PIGU	0	7	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:56-06:58	1	7	PIGU	0	11	0	A
Harris Pt-Cuyler Hbr	04/24/07	8:33	1	8	PIGU	0	19	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:21-09:22	1	8	PIGU	0	5	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:55-11:04	1	8	PIGU	0	5	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:15-10:18	1	8	PIGU	0	5	0	N
Harris Pt-Cuyler Hbr	05/24/07	06:58-07:01	1	8	PIGU	0	10	0	A
Harris Pt-Cuyler Hbr	04/24/07	8:45	1	9	PIGU	0	20	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:23-09:25	1	9	PIGU	0	8	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:09-11:22	1	9	PIGU	0	3	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:18-10:20	1	9	PIGU	0	6	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:01-07:07	1	9	PIGU	0	14	0	A
Harris Pt-Cuyler Hbr	04/24/07	8:54	1	11	PIGU	0	18	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:26-09:39	1	11	PIGU	0	9	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:22-11:26	1	11	PIGU	0	4	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:20-10:24	1	11	PIGU	0	14	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:10-07:14	1	11	PIGU	0	4	0	A

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Harris Pt-Cuyler Hbr	04/24/07	8:58	1	12	PIGU	0	3	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:26-09:39	1	12	PIGU	0	22	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:26-11:32	1	12	PIGU	0	21	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:24-10:27	1	12	PIGU	0	20	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:14-07:18	1	12	PIGU	0	54	0	A
Harris Pt-Cuyler Hbr	04/24/07	9:07	1	13	PIGU	0	2	0	Y
Harris Pt-Cuyler Hbr	05/22/07	11:32-11:44	1	13	PIGU	0	3	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:27-10:31	1	13	PIGU	0	8	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:18-07:21	1	13	PIGU	0	5	0	A
Harris Pt-Cuyler Hbr	04/24/07	9:14	1	14	PIGU	0	24	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:40-09:41	1	14	PIGU	0	10	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:44-11:48	1	14	PIGU	0	9	0	N
Harris Pt-Cuyler Hbr	05/24/07	07:21-07:25	1	14	PIGU	0	8	0	A
Harris Pt-Cuyler Hbr	04/24/07	9:16	1	15	PIGU	0	1	0	Y
Harris Pt-Cuyler Hbr	05/03/07	09:42-09:43	1	15	PIGU	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:48-11:50	1	15	PIGU	0	1	0	N
Harris Pt-Cuyler Hbr	06/20/07	07:47-07:53	5	4	RHAU	0	0	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:15	1	5	RHAU	0	3	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:20	1	6	RHAU	0	1	0	Y
Harris Pt-Cuyler Hbr	04/23/07	13:20	1	7	RHAU	0	1	0	N
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	RHAU	0	1	0	Y
Harris Pt-Cuyler Hbr	05/24/07	07:18-07:21	1	13	RHAU	0	1	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:00-10:02	1	1	WEGU	0	1	0	Y
Harris Pt-Cuyler Hbr	04/24/07	7:29	1	2	WEGU	0	40	3	N
Harris Pt-Cuyler Hbr	05/22/07	10:02-10:12	1	2	WEGU	0	2	0	Y
Harris Pt-Cuyler Hbr	04/24/07	7:50	1	3	WEGU	0	13	0	N
Harris Pt-Cuyler Hbr	04/24/07	7:59	1	3	WEGU	0	5	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:12-10:19	1	3	WEGU	0	26	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:01	1	4	WEGU	0	10	2	N
Harris Pt-Cuyler Hbr	05/22/07	10:19-10:35	1	4	WEGU	2	14	4	Y
Harris Pt-Cuyler Hbr	04/24/07	8:20	1	6	WEGU	0	5	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:40-10:44	1	6	WEGU	3	5	1	Y

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Harris Pt-Cuyler Hbr	04/24/07	8:22	1	7	WEGU	0	172	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:44-10:49	1	7	WEGU	0	194	166	Y
Harris Pt-Cuyler Hbr	04/24/07	8:33	1	8	WEGU	0	13	0	N
Harris Pt-Cuyler Hbr	05/22/07	10:55-11:04	1	8	WEGU	6	10	0	Y
Harris Pt-Cuyler Hbr	04/24/07	8:45	1	9	WEGU	0	11	1	N
Harris Pt-Cuyler Hbr	04/23/07	13:08	1	10	WEGU	0	35	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:04-11:09	1	10	WEGU	3	11	3	Y
Harris Pt-Cuyler Hbr	05/22/07	11:22-11:26	1	11	WEGU	0	1	0	Y
Harris Pt-Cuyler Hbr	05/22/07	11:26-11:32	1	12	WEGU	0	2	0	Y
Harris Pt-Cuyler Hbr	04/24/07	9:07	1	13	WEGU	0	3	0	N
Harris Pt-Cuyler Hbr	05/22/07	11:32-11:44	1	13	WEGU	1	3	1	Y
Harris Pt-Cuyler Hbr	05/22/07	11:48-11:50	1	15	WEGU	0	1	0	Y
Harris Pt-Cuyler Hbr	05/23/07	9:52	1	1	ZERO	0	0	0	N
Harris Pt-Cuyler Hbr	05/03/07	09:26-09:39	1	10	ZERO	0	0	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:20	1	10	ZERO	0	0	0	N
Harris Pt-Cuyler Hbr	05/03/07	09:26-09:39	1	13	ZERO	0	0	0	N
Harris Pt-Cuyler Hbr	05/23/07	10:32	1	14	ZERO	0	0	0	N
Harris Pt-Cuyler Hbr	05/24/07	7:27	1	15	ZERO	0	0	0	N
Hoffman Pt Area	04/24/07	10:00	1	2	BLOY	0	1	0	N
Hoffman Pt Area	05/22/07	12:41-13:35	4	2	BLOY	0	1	0	Y
Hoffman Pt Area	04/24/07	9:53-9:59	1	3	BLOY	0	1	0	N
Hoffman Pt Area	05/22/07	12:36-12:40	4	3	BLOY	0	4	0	Y
Hoffman Pt Area	04/24/07	10:00	1	2	BRCO	0	4	0	N
Hoffman Pt Area	04/24/07	10:00	1	2	PECO	3	14	6	N
Hoffman Pt Area	05/22/07	12:41-13:35	4	2	PECO	17	22	3	Y
Hoffman Pt Area	04/24/07	9:53-9:59	1	3	PECO	0	1	0	N
Hoffman Pt Area	04/24/07	10:00	1	2	PIGU	0	39	0	Y
Hoffman Pt Area	05/03/07	09:54-10:05	1	2	PIGU	0	30	0	N
Hoffman Pt Area	05/22/07	12:41-13:35	4	2	PIGU	0	18	0	N
Hoffman Pt Area	04/24/07	10:00	1	2	WEGU	0	19	5	N
Hoffman Pt Area	05/22/07	12:41-13:35	4	2	WEGU	1	13	1	Y
Hoffman Pt Area	04/24/07	9:53-9:59	1	3	WEGU	0	12	0	N

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Hoffman Pt Area	05/22/07	12:36-12:40	4	3	WEGU	3	7	0	Y
Hoffman Pt Area	04/24/07	9:52	1	1	ZERO	0	0	0	N
Hoffman Pt Area	05/03/07	09:54-10:05	1	1	ZERO	0	0	0	N
Hoffman Pt Area	05/22/07	12:35-12:36	4	1	ZERO	0	0	0	N
Prince Island	04/25/07	07:00-7:43	1	99	BLOY	0	4	0	N
Prince Island	05/22/07	12:09-12:31	4	99	BLOY	0	2	0	Y
Prince Island	05/24/07	07:49-08:13	1	99	BLOY	0	2	0	A
Prince Island	04/25/07	07:00-7:43	1	99	BRCO	0	4	0	N
Prince Island	05/03/07	08:14-08:35	1	99	BRCO	0	207	0	N
Prince Island	05/22/07	12:09-12:31	4	99	BRCO	150	369	0	Y
Prince Island	05/24/07	07:49-08:13	1	99	CAAU	0	1	0	N
Prince Island	04/23/07	15:19	2	99	COMU	0	2	0	N
Prince Island	04/24/07	8:30	7	99	COMU	0	50	0	N
Prince Island	04/25/07	07:00-7:43	1	99	COMU	0	60	0	N
Prince Island	05/01/07	11:24	3	99	COMU	0	10-15	0	N
Prince Island	05/03/07	08:14-08:35	1	99	COMU	0	70	0	Y
Prince Island	05/22/07	12:09-12:31	4	99	COMU	0	3	0	N
Prince Island	05/22/07	15:10-15:14	4	99	COMU	0	0	0	N
Prince Island	05/23/07	06:12-06:17	1	99	COMU	0	0	0	N
Prince Island	05/23/07	11:24-11:37	1	99	COMU	0	31	0	N
Prince Island	05/24/07	8:24	1	99	COMU	0	52	0	N
Prince Island	05/24/07	07:49-08:13	1	99	COMU	0	43	0	N
Prince Island	06/19/07	13:05	5	99	COMU	0	0	0	N
Prince Island	06/19/07	14:07-14:17	5	99	COMU	0	1	0	N
Prince Island	06/20/07	06:54-07:00	5	99	COMU	0	5	0	N
Prince Island	06/20/07	07:02-07:06	5	99	COMU	0	17	0	N
Prince Island	06/20/07	07:21-07:23	5	99	COMU	0	29	0	N
Prince Island	06/20/07	08:06-08:09	5	99	COMU	0	26	0	N
Prince Island	04/25/07	07:00-7:43	1	99	DCCO	0	4	0	N
Prince Island	05/03/07	08:14-08:35	1	99	DCCO	0	1	0	N
Prince Island	04/25/07	07:00-7:43	1	99	PECO	0	21	0	N
Prince Island	05/02/07	12:34	3	99	PECO	5	7	0	N

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Prince Island	05/22/07	12:09-12:31	4	99	PECO	2	5	0	N
Prince Island	05/23/07	11:24-11:37	1	99	PECO	11	11	0	Y
Prince Island	04/25/07	07:00-7:43	1	99	PIGU	0	257	0	N
Prince Island	05/02/07	12:34	3	99	PIGU	0	11	0	N
Prince Island	05/03/07	08:14-08:35	1	99	PIGU	0	147-177	0	N
Prince Island	05/22/07	12:09-12:31	4	99	PIGU	0	115	0	N
Prince Island	05/24/07	07:49-08:13	1	99	PIGU	0	364	0	Y
Prince Island	05/03/07	08:14-08:35	1	99	RHAU	0	1	0	N
Prince Island	05/23/07	06:12-06:17	1	99	RHAU	0	0	0	N
Prince Island	05/24/07	07:49-08:13	1	99	RHAU	0	4	0	Y
Prince Island	06/19/07	14:07-14:17	5	99	RHAU	0	3	0	N
Prince Island	06/19/07	15:03-15:08	5	99	RHAU	0	1	0	N
Prince Island	06/20/07	07:21-07:23	5	99	RHAU	0	1	0	N
Prince Island	06/20/07	08:06-08:09	5	99	RHAU	0	1	0	N
Prince Island	04/23/07	15:19	2	99	TUPU	0	0	0	N
Prince Island	05/01/07	11:24	3	99	TUPU	0	0	0	N
Prince Island	05/03/07	08:14-08:35	1	99	TUPU	0	0	0	N
Prince Island	05/22/07	15:10-15:14	4	99	TUPU	0	0	0	N
Prince Island	05/23/07	06:12-06:17	1	99	TUPU	0	0	0	N
Prince Island	05/23/07	11:24-11:37	1	99	TUPU	0	0	0	N
Prince Island	06/19/07	13:05	5	99	TUPU	0	0	0	N
Prince Island	06/19/07	14:07-14:17	5	99	TUPU	0	0	0	N
Prince Island	06/20/07	06:54-07:00	5	99	TUPU	0	0	0	N
Prince Island	06/20/07	07:02-07:06	5	99	TUPU	0	0	0	N
Prince Island	06/20/07	08:06-08:09	5	99	TUPU	0	0	0	N
Pt Bennett	05/23/07	08:47-08:54	1	9	BLOY	0	4	0	Y
Pt Bennett	05/23/07	08:40-08:47	1	8	BRCO	10	35	0	Y
Pt Bennett	05/23/07	08:47-08:54	1	9	BRCO	0	9	0	Y
Pt Bennett	05/23/07	08:40-08:47	1	8	PECO	3	8	0	Y
Pt Bennett	05/23/07	08:47-08:54	1	9	PECO	7	10	0	Y
Pt Bennett	05/23/07	08:54-09:01	1	10	PECO	10	12	0	Y
Pt Bennett	05/23/07	08:40-08:47	1	8	PIGU	0	11	0	Y

Colony Name	Date	Census Time	Observer	Subcolony	Species	Nests	Birds	Sites	Best
Pt Bennett	05/23/07	08:47-08:54	1	9	PIGU	0	4	0	Y
Richardson Rock	05/23/07	14:10-14:15	6	99	BLOY	0	1	0	Y
Richardson Rock	05/23/07	14:10-14:15	6	99	BRCO	0	25	0	Y
Richardson Rock	05/23/07	14:10-14:15	6	99	PECO	1	5	0	Y
Richardson Rock	05/23/07	14:10-14:15	6	99	PIGU	0	8	0	Y
Richardson Rock	05/23/07	14:10-14:15	6	99	WEGU	0	8	1	Y
Simonton Cove Area	05/23/07	09:28-09:39	1	3	BLOY	0	1	0	Y
Simonton Cove Area	05/23/07	09:39-09:43	1	5	BLOY	0	2	0	Y
Simonton Cove Area	05/23/07	09:23-09:28	1	1-2	PECO	1	6	0	Y
Simonton Cove Area	05/23/07	09:45-09:50	1	6	PECO	2	12	0	Y
Simonton Cove Area	05/23/07	09:23-09:28	1	1-2	WEGU	20	30	0	Y
Simonton Cove Area	05/23/07	09:28-09:39	1	3	WEGU	16	46	0	Y
Simonton Cove Area	05/23/07	09:39-09:43	1	5	WEGU	0	20	14	Y
Simonton Cove Area	05/23/07	09:44-09:45	1	4	ZERO	0	0	0	Y
Tyler Bt-Adams Cv	05/23/07	15:16	6	1	BLOY	0	1	0	Y
Tyler Bt-Adams Cv	05/23/07	15:03-15:10	6	4	PECO	9	13	0	Y
Tyler Bt-Adams Cv	05/23/07	15:11	6	2	WEGU	0	9	9	Y
Tyler Bt-Adams Cv	05/23/07	15:16	6	1	WEGU	0	5	0	Y
Tyler Bt-Adams Cv	05/23/07	15:00-15:03	6	3	WEGU	0	5	0	Y
Tyler Bt-Adams Cv	05/23/07	15:03-15:10	6	4	WEGU	0	25	21	Y
Tyler Bt-Adams Cv	05/23/07	15:12-15:15	6	5	WEGU	0	16	12	Y