RESTORATION OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2006

REPORT TO THE *APEX HOUSTON* TRUSTEE COUNCIL
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COMMAND TRUSTEE COUNCIL

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U.S. Fish and Wildlife Service
San Francisco Bay National Wildlife Refuge Complex
9500 Thornton Avenue
Newark, CA 94560 USA

FINAL REPORT
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Suggested Citation: McChesney, G. J., L. E. Eigner, T. B. Poitras, P. J. Kappes, N. M. Jones, D. N. Lontoh, P. J. Capitolo, R. T. Golightly, D. Le Fer, H. R. Carter, S. W. Kress, and M. W. Parker. 2007. Restoration of Common Murre colonies in central California: annual report 2006. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

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ACKNOWLEDGMENTS

The Common Murre Restoration Project is conducted cooperatively by the U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex (USFWS-SFBNWRC), Humboldt State University (HSU), the National Audubon Society (NAS), and other public and private organizations, with oversight by the *Apex Houston* Trustee Council (made up of USFWS, National Oceanic and Atmospheric Administration [NOAA], and California Department of Fish and Game [CDFG]) and *Command* Trustee Council (made up of USFWS, NOAA, CDFG, California State Parks, and California State Lands Commission).

Special thanks go to the *Apex Houston* Trustee Council for their support throughout the project: Dan Welsh (USFWS-Sacramento Field Office); Maria Brown (NOAA-Gulf of the Farallones National Marine Sanctuary [GFNMS]), Steve Hampton (CDFG-Office of Spill Prevention and Response [OSPR]), Joelle Buffa (USFWS alternate representative), and Jennifer Boyce (NOAA alternate representative). To the *Command* Trustee Council, special thanks go to: Jennifer Boyce (NOAA - Restoration Center); Steve Hampton (CDFG-Office of Spill Prevention and Response [OSPR]); Dan Welsh (USFWS-Sacramento Field Office); Joanne Kerbavaz (California Department of Parks and Recreation); and Jennifer Lucchesi (California State Lands Commission).

Many other individuals and organizations have helped to make this project a great success through their support and hard work. Special thanks to Mendel Stewart (Refuge Complex Manager), John Bradley (Deputy Refuge Complex Manager), Joelle Buffa (Supervisory Refuge Biologist), and many other staff and volunteers of the USFWS-SFBNWRC, especially: Cindy Ballard, Ellen Tong, Diane Kodama, Clyde Morris, and Larry Wade. Other assistance was provided by Rich Young and Erin Raboin. At HSU, special thanks to Talitha Penland, Nicole Good, Donna Shafer, Joe Bonino, and other staff at the HSU Sponsored Programs Foundation for their administrative efforts.

We owe special thanks to the staff of Point Reyes National Seashore, especially Sarah Allen, Ben Becker, and Dawn Adams, for assistance with field site housing, research permits, and access.
Very special thanks to the staff at the Point Montara Lighthouse Hostel, especially Chris Bauman and Janice Pratt, for their continued support and assistance.

Special thanks also to: pilots Wayne Burnett, Ron van Benthuysen and Robert Morgan (CDFG-Air Services) for their continued support, expertise and safety on our aerial seabird surveys, and to Paul Kelly (formerly of CDFG-OSPR) for his continued support of these surveys; Julie Yee and Bill Perry (U.S. Geological Survey, Western Ecological Research Center); Rose Borzik (National Audubon Society Seabird Restoration Project); Jan Roletto (NOAA-GFNMS); Deirdre Hall and Scott Kathey (NOAA, Monterey Bay National Marine Sanctuary); Daniel Zatz, Konrad Schaad, Malcolm Gaylord, and Matt Pawuk (SeeMore Wildlife Systems); Armand and Eliane Neukermans; Mike Hink and Jack Van Zander (Bestor Engineers); Russell Bradley and Pete Warzybok (PRBO); and Breck Tyler (U.C. Santa Cruz). Jason Minton (Garcia and Associates), Dave Pang (California Department of Transportation; CalTrans), and several others at CalTrans provided valuable logistical assistance and cooperation during an extended Highway 1 closure at Devil's Slide between March and August 2006.

Aerial survey work in the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries was conducted under a permit from NOAA (permit MULTI-2003-003). Observations of Devil's Slide Rock and San Pedro Rock were conducted from the mainland under Encroachment Permit No. 0406-NSV0039 from CalTrans. Research at Point Reyes National Seashore was conducted under NPS Collecting Permit 95-10.

EXECUTIVE SUMMARY

This report summarizes the eleventh year of seabird restoration and associated monitoring in central California conducted by the Common Murre Restoration Project (CMRP) in 2006. These efforts began in 1995 to restore breeding colonies of seabirds, especially Common Murres, harmed by the 1986 *Apex Houston* oil spill, gill net fishing, and other factors. Our initial primary goal was to restore the extirpated Devil's Slide Rock murre colony, as well as to monitor and restore other colonies impacted by the spill. In 2005-06, the CMRP was augmented with restoration funds from the 1998 *Command* oil spill, with the goal to restore affected breeding colonies mainly through reduction of human disturbance.

For the first time since 1996, no social attraction was used at the recently restored Devil's Slide Rock murre colony. Data were collected on various aspects of murre and other seabird breeding and population ecology, as well as both anthropogenic and non-anthropogenic disturbances, to assist and guide monitoring efforts. Colonies monitored regularly included: Devil's Slide Rock and Mainland; Castle/Hurricane Colony Complex; Point Reyes; Point Resistance; Millers Point Rocks; and Double Point Rocks. Aerial photographic counts were also conducted at the North Farallon Islands, South Farallon Islands, Alcatraz Island, Lobos Rock and Land's End, Seal Rocks, and Año Nuevo Island. Data collected on Common Murres included: seasonal attendance patterns; breeding population sizes; breeding phenology; reproductive success; and adult co-attendance and chick provisioning (Devil's Slide Rock only). For the Brandt's Cormorant, data were collected on breeding phenology, productivity, and breeding population sizes. We also surveyed population sizes of Double-crested Cormorant, Pelagic Cormorant, Black Oystercatcher, Western Gull, and Pigeon Guillemot, and monitored productivity for the latter four species on an opportunistic basis.

On Devil's Slide Rock in 2006, 361 breeding pairs of murres were estimated, a 120% increase from 2005 and the largest number of breeding pairs since restoration efforts began in 1996. Breeding success of a sample of 176 nests was 0.29 chicks per pair, the lowest recorded to date but similar to 2005 (0.32). Murres also bred on the Devil's Slide Mainland (24 pairs) for the second consecutive year. Attendance increased at all other central California colonies as well. Counts from aerial photographic surveys increased 30% from 2005 at all colonies combined and increases ranged 12-110% at individual colonies. Murre breeding success varied among colonies. Murre breeding success at Point Reyes (0.63) was above the long-term average. Large-scale Brown Pelican disturbance at Castle Rocks and Mainland led to low murre breeding success (0.31) there. Low productivity at Devil's Slide was attributed mainly to poor foraging conditions due to a lack of spring upwelling and unusually warm water conditions in central California. For Brandt's Cormorant, numbers of nests increased from 2005 at nearly all colonies and 59% at all sample colonies combined, with some colonies at or near historic highs despite warm water conditions. Breeding success was also relatively high. However, many nests on Devil's Slide Mainland were abandoned due to predation. Productivity of other seabird species varied, with relatively high success at Point Reyes and low success at Devil's Slide and Castle/Hurricane. Human disturbance from aircraft and boats increased from 2005 at both Devil's Slide and Point Reyes while few aircraft or boats were observed at the Castle/Hurricane Colony Complex.

INTRODUCTION

Common Murre (*Uria aalge*) colonies in central California occur on certain nearshore rocks and adjacent mainland points between Marin and Monterey counties as well as at the North and South Farallon islands, 20 to 40 kilometers offshore (Carter et al. 1992, 2001). A steep decline in the central California population between 1980 and 1986 is attributed primarily to mortality in gill nets and oil spills, including the 1986 *Apex Houston* oil spill (Page et al. 1990; Takekawa et al. 1990; Carter et al. 2001, 2003). Between 1982 and 1986, a colony of close to 3,000 breeding murres on Devil's Slide Rock in northern San Mateo County was extirpated by these mortality events. Since 1996, the Common Murre Restoration Project (CMRP) has sought to restore this and other central California colonies using social attraction and other techniques. Social attraction has been utilized at Devil's Slide Rock and nearby San Pedro Rock, which was extirpated in the early 20th century primarily by commercial egg harvesters (Ray 1909; Carter et al. 2001). Efforts at other colonies, especially the Castle/Hurricane Colony Complex, have focused mainly on working with other agencies and the public to reduce anthropogenic disturbance and mortality factors.

Despite small to moderate increases in the central California murre population in the early 1990s apparently due to partial restrictions on gill-net fishing and reduced oil pollution (Carter et al. 2001), Devil's Slide Rock was not recolonized by 1995 and most colonies remained in a reduced state. Until more extensive gill-net closures (< 60 fathoms from Point Reyes to Point Arguello) were enacted by California Department of Fish and Game in September 2002, gill-net mortality of murres continued through at least 2000 (Forney et al. 2001; National Marine Fisheries Service, unpubl. data). In addition, oil pollution (e.g., *Command* Oil Spill and the series of oil releases from the sunken vessel *S.S. Jacob Luckenbach*) has continued to kill thousands of murres in central California (Carter 2003; Carter and Golightly 2003; Hampton et al. 2003; Roletto et al. 2003) and anthropogenic disturbance has affected colonies as well (Rojek et al. 2007; USFWS, unpubl. data).

The *Apex Houston* Oil Spill

Between 28 January and 4 February 1986, the barge *Apex Houston* discharged approximately 20,000 gallons of San Joaquin Valley crude oil while in transit from San Francisco Bay to Long Beach Harbor, California. Between Sonoma and Monterey counties, an estimated 9,900 seabirds were killed, of which approximately 6,300 were Common Murres (Page et al. 1990, Carter et al. 2003). The murre colony at Devil's Slide Rock was subsequently abandoned (Takekawa et al. 1990; Carter et al. 2001, 2003).

In 1988, state and federal natural resource trustees began litigation against potentially responsible parties. In 1994, the case was settled in a Consent Decree for $6,400,000. The *Apex Houston* Trustee Council, with representatives from U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG), and National Oceanic and Atmospheric Administration (NOAA) was given the task of overseeing restoration actions for natural resources injured by the spill. A restoration plan was published (USFWS 1995) and the amount of $4,916,430 was assigned to USFWS for the implementation of the Common Murre Restoration Project.

The *Command* Oil Spill

Shortly after departing San Francisco bound for Panama on the evening of 26 September 1998, the T/V *Command* spilled approximately 3,000 gallons of Intermediate Bunker Fuel (IBF) 380 just off the San Francisco and San Mateo county coasts (USFWS et al. 2004). This spill mainly oiled the San Mateo County coastline and adjacent waters. An estimated 1,490 Common Murres and other seabirds were killed or injured from the spill.

The *Command* litigation resulted in a total settlement of $5,518,000, of which $4,007,242 was allocated to restoration of damaged natural resources. The Seabird Colony Protection Program (SCPP) is one of several projects funded by the *Command* Oil Spill Restoration Fund (USFWS et al. 2004). The goal of SCPP is to restore seabird colonies damaged by the spill mainly by reducing human disturbance. The CMRP is conducting the monitoring and colony surveillance component of the SCPP. Another component of the program, conducted by the Gulf of the Farallones National Marine Sanctuary, focuses on education, outreach, and other methods that will lead to better protection of colonies from human disturbance.

Common Murre Restoration Project

In 1995, the *Apex Houston* Trustee Council developed a restoration plan consisting of a Scientific Program and an Environmental Education Program for the Common Murre Restoration Project (USFWS 1995). Field work for the Scientific Program has been conducted since 1996 by USFWS-San Francisco Bay National Wildlife Refuge Complex (hereafter “Refuge”), in collaboration with the USFWS-Ecological Services (Sacramento Field Office), Humboldt State University (HSU), and the National Audubon Society. Additional assistance has been provided by: Carter Biological Consulting; CDFG; U.S. Geological Survey (Western Ecological Research Center; USGS); Point Reyes Bird Observatory (PRBO); National Park Service (Point Reyes National Seashore); National Oceanic and Atmospheric Administration (NOAA; Gulf of the Farallones and Monterey Bay National Marine Sanctuaries); and California Department of Parks and Recreation.

The primary goals of the CMRP have been the restoration of extirpated Common Murre colonies at Devil’s Slide and San Pedro rocks (Figures 1, 2). Social attraction was selected as the best-available technique to be used to recolonize these rocks (Parker et al. 1997, 2007; Carter et al. 2003) because of its effective use elsewhere in encouraging seabirds to recolonize extirpated colonies (Kress 1983; Podolsky 1985; Kress and Nettleship 1988; Podolsky and Kress 1989, 1991; Schubel 1993). Secondary goals have been to restore other depleted colonies, such as the Castle/Hurricane Colony Complex in Monterey County (Figures 1, 3). Reducing anthropogenic impacts (such as disturbance) and avian predation have been the primary restoration methods used to aid this and other colonies. Monitoring at other more established colonies, such as Point Reyes (Figures 1, 4), has been conducted to compare with restoration sites, examine broad-scale patterns and trends in ecological parameters, and identify other potential restoration needs.

In January 1996, social attraction equipment (murre decoys, mirror boxes, and two sound systems) was deployed on Devil’s Slide Rock for the first time (Parker et al. 2007) and was re-deployed in a similar manner each year until 2005 (McChesney et al. 2006). Successful breeding by six pairs was recorded in 1996 and the number of breeding pairs has increased steadily since then. Because of the continuous annual growth of the Devil’s Slide colony since 1996, the amount of social attraction equipment was reduced in later years to promote higher density nesting and provide additional breeding space within decoy areas. In 2005, decoys were re-deployed only on the eastern half of the rock to examine the effects of large-scale decoy removal. No negative effects were detected, and breeding murres occupied space formerly occupied by decoys (McChesney et al. 2006)

In 2006, our efforts to restore seabird colonies in central California was augmented for the second consecutive year by the *Command* Trustee Council. Under the *Command* Oil Spill Restoration Plan, reductions in human disturbance to breeding colonies was identified as the main technique to restore seabird populations damaged from the spill. Funds from *Command* allowed us conduct monitoring and disturbance surveillance at Point Reyes (PRH), the Point Resistance/Double Point (or, Drakes Bay) Colony Complex (DBCC; Figures 1, 5), and the Castle/Hurricane Colony Complex (CHCC).

This report summarizes restoration and monitoring efforts conducted by the Common Murre Restoration Project in 2006. Monitoring included data collection similar to previous years on murre colony population sizes, seasonal attendance patterns, nesting phenology and productivity, adult co-attendance patterns, as well as both anthropogenic and non-anthropogenic disturbances. We also report on Brandt's Cormorant (*Phalacrocorax penicillatus*) nest surveys, breeding phenology and productivity, as well as available population surveys and productivity of Double-crested Cormorant (*P. auritus*), Pelagic Cormorant (*P. pelagicus*), Black Oystercatcher (*Haematopus bachmani*), Western Gull (*Larus occidentalis*), and Pigeon Guillemot (*Cepphus columba*).

METHODS

Social Attraction

Devil's Slide Rock

There were no decoys deployed on Devil's Slide Rock (DSR) for the 2006 breeding season. High pre-breeding and breeding season attendance in recent years indicated that social attraction techniques may no longer be necessary (McChesney et al. 2006; see Discussion, below).

Video System Installation

The remote video monitoring system, developed by SeeMore Wildlife Systems (Homer, Alaska), was reinstalled on DSR on 24-25 February 2006 to enhance monitoring work and provide public outreach. Two high resolution video cameras were anchored to the top ridge of the rock: one on the east side and one on the west side of the rock. Both cameras were connected to a transmitter that sent live-streaming images to a receiving station at the Point Montara Lighthouse Hostel 4.5 km south of DSR, as well as to a portable, manually operated receiving system on the mainland adjacent to DSR. The receiving system included a desktop computer equipped with software for remote control of the cameras, with zoom, tilt, and panning capabilities, squirter and wiper for lens cleaning, and the ability to take still pictures and video. At the hostel, the receiving system was connected to the internet, permitting viewing and control from off-site computers as well as a live web cam hosted by the National Audubon Society. A digital video recorder captured and stored all video images.

Between the two cameras, nearly all active nesting areas on DSR could be viewed with the exception of former decoy plot 7 on the west-central portion of the rock. The cameras greatly enhanced our monitoring capabilities by providing closer, clearer views of nests and birds, views of nests not visible from mainland vantage points, and permitted data collection when poor visibility or heat waves precluded viewing from the mainland.

Some technical difficulties hindered video system use at times. The East camera stopped transmitting video intermittently throughout the season. On 5 July, the cameras were not functioning due to insufficient battery power. Once the solar-powered batteries recharged, the use of the video system was limited to a few hours each day to conserve battery power. Both video cameras were taken down on 25 September 2006 for maintenance and preparation for reinstallation in winter 2007.

Monitoring Effort

Using our former standardized scope and binocular techniques, DSR and Devil's Slide Mainland (DSM) areas were monitored for 28.7 hours (28.7 person hours) on 12 observation days between 20 January 2006 and 13 April 2006 (hereafter referred to as "pre-breeding season") and 522.7 hours (1060 person hours) on 110 observation days between 18 April and 31 August (hereafter referred to as "breeding season"). Using the remotely controlled video cameras, DSR was monitored an additional 265.9 hours (278.4 person hours) on 31 observation days between 18 April and 19 July. With both monitoring techniques, the Devil's Slide Rock and Mainland (DSRM) colony was monitored for a total of 788.6 hours on 113 days during the 2006 breeding season. San Pedro Rock (SPR) was monitored using traditional techniques for 21.0 hours (21.0 person hours) on 18 observation days between 18 April and 27 July.

The Castle/Hurricane Colony Complex (CHCC) was monitored for 48.0 hours (54.1 person hours) on 10 days during the pre-breeding season (10 January to 6 April) and 495.3 hours (532.2 person hours) on 78 days during the breeding season (17 April to 10 August).

Point Reyes (PRH) was monitored for 389.1 hours (467.3 person hours) on 78 days during the breeding season (20 April to 17 August 2006). In the Drakes Bay Colony Complex (DBCC), Point Resistance (PRS) was monitored for 6.2 hours (6.2 person hours) on six days between 27 April and 5 August; Millers Point Rocks (MPR) was observed for 11.8 hours (11.8 person hours) on six days between 27 April and 5 August; and Double Point Rocks (DPR) was monitored for 25.9 hours (30.3 person hours) on six days between 22 April and 25 July.

Common Murre Seasonal Attendance Patterns

At each colony, seasonal attendance patterns of Common Murres were monitored from standardized mainland vantage points using 65-130X or 15-60X spotting scopes. Attending murres were counted at each colony, subcolony, or index plot. Three consecutive counts were performed and the means are reported. Seasonal attendance data were collected at all active subcolonies during the pre-breeding season (before 15 April) and throughout the breeding season (15 April until all chicks fledged and adult attendance ceased).

Devil's Slide Rock and Mainland, San Pedro Rock

All seasonal attendance counts for DSR using spotting scopes were performed from the standardized observation site, "Traditional DSR Pullout" (see Parker et al. 1998). Pre-breeding season attendance was monitored sporadically from 10 January to 13 April. Observations were typically conducted once or twice a week between 0800 and 1100 h. Breeding season (15 April to 21 August) counts using spotting scopes were conducted every other day (weather permitting) between 1000 and 1400 h, usually about 1000 h. On days when more than one count was performed between 1000 and 1400 h, the count closest to 1000 h is reported.

On DSM, attendance patterns were determined for six subareas (Figures 2, 6): April's Finger (subcolony, or "SC", 05); Upper Mainland South (SC05); Lower Mainland South (SC05); Mainland South Roost (SC05); Turtlehead (SC05); and a new subarea called "Mainland North" (SC02). Mainland South subareas and Turtlehead were viewed from the traditional Turtlehead Cove overlook as well as a new viewing location at the south end of the cove, called "Peregrine Falcon Point" (or, "PEFA Pt."), located at 70 m elevation and about 250 m from the Mainland South nesting area. PEFA Pt. was used to avoid disturbance to nesting Peregrine Falcons (*Falco peregrinus*). Counts were conducted a minimum of once per week.

For San Pedro Rock, colony counts were conducted once per week throughout the breeding season. Due to road repair work on Highway 1, observations were conducted from an alternate viewing location 125 m south of "Pipe Pullout" (see Parker et al. 1998) about 1700 m from SPR at an elevation of approximately 100 m.

Castle/Hurricane Colony Complex

Seasonal attendance patterns of murres were determined for 11 subcolonies at Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (HPR; Figure 3). Counts were conducted sporadically during the pre-breeding season and twice per week during the breeding season. At three subcolonies, separate subarea counts also were obtained: CRM-04, "productivity plot"; CRM-06 South, "south" and "north" sides; and HPR-02, "Ledge" and "Hump".

Point Reyes

Seasonal attendance patterns were determined for all murre subcolonies visible from mainland observation sites during the breeding season (20 April to 17 August; Figure 4). In 2006, 14 mainland and 20 nearshore subcolonies were monitored from 10 standardized observation locations a minimum of once per week. Counts were conducted between 1000 and 1400 h when possible, but due to restricted visibility caused by poor weather conditions and the large number of sites monitored, count times ranged from 0925 to 1615 h. Attendance was recorded at established "Type II" index plots (see Birkhead and Nettleship 1980) on Lighthouse, Boulder, and Cone (Lower portion) rocks because the number of murres attending these subcolonies were too large to be counted regularly and accurately in their entirety. For the same reason, index plots were also established on Flattop Rock in 2005 and Middle Rock in 2006. At Lighthouse Rock (~24,000 breeding birds), three index plots were used: Ledge plot (~150 birds); Dugout plot (~150 birds); and Edge plot (~75 birds). At Boulder Rock (~3,600 breeding birds), Flattop (~3,300 birds), Middle Rock (~1,500 birds), and Cone Rock-Lower (~3,000 breeding birds), one index plot each was utilized (~150, ~250, ~250 and ~275 birds, respectively).

Drakes Bay Colony Complex

Seasonal attendance of murres was monitored at PRS, MPR, and DPR between 22 April and 5 August (Figure 5). Counts were conducted from standardized observation points between 1000 and 1400 h when possible, but counts began as early as 0845 h. Type II index plots were established at PRS and Stormy Stack (DPR) because of the large numbers of murres attending these sites. Four index plots (Club, Grotto Ledge, Lower Ledge, and Cup) were used at PRS and five plots (Lower Left, Lower Right, Crack Pot, Pond, and Cliff) on Stormy Stack.

Common Murre Productivity

As in prior years, productivity of Common Murres was monitored at DSRM, CRM and PRH at least every two to three days (weather permitting) from mainland vantage points using 65-130x Questar spotting scopes. At DSR, two remote video cameras also were used in conjunction with scopes to monitor murre productivity. All plots were monitored in a manner consistent with “Type I” plots (Birkhead and Nettleship 1980). The locations of returning or new breeding and territorial sites were identified using maps and photographs updated from the 2005 breeding season. At DSR, locations of murre sites were refined through the interpretation of aerial photographs taken on 7 June 2006. A “breeding site” was defined as any site where an egg was observed or inferred. A “territorial site” had attendance on $\geq$ 15% of observation days but where apparently no egg was laid. “Sporadic sites” were attended on at least two days but on less than 15% of observation days; however, many possible “sporadic” sites were not identified as such because of frequent movement by visiting birds. Chicks were considered to have fledged if they survived to at least 15 days of age and were not known to have subsequently perished otherwise.

Devil’s Slide Rock and Mainland

Due to the widespread growth and increasing difficulty monitoring the entire colony, three Type I productivity plots (A, B, and C) were established on DSR in 2006. Prior to the breeding season, plot boundaries were delineated with 2' x 2' wooden boards approximately 1 m in length and 11 painted wooden dowels 0.46 m (1.5 feet) in height (Figure 7). Criteria for selecting plot locations included: ease of viewing from standard observation locations; density of breeding and territorial sites; locations of both long-established and newer breeding sites; and designated “center” and “edge” areas (Birkhead and Nettleship 1980). Natural topographic features also were considered when determining plot boundaries. All active sites located within plots were monitored daily. Observations were conducted from several mainland vantage points located about 380-470 m from the colony as well as with the remote video system.

To determine the total number of breeding pairs on DSR and compare newly-established plots to the entire colony, active murre sites located outside of plot boundaries were monitored during seven weekly surveys spread throughout the egg and chick periods (23 May and 20 July). Breeding status of each bird was determined by confirmed presence of an egg or chick, or inferred by two or more consecutive observations of a bird in an incubating or brooding posture. A territorial site was determined by the presence of a bird on at least two surveys with no evidence of breeding.

Castle/Hurricane Colony Complex
All active and inactive murre nesting sites were monitored within one Type I plot on CRM-04 (established in 1996). An additional study plot on CRM-03 East, established in 1999, did not host breeding murres in 2006. Observations of the plots were conducted from or near the "Castle Pullout" located along the side of Highway 1 and from adjacent private property, approximately 300 m from the plot.

Point Reyes
Murre productivity was monitored at PRH within two established Type I plots on Lighthouse Rock (LHR): Ledge Plot is within the center and Edge Plot is on the edge of the colony. Because the LHR subcolony is relatively large (*ca.* 12,000 pairs), center and edge plots were selected to examine differences in reproductive success that may occur due to location (Birkhead 1977, Parker et al. 1997). Observations of both plots were conducted from within or just outside of the Point Reyes Foghorn Building, located almost directly above the colony at a distance of approximately 100 m. In addition to the traditional Foghorn Building observation site, during peak chick hatching and on extremely foggy days observations were conducted on the slope below the Foghorn Building about 70 m from the colony.

In 2006, the size of the Ledge Plot was reduced by about half and now only includes the lower, northern portion of the plot. This reduction was to reduce monitoring effort by eliminating the most difficult nests to follow accurately and efficiently. Analyses comparing the two portions of the Ledge Plot between 1996 and 2002 showed no significant difference in breeding success. Thus, we do not believe that reducing the size of this plot will substantially affect interannual comparisons.

Common Murre Co-attendance and Chick Provisioning

Co-attendance and chick provisioning observations were conducted at DSR after approximately half to two-thirds of the breeding sites had chicks, following past methods (see Parker 2005, McChesney et al. 2006). Criteria for selecting sites included:

1) Prior knowledge that the site was indeed a nesting site;
2) Ease of viewing both adults (when both adults were attending the site simultaneously);
3) Proximity to other breeding sites; and
4) Ability to include additional nearby breeding sites, if necessary.

The video cameras were utilized on 28 June and 3 July to conduct observations. On 7 July the cameras did not have sufficient battery power to operate, and Questar spotting scopes (65-130X) were used instead. Adult arrivals, departures, and food deliveries to chicks (including prey type, size, and fate) at each monitored site were recorded. In addition, the number of birds at each site was recorded every 15 minutes throughout the entire watch. Observations were conducted by a rotation of primary observers in 2-3 hour shifts. All observations were recorded on a hand-held tape recorder and transcribed later. Reported are average time murres spent in co-attendance at breeding sites per day and average rate of food deliveries.

Nest Surveys

To assess breeding population sizes and colony distribution, nest counts of Brandt's Cormorants, Pelagic Cormorants, Western Gulls, and Black Oystercatchers were conducted weekly (DSRM, CHCC, and PRH) or biweekly (DBCC colonies) during the breeding season. For most species, the numbers of nests and adults were counted. For Brandt's Cormorant, territorial and nest sites were classified into five groups that roughly describe the nesting stage:

1) Territorial site: little nesting material, courtship displays;
2) Poorly built nest: disorganized mound or a flat pile of nesting material;
3) Fairly built nest: well-defined, roughly circular pile of nesting material up to about 15 cm in height, with partially formed nest bowl;
4) Well-built nest: Substantial (> 15 cm height) amount of nesting material, forming a clearly defined circular nest structure and well-developed nest bowl; and
5) Nests with brooded chicks: nests where chicks were visibly brooded.

In addition, the number of large cormorant chicks (*ca.* >30 days old) were counted.

To provide more complete colony coverage, surveys from the mainland were augmented with boat surveys conducted in the Devil's Slide/San Pedro Rock area on 3 June and at PRH on 13 June.

Brandt's Cormorant Productivity

Breeding phenology and productivity of Brandt's Cormorants were monitored at DSRM (DSR, April's Finger, and Turtlehead), CHCC (CRM-09), and PRH (Border Rock, Area B Mainland, Cone Rock, and Spine Pt.). Monitored nests were checked every 2-7 days from mainland vantage points using binoculars, spotting scopes, or remote video cameras (DSR only). Chicks were considered to have fledged if they survived to at least 30 days of age, unless they were known to have subsequently died otherwise. After that age, chicks begin to wander from their nests and become impossible to identify with certainty without marking (Carter and Hobson 1988; McChesney 1997).

Pelagic Cormorant, Black Oystercatcher, and Western Gull Productivity

Productivity of Pelagic Cormorants, Black Oystercatchers, and Western Gulls were determined opportunistically at nests easily visible from mainland vantage points at DSRM, CHCC, and PRH. Nests were checked at least once per week. Chicks were considered to have fledged if they survived to at least 30 days of age, unless they were known to have subsequently died otherwise.

Pigeon Guillemot Surveys

Because Pigeon Guillemots are crevice nesters, the number of birds rafting on the water and roosting on land were counted to assess population status and seasonal attendance patterns. Surveys at DSRM, CHCC, and PRH were conducted about once per week from standardized observation points between one-half hour after sunrise and 0830 h (when guillemot counts tend to be highest; Carter et al. 1992, Warzybok et al. 2006) from late April to late July. Surveys at DBCC colonies were conducted weekly to bi-weekly at midday hours. At DSRM, we surveyed the entire coast between San Pedro Point and the "South Bunker Point." At CHCC, surveys covered the entire coast between Rocky Point and the south edge of the Hurricane Point Rocks colony. At PRH, weekly surveys covered only the area that can be viewed easily from the lighthouse, but a survey of the entire PRH was conducted on 5 May. In addition, boat surveys were conducted at San Pedro Rock and DSRM on 3 June and at PRH on 13 June.

Disturbance

Disturbances were defined as any event that caused adult birds to be alarmed or agitated (e.g, head-bobbing in murres, raised head or wing flapping in cormorants), flushed or otherwise displaced. All observed anthropogenic disturbance events affecting murres and other seabirds at study colonies were recorded. Non-anthropogenic (e.g., avian) disturbances also were recorded for significant disturbances. For each disturbance event, we recorded the numbers of birds affected and the numbers of eggs or chicks exposed, displaced, or depredated. For anthropogenic disturbances, we report the numbers of disturbance events and numbers per observation hour for comparisons between sites and between years. For non-anthropogenic disturbances, we report the species that caused disturbances and summarize major events.

All aircraft flying at or below 1,000 feet (305 m) above and boats within 1,500 feet (460 m) of any seabird nesting area were recorded to examine use patterns of potential sources of anthropogenic disturbance. Information recorded on aircraft and boats included: type of craft, identification number or name, direction of travel, and distance from the nearest seabird nesting or roosting area.

Common Raven Surveys

Common Raven (*Corvus corax*) surveys were conducted from a vehicle along California State Highway 1 between Point Lobos and Point Sur to assess relative distribution and abundance in the vicinity of CHCC. Each morning (0500-0630 h), a survey was conducted while driving south from Point Lobos to the CRM Pullout (16.6 km). Afternoon surveys (1230-1500 h) were also conducted sporadically throughout the breeding season while driving north from Point Sur to Point Lobos. Each individual or group of ravens seen was considered a "detection". All raven detections were recorded on a Garmin Etrex GPS unit and plotted on National Geographic Topo mapping software. Raven detections were summarized within two survey areas: Point Lobos to CRM Pullout (16.6 km) and CRM Pullout to Point Sur (9.2 km).

Aerial Photographic Surveys

In 2006, aerial photographic surveys were conducted at all murre colonies and most (greater than about 10 nests) Brandt's and Double-crested Cormorant colonies in northern and central California from the Oregon border south to Point Conception. These surveys are a continuation of a long-term data set focused on monitoring seabird breeding populations in California (e.g., Sowls et al. 1980; Takekawa et al. 1990; Carter et al. 1992, 2001; Capitolo et al. 2004, 2006). Surveys were conducted between 30 May and 20 June from a CDFG twin-engine, fixed-wing Partenavia aircraft. Survey altitudes varied between colonies, but ranged from 600-1200 ft (183-366 m). The Double-crested Cormorant colony at the San Mateo Bridge & P.G.&E. Towers, located near the runway approach for San Francisco International Airport, was not surveyed with aerial photographs due to the high volume of commercial airline traffic in the area. Caspian Tern (*Hydroprogne caspia*) colonies at Arcata Bay Sand Island, Brooks Island Area and Salinas River Mouth also were photographed.

Two personnel photographed colonies through a hatch opening in the belly of the aircraft using 35 mm cameras. Overview photographs of each colony were taken with a 50 mm or 70-200 mm zoom lens, while close-up photographs used for counting were taken mostly with 300 mm lenses or occasionally with a 70-200 mm zoom lens. Surveys of some areas were delayed by fog but were completed later in the survey period. Most colonies were photographed on one day only. To assist field mapping of murre breeding sites, a survey of DSR was conducted just prior to the breeding season on 26 April; digital aerial photographs of DSR were taken during this survey and on 7 June with a Canon 20D digital SLR camera loaned by W. B. Tyler (University of California, Santa Cruz).

Counts at sample colonies were conducted using the "dotting" method and followed a standardized protocol. Standardized count areas at the South Farallon Islands followed Capitolo et al. (2002). As in other years since 1996, we determined counts for all central California murre colonies and Brandt's Cormorant colonies within the Gulf of the Farallones area (Point Reyes to Año Nuevo). For murres, only birds were counted since they do not build nests. For cormorants, birds, nests, and territorial sites were counted. Nests and territorial sites were categorized as follows: 1) well-built nest with incubating/brooding adult; 2) nest with adult and visible chicks in the nest bowl; 3) empty nest (i.e., no eggs or chicks) with standing adult present; 4) abandoned nest (evidence of fairly built to well-built nest with no adult present); 5) poorly built nest; 6) adult on territorial site with little or no nesting material; and 7) undetermined site (either nest or territorial site). We considered categories 1-5 as “nests” and categories 6 and 7 as territorial “sites”.

We also counted Western Gulls and Pelagic Cormorants at certain colonies or subcolonies where photographic coverage of their nesting areas was complete. Roosting Brown Pelicans (*Pelecanus occidentalis*) were counted and aged as adults or immature. For the North Farallon Islands, where complete photographic coverage of all pinniped haul-out areas is easily obtained while surveying the seabird colonies, California (*Zalophus californianus*) and Steller Sea Lions (*Eumetopias jubatus*) also were counted.

RESULTS

Common Murre Seasonal Attendance Patterns

Devil’s Slide Colony Complex

Devil’s Slide Rock - Murres were observed on DSR on 65 of 68 (95.6%) count days between 10 January and 21 August 2006 (Figure 8). Murres were not observed on 10 January and on the last two counts of the season after all remaining chicks had fledged.

Pre-breeding season attendance was the highest recorded on the project, averaging 369 ± 197 (SD) murres per count (n = 12). The highest counts of murres were recorded during the pre-breeding and early egg-laying periods. The high count of 2006, 670 murres on 28 April, was also the highest recorded since monitoring began in 1996 (previous high, 477 on 16 May 2005). However, this count occurred outside of the standardized breeding season count period (1000-1400 h) and is not included in Figure 8. Highest standardized counts were 638 birds (20 March) for the pre-breeding season and 586 birds (12 May) for the breeding season. Attendance decreased and was less variable during the incubation and chick periods and then began a rapid decline in mid-July as chicks fledged and adults departed the colony. The last two murres observed were on 14 August. Increased attendance in 2006 reflected a combination of increased densities in core nesting areas, expansion of core nesting areas, and to a lesser extent, establishment of new nesting groups (Figure 9).

Devil’s Slide Mainland - Murres were observed on April’s Finger, Lower Mainland South, Upper Mainland South, Turtlehead, and a new subarea called “Mainland North” (Figures 2, 6, 10). All of these murre groups were among nesting Brandt’s Cormorants. Attendance patterns differed substantially between subareas. Lower Mainland South, followed by Turtlehead, had the highest and most consistent attendance throughout the pre-breeding and breeding seasons. These were also the only subareas with confirmed breeding in 2005 (McChesney et al. 2006) and 2006 although prospecting behavior was observed at other subareas. High counts were: April’s Finger, 16 (10 May); Lower Mainland South, 73 (21 June, 11 July); Upper Mainland South, 12 (21 April, 19 May); and Turtlehead, 30 (19 April). Counts were similar to 2005 except at Lower Mainland South, where higher counts in 2006 partly reflected the new viewing location at PEFA Pt. (high count 18 birds in 2005). Murres (9-11 birds) were observed at Mainland North on 4 and 6 July only. At other non-breeding areas, regular attendance by murres ceased by mid-June.

San Pedro Rock - No murres were recorded during 18 observation days between 18 April and 27 July.

Castle/Hurricane Colony Complex

Murre attendance patterns were mostly sporadic through the pre-breeding season until the start of daily observations on 17 April (Figures 11-14). Attendance patterns at BM227X-02 and HPR remained sporadic until egg laying began in early May. At CRM, most subcolonies with confirmed breeding in 2006 were attended consistently from mid-April to mid-July, except for CRM-03E and CRM-07. At CRM-07, no murres were present on 24 April, perhaps due to an unknown disturbance. After fairly consistent pre-breeding season attendance since 10 January at CRM-03E, murre attendance became sporadic in mid-April and was discontinued after 27 April. High count variability at certain subcolonies in late April and early May (especially HPR-02) and the late arrival of the HPR-01 subcolony were indicative of the late initiation of egg-laying in 2006 (see below).

Attendance at CRM declined substantially after a major Brown Pelican (*Pelecanus occidentalis*) disturbance event on 27-29 June (see Non-anthropogenic Disturbance, below). By 21 July, most of the affected subcolonies (CRM-02, CRM-03 West, CRM-05, and CRM-07) were no longer attended. At certain areas, small numbers of murres were present until early August. These included a small group of breeders on CRM-04 that apparently were unaffected by the pelican disturbance, and small numbers on HPR-02. On BM227X-02, small numbers of murres remained among roosting Brandt’s Cormorants through 10 August, unusually late for this colony. The lingering CRM-04 birds, in particular, may have represented how long more of the colony would have attended without disturbance.

In addition to CRM-04, subcolonies with confirmed breeding in 2006 were: BM227X-02 (Esselen Rock); CRM subcolonies 02, 03 West, 06 South and 07; and HPR-02 (both Ledge and Hump). Breeding was suspected but not confirmed on CRM-05, CRM-06 North (based on aerial surveys and frequency of birds flying in and out of the area), and HPR-01. All but Esselen Rock and CRM-06 South are established subcolonies with annual breeding in recent years. At Esselen Rock, breeding has occurred sporadically since 1996; as in most previous years (with the exception of 2003 and 2005), murres mainly occurred among nesting Brandt’s Cormorants. At CRM-06 South in 2005, murres bred in association with Brandt’s Cormorants. However, no Brandt’s Cormorants bred on this subcolony in 2006. As in 2005, murres attended the mainland subcolony of CRM-06 South (North side) in 2006. Interestingly, Brandt's Cormorants did not nest at this location as they had in 2005 (although cormorants were observed nest building in February and March).

Point Reyes

All well-established nesting areas were active in 2006 (see McChesney et al. 2006). In addition, murre attendance was recorded at several “ephemeral” subcolonies, i.e., areas not attended each year. An unusually large number of such ephemeral areas were active in 2006. Several occurred within Brandt’s Cormorant nesting colonies and were potential breeding areas for murres. These were located within subcolonies 05C (Pebble Point), 06B (Slide), 06C, 06E, 06F, 08B (Greentop), 08C (Trinity Point), 09B (Cliff Colony East), 11A (Chip Rock), 11D (Arch Rock), 11E (Wishbone and Spine points), 12 (Sloppy Joe), portions of 13 (Cone Rock Shoulder, Upper, and West), 14C (Border Rock), and 14D (Miwok Rock; Figure 4). Murre attendance at several “clubs” (i.e., roosting by nonbreeders) also was high, continuing a trend noted in 2005 (McChesney et al. 2006). In particular, high or frequent club attendance was observed on rocks and cliffs in the lighthouse area (subcolonies 02 and 03), with most activity during the incubation and chick periods (after mid-May). Aalge Ledge (subcolony 03D) is a consistently used club that had higher attendance than in past years.

Examples of murre attendance patterns at established (Lighthouse, Boulder, and Cone rocks) and ephemeral (Slide, Greentop, and Border rocks) subcolonies are shown in Figures 15-17. Established subcolonies were active throughout the count period with low count variability until chicks fledged and adults departed in late July and early August. In contrast, attendance was highly variable at ephemeral subcolonies. Some were active only early in the season (Pebble Pt.), some later (Slide), and others throughout the breeding season (Greentop, Border Rock). Murres at Pebble Point and Subcolony 06F were associated with nesting Brandt’s Cormorants that abandoned in early to mid-June, while murres at Slide and certain other areas were among later nesting groups of cormorants.

In addition to Lighthouse Rock (see Productivity, below), breeding was confirmed at 12 subcolonies including some ephemeral locations: Aalge Ledge, Boulder Rock, Greentop (ephemeral), Northwest Rock, Flattop Rock, Middle Rock, East Rock, Beach Rock, Face Rock, Wishbone Point (ephemeral), Cone Rock (Lower portion; index plot), and Cone Rock (Upper portion; ephemeral). Aalge Ledge is mainly known as a clubbing area, but at least 20 breeding sites were observed this year including several chicks that reached fledging age. In addition, frequent attendance and murre breeding behavior suggested that breeding may have occurred at Pebble Point, Cliff Colony East, Tim Tam, rocks in Area B, and Border Rock. Of these, only Tim Tam appears to be an established breeding area.

Drakes Bay Colony Complex

All DBCC colonies and subcolonies were regularly attended by murres from late April until at least mid-July (Figure 18). By early August, all adults had departed following chick fledging. In addition to the major subcolonies, murres also regularly attended a small rock within MPR-03 and another small rock just north of Stormy Stack (DPR). At the former location, continuous attendance and murre breeding behavior (e.g., birds in incubation postures) suggested that breeding may have occurred. At the latter location, successful breeding by a small number of murres was documented; in the past, this location has been known only as a roost rock and is now considerd subcolony 03 with confirmed breeding by seabirds (a Western Gull pair also nested).

Common Murre Productivity

Devil's Slide Rock and Mainland

Of 447 sites documented on DSR in 2006, 361 (80.8%) were egg-laying and 86 (19.2%) were territorial. The number of egg-laying sites increased 120% from 2005 and was 90% higher than the previous high in 2004 (Figure 19). Of all active sites, 196 (43.8%) were in Type I plots and 251 (56.2%) were outside of plots (Figure 7).

Within plots, 176 (89.8%) sites were egg-laying while 20 (10.2%) were territorial (Tables 1, 2). Mean egg-laying date of first eggs was 24 May (range 5 May - 4 July, n = 168), matching the long-term (1996-2005) average. A total of 190 eggs were laid, including 14 replacement eggs. Hatching and fledging success were low. Only 0.29 chicks fledged per pair, 55% lower than the long-term average. Breeding success was the lowest since DSR was recolonized in 1996 but was similar to 2005 (0.32 chicks/pair). By applying estimated breeding success to the total number of breeding pairs recorded, an estimated 105 chicks fledged from DSR in 2006. Fledged chicks remained on the rock for an average of 22.9 days after hatching and the last chick was seen on 31 July.

Outside of productivity plots, 185 breeding and 66 territorial sites were documented. Given the lower survey frequency, this is likely an underestimate since eggs may have been laid and lost between checks. On the other hand, birds identified as breeders based on behavior may not have been. The first egg was observed on 1 May, and egg-laying peaked in mid- to late May and hatching peaked between 23 June and 1 July (Figure 20). Sixty-nine chicks were recorded and the last chick was observed on 7 August. Although techniques were not completely comparable, birds outside of plots apparently had slightly earlier breeding phenology and somewhat higher hatching success than birds within plots but these differences do not appear to have been substantial (Figure 20).

On DSM (subcolony 05), breeding murres were documented for the second consecutive year on Lower Mainland South and Turtlehead subareas, among nesting Brandt's Cormorants (Figure 2, 6). The number of breeding sites increased from four in 2005 to 24 in 2006. Of the 71 sites monitored on both subareas, 24 (33.8%) were egg-laying, 27 (38%) were territorial, and 20 (28.2%) were sporadically attended (Table 2). Frequent movements of prospecting murres may have caused the number of sporadic sites to be overestimated. The mean egg-laying date was 13 June (range 18 May-29 July, n = 18). Hatching success was low but fledging success was fairly high. There were no replacement eggs laid. The number of chicks fledged per pair was 0.33. Chicks fledged at an average age of 21.1 days and the last chick was seen on 4 August.

Combining DSR and DSM, 385 breeding pairs of murres were documented at DSRM in 2006, breeding success was 0.30 chicks per pair, and 113 chicks fledged.

Castle/Hurricane Colony Complex

Of 117 monitored sites in the CRM-04 plot, 94 (80.3%) were egg-laying, 21 (17.9%) were territorial, and two (1.7%) were attended sporadically. The number of breeding sites increased 30.6% from 2005. The mean egg-laying date of 22 May (range 8 May-17 June; Table 2) was three days later than the 1996-2005 average. One replacement egg was laid. Low hatching (51.1%) and fledging (60.4%) success were largely due to disturbance by a juvenile Brown

Pelican on 27-29 June (see Disturbance, below). This event occurred during the late incubation and early hatching phase and resulted in 35 lost eggs and 18 lost chicks within the plot. The last chick observed in the plot was on 14 July, 15 days after the pelican disturbance event ended. Productivity of 0.31 chicks fledged per pair was 42% lower than the 1996-2005 average.

Point Reyes

A total of 131 sites were monitored at Edge (n = 56; 42.7%) and Ledge (n = 75; 57.3%) plots on Lighthouse Rock. In Edge Plot, 51 (91.1%) sites were egg-laying and five (8.9%) were territorial. The number of breeding sites monitored increased 42% from 2005. The mean egg lay date for Edge Plot was 1 June (range 22 May - 26 June). One pair laid one replacement egg and another laid two replacement eggs. The number of chicks fledged per breeding pair was 0.63 (Table 2).

In Ledge Plot, 64 (85.3%) sites were egg-laying and 11 (14.7%) were territorial. In the portion of Ledge Plot monitored in 2006, the number of breeding sites was 37% lower than in 2005. The mean egg lay date for Ledge Plot was 29 May (range: 19 May-21 June; Table 2). Two replacement eggs were laid. The number of chicks fledged per breeding pair was 0.63.

Combining Edge and Ledge plots, the mean egg-laying date was 30 May (Table 2), three days later than the long-term average (including 1996-2002 and 2005; no data for 2003-2004). Productivity of 0.63 chicks per pair was 11% higher than the long-term average. Fledged chicks remained on the rock an average of 19.7 days on Edge and 21.3 days on Ledge. The last chicks in Edge and Ledge Plots were seen on 30 July and 7 August, respectively.

Common Murre Adult Co-attendance and Chick Provisioning

At DSR, co-attendance and chick provisioning observations were conducted from sunrise to sunset on 28 June, 3 July, and 7 July. Eleven to 14 breeding sites were monitored, resulting in a total of 37 site-days monitored. Mean percent of sampling period spent in co-attendance was 9.9% (range 0-35.1%, n = 14). During co-attendance observations, 166 mate arrivals were recorded at 14 nest sites. On average, mates arrived 0.31 times per site per hour (range 0-0.63, n = 14). Of all mate arrivals seen, 58.4% were observed carrying prey, 32.5% had no prey, and for 9.0% it was unknown if birds carried prey or not. Of prey deliveries, 94.8% were consumed by chicks. On average, chicks were fed 0.17 (range 0.00-0.4, n = 14) times per hour. In addition, there were two events recorded in which a chick was fed by a neighboring adult.

Brandt’s Cormorant Nest Surveys and Productivity

Devil’s Slide Rock and Mainland

Nest surveys - In 2006, Brandt’s Cormorants bred on DSR, at traditional mainland subareas April’s Finger, Mainland South, and Turtlehead, and a new location on the northwestern cliffs of the Devil’s Slide promontory (Mainland North; Figure 2). Nest and territorial sites were counted at all nesting areas between 13 April and 27 July (Figure 21). However, male courtship displays and nest-building activities were observed as early as March. The first well-built nests were observed on 26 April, corresponding to the start of egg laying at monitored nests (see below).

Peak counts of well-built nests (n = 343) were recorded for nearly all subcolonies on 17 May, just after mean clutch initiation and during the same week as first hatching at monitored nests. As the season progressed, counts of well-built nests declined as chicks began to wander between nests and nests were destroyed by heavy use.

On April's Finger, cormorants began abandoning nests between 25-29 May, before hatching had begun. Egg loss was first noted on 29 May and by 1 June all 48 nests had lost their eggs and many were completely abandoned. It was unclear whether this abandonment was the result of human activity or of natural origin (e.g., predator). Interestingly, the first nests to be abandoned were on the outer-most portion of the colony. It is difficult to imagine how a mammalian predator could have reached those nests without first impacting nests closer to potential landward access points. Thus, an avian predator (e.g., owl) may have been more likely.

Soon after April's Finger was abandoned, Upper Mainland South cormorants also suffered massive nesting failure. Nest abandonment was observed as early as 6 June, apparently in response to predation. On 6 June, at least 29 fresh chick carcasses were strewn about the upper nesting area and 50 well-built nests were empty and unattended. Apparently, all young (< 2 weeks) chicks were killed. Predation and abandonment continued for the next two weeks. From 30 May to 20 June, numbers of well-built nests counted declined from 99 (47 with chicks) to 11 nests (all with chicks). Only eleven nests successfully raised chicks to creching age. This time, the pattern of afflicted nests suggested a land-based approach (i.e., mammalian predator). Nests closest to the cliff tops were depredated first, followed by those further downslope, while those dispersed across near-vertical cliffs and ledges remained undisturbed. Fresh prints and scat nearby appeared to be from a fox. A bobcat (*Lynx rufus*) was also seen in the area this season. Although these cliffs are steep and appear almost inaccessible, access by an agile predator such as a gray fox (*Urocyon cinereoargentatus*) or bobcat may be possible.

Shortly after cormorants abandoned April's Finger and Upper Mainland South, a new subcolony formed on the northern face of the mainland. This nesting area could only be viewed from the construction zone near Pipe Pullout and was not noted until 3 July. On 4 July, there were 53 well-built nests with adults in incubation posture, as well as an additional 30 sites engaged in nest building. It is possible that this subcolony began to form as early as the second or third week of June since it was not present during boat and aerial surveys on 3 and 7 June, respectively. By 19 July, however, cormorants had abandoned this nesting area for unknown reasons and it is unclear how many birds laid eggs, if any.

Productivity - Productivity was monitored at DSR, April's Finger, and Turtlehead (Table 3). For all subareas combined, the mean clutch initiation date of 8 May (range 22 April - 19 July, n = 174) was close to the long-term mean (1997-2005) of 6 May, although nesting began later on April's Finger. Clutch sizes averaged 3.3 eggs. One replacement clutch was recorded on Turtlehead. This nest hatched two of three replacement eggs, but no chicks fledged. There were three replacement clutches on DSR. One pair relaid once and fledged all of three chicks; a second pair relaid twice but and failed to hatch any chicks. Productivity ranged from 0.0 at April's Finger to 2.2 chicks per pair at DSR Overall productivity of 1.6 chicks per pair was below the 1997-2005 average of 2.0 chicks per pair.

Castle/Hurricane Colony Complex

Nest surveys - Brandt's Cormorant nest and territorial site counts were conducted from 13 February to 8 August (Figure 22). Subcolonies with confirmed breeding in 2006 were: BM227X subcolonies 02 (Esselen Rock), 03 (Esselen mainland), and 05 (Slea Stack); and CRM subcolonies 04 and 09. Early in the season, nest building was observed at CRM subcolonies 03 East, 07, 06 South (North side), and 06 South (South side), although all were abandoned by mid-April.

As in 2005, nesting activity began earlier than normal in 2006, with courtship displays and nest-building underway by mid-February. In early March to early April, many nests were abandoned following a series of strong spring storms. Egg laying likely began in early April, as indicated by the first well-built nests, and continued until early- to mid-June. A peak total count of 92 well-built nests was reached on 9 June, but dates of high counts varied among subcolonies. Later breeding efforts were especially evident at BM227X subcolonies 02, 03, and 05, where most nest building was initiated in mid- to late April and nest counts peaked in late May to early June at BM227X-03 and late June at BM227X-02 and 05.

Productivity - Brandt's Cormorant productivity was monitored at CRM-09, where birds nested on a broad cliff ledge only 50-100 m from a location that provided clear views into most nests. When this subcolony was discovered on 1 May, 14 of 34 monitored nests had already initiated egg laying. For these nests, clutch initiation dates were estimated by backdating from the number of eggs present on 1 May (for incomplete clutches) or from chick hatch dates (assuming a 30-day incubation period). The mean clutch initiation date was 24 April (range 4 April-23 May, n = 30) and average clutch size was 2.7 eggs (Table 3). No replacement clutches were recorded. Productivity was 1.82 chicks per pair.

Point Reyes

Nest surveys - In 2006, Brandt's Cormorant nest counts were conducted between 21 April and 17 August (Figure 23). Cormorants had an unusually large nesting effort, with subcolonies spread throughout the western portion of the headlands, including: Pebble Point, Slide, Area C, Area E, Area F, Greentop, East Cliff Colony, Northwest Rock, Chip Rock, Face Rock, Arch Rock, Wishbone and Spine Points, Cone Rock (Lower, Upper, and Shoulder), Area B, and Border Rock. At Trinity Point, two nests and 20 birds were counted on 6 July only and egg laying seems unlikely.

The first well-built nest and first egg were observed on 21 April, indicating that clutch initiation had just begun when observations began. The peak total count of 597 well-built and brooding nests occurred during the week of 6 June, well after the mean clutch initiation date at monitored nests (see below). This difference was largely related to a wave of later nesting birds that began building nests in late May and early June.

The Pebble Point, Area E and Area F subcolonies were unsuccessful and completely abandoned, most likely due to predation. Most abandonment at Pebble Point occurred between 7 and 13 June. Area E was abandoned between 30 June and 6 July. Most abandonment at Area F occurred between 19 and 30 June and the area was completely empty by 6 July. These three subcolonies, as well as Spine Point (see Productivity, below), are on the mainland and are likely more accessible to mammalian predators although avian predation (e.g., owls) was also possible.

Productivity - A total of 135 nests were monitored between four subcolonies. All clearly visible egg laying sites on Spine Point, Area B, and Border Rock were monitored as well as a large, contiguous sample of nests on Cone Rock (Table 3). For all subcolonies combined, the average clutch initiation date was 11 May (range 21 April-21 June, n = 105). Based on productivity and nest survey data that included other parts of PRH, there were two distinct pulses in egg laying: one group that completed egg laying by mid-May and another group that initiated egg laying in the last week of May through the first week of June (including portions of Cone Rock). Many later breeders did not hatch young, potentially accounting for lower hatching success at Cone Rock.

Productivity averaged 2.0 chicks per pair and ranged from 1.1 (Spine Point) to 2.5 (Border Rock) at each subcolony. Low breeding success at Spine Point resulted from a predation event that occurred in mid-July. By that time, most nests on Spine Point had chicks $\geq$ 30 days old and would have been considered "fledged" by protocol. However, between 11 and 13 July, several chick carcasses were observed throughout the colony. A total of 45 chicks were recorded as dead or missing, 15 nests had lost all young, and several other nests lost one to two young. Since we knew these chicks did not fledge, nests where chicks were dead or missing were counted as failed. If these chicks had been considered fledged as per our protocol, productivity at PRH would have been 2.33 chicks/pair. Many nests that were lost were located at the point farthest from mainland access, suggesting that an avian predator may have been responsible.

Drakes Bay Colony Complex

Nest surveys - Brandt's Cormorant nests were counted between 22 April and 5 August (Figure 24). Breeding was confirmed at Miller's Point North Rock (MPR-01), Miller's Point South Rock (MPR-02), Miller's Point South Far Rock (MPR-03), and Stormy Stack (DPR-01). Peak counts of well-built nests were 3 June at MPR (108 nests) and 27 May at DPR (76 nests). Breeding phenology appeared to be similar to PRH. PRS had little nesting activity earlier in the season but eight nests were counted on 15 July. It is uncertain if eggs were laid in any of those nests.

Pelagic Cormorant, Black Oystercatcher, Western Gull, and Pigeon Guillemot

Nest and bird surveys - High counts of nests (cormorant, oystercatcher, gull) or birds (guillemot) at each colony are summarized in Table 4. Land-based counts were generally more thorough than in past years. For the Devil's Slide to San Pedro Rock area and PRH, high weekly counts from land, single boat counts, and combined land/boat counts are reported. Boat surveys were generally more complete since they covered areas not visible from mainland vantage points.

Pelagic Cormorants bred in higher numbers than in 2005, when only one nest was seen at DSRM (boat and land surveys), four at CHCC (land surveys only), and none at PRH (land surveys only; McChesney et al. 2006). Western Gull numbers also appeared to be slightly higher in 2006 than in 2005.

Pigeon Guillemots were surveyed weekly in early morning at DSRM, CHCC, and the Lighthouse area at PRH (Figure 25). Counts were generally highest in late April through mid-

May and then declined, presumably as birds laid eggs and incubating birds were hidden in nest crevices. Counts from land-based surveys are not comparable to 2005, when counts were conducted later in the day. The boat count of 123 birds between Devil's Slide and San Pedro Rock on 3 June was similar to the boat count of 102 birds in 2005 (McChesney et al. 2006). In addition to weekly counts in the Lighthouse area, complete surveys of PRH were conducted from both land (289 birds, 4 May) and boat (217 birds, 15 June). No guillemots were observed carrying fish at any colony, indicating that nesting efforts may have failed.

Productivity - Easily visible nests of Pelagic Cormorants, Black Oystercatchers, and Western Gulls were monitored opportunistically at DSRM, CRM, and PRH (Table 5). Our main goal was simply to determine the numbers of chicks fledged per pair. Productivity of these species had not been monitored in recent years at these colonies but prior data are available.

For Pelagic Cormorants, productivity was low at CRM, where one very early nest fledged one chick. Interestingly, the same or another pair remained at the nest and laid another clutch of three eggs that disappeared shortly afterward. Productivity was not particularly high or low at DSRM and PRH. Western Gull productivity was very low at CRM and DSRM but was fairly high at PRH. Only one oystercatcher nest was followed (at CRM) and one chick fledged.

Aerial Photographic Surveys

Aerial photographic survey data on Common Murres, Brandt's Cormorants, and Double-crested Cormorants at sample central California colonies are reported by colony in Table 6 and by subcolony in Appendix 1.

Common Murre - Compared to 2005 (McChesney et al. 2006), the total number of murres counted at all central California colonies combined was 30% higher in 2006. This increase mostly reflected substantially higher counts at the North (+30%) and South (+27%) Farallon Islands, which together totaled 75% of all murres counted in central California. However, a similar percent change (+37%) occurred for all nearshore colonies combined.

At individual nearshore colonies, higher counts occurred at all colonies and changes from 2005 to 2006 ranged from +12% at PRS to +110% at DSRM. Total counts of murres at DBCC (including PRS, MPR, and DPR) and CHCC (including BM-227X, CRM, and HPR) were 22% and 69% higher than in 2005, respectively. The DSRM count on 7 June (675 birds) included 618 and 57 murres on DSR and DSM, respectively.

Brandt's Cormorant - The 2006 nest total for all sample colonies combined was 59% higher than in 2005 (McChesney et al. 2006); percent changes were similar for nearshore colonies (+61% combined) and offshore colonies (+58% for the North and South Farallones combined). Nest totals for nearshore colonies or colony complexes were higher at PRH (+197%), DBCC (+48%), Alcatraz (+37%), Año Nuevo (+59%) and CHCC (+68%), and lower only at Lobos/Seal Rocks (-24%). At Alcatraz and Año Nuevo islands, nest totals were the highest ever recorded since these colonies formed in 1989 and 1991, respectively (Carter et al. 1992, 1996, 2000; Knechtel et al. 2003; Capitolo et al. 2004; McChesney et al. 2004, 2005, 2006; Saenz et al. 2006; USFWS unpubl. data). The South Farallon Islands, the largest known Brandt's Cormorant colony, increased 58% to 11,739 nests which was similar to the highest previous breeding population estimate of 23,800 birds (or 11,900 nests) in 1974 (Ainley and Boekelheide 1990, Carter et al. 1992, Capitolo et al. 2004).

Sample colonies do not include all Brandt's Cormorant colonies in the region, as several large colonies occur between Año Nuevo and CHCC. Inclusion of all colonies will be needed to further assess overall population changes for this species in 2006.

Double-crested Cormorant - We counted only one Double-crested Cormorant colony. The South Farallon Islands is the only outer coast colony in our focal area between Point Reyes and Point Sur, although several other colonies occur in the San Francisco Bay area. Our nest count in 2006 (607 nests) was 80% higher than in 2005, but only 8% higher than in 2004. A group of 17 nests and four territorial sites near a ridge in Pelican Bowl represented the first known nesting outside the traditional colony location on Maintop since the late 1800s (Emerson 1904, Ainley and Lewis 1974). Three nests also occurred along the boundary between Raven's Cliff and Maintop, showing the colony appears to be spreading.

Other species - Roosting Brown Pelicans were present during surveys at five of our murre and cormorant sample colonies. The high count of 120 pelicans at PRH on 20 June was comprised mostly of immatures (92%), in contrast to the count of 60 pelicans at Año Nuevo Island earlier in the month on 2 June (75% adults). At the North Farallon Islands, 70 California Sea Lions, 107 Steller Sea Lions, and five unidentified sea lions were counted.

Anthropogenic Disturbance

Devil's Slide Rock and Mainland

There were a total of 249 aircraft and 34 watercraft observations in the DSRM area, or 0.476 and 0.065 per hour, respectively (Table 7). The number of aircraft/hr was 61.4% higher than in 2005; plane overflights increased 58.2% while helicopter overflight rates were nearly identical to 2005. The number of watercraft/hr was also similar (-1.6%) to 2005. Plane overflights increased despite the cancellation of the Half Moon Bay "Dream Machines" event, scheduled in late April, due to the closure of Highway 1 at Devil's Slide. Since 2003, aircraft associated with the Dream Machines event have accounted for a large proportion of annual overflights (especially planes).

All disturbance events involved either murres or Brandt's Cormorants. Eleven aircraft and five watercraft observations caused flushing of one or more roosting seabirds. There were no seabirds observed to be displaced from nesting sites. An additional 83 aircraft and 14 watercraft caused agitation/alarm behaviors. Flushing rates caused by aircraft and watercraft increased 40.1% from 2005; disturbance rates by aircraft (0.02/hr) increased 100% while watercraft disturbance (0.009/hr) decreased 18%. Low-flying helicopters caused most aerial disturbance, accounting for 91% of aircraft flushing events. However, when alarm behaviors are included, planes elicited higher disturbance rates (0.086/hr) than helicopters (0.057/hr) .

Jetskis and kayaks accounted for only 24% of watercraft observations, but these small vessels were responsible for all flushing events. All four jetski events were caused by the same individuals on a single day. High disturbance rates by these crafts may have been related to their high maneuverability, ability to approach shorelines very closely, and in the case of the jetskis, high speed and noise.

Additional disturbance was associated with road work on Highway 1 to repair damage caused by intense spring rains. As part of this process, the California Department of Transportation (CalTrans) used explosives to dislodge and clear large rocks from the slide area above the road. Charges were detonated three times on 18 April, twice on 21 April (both dates prior to egg-laying), and once on 28 July (late chick period). All explosions occurred on the slopes above the Pipe Pullout at distances of 500-700 m from DSR. CalTrans coordinated with Project staff in an attempt to minimize impacts on the DSR colony and provide a means for monitoring. DSR was monitored during all blasting activities, with bird counts conducted prior to and after blasts as well as numbers of birds affected. Bird behavior was also recorded from the video system. To monitor noise levels of the blasts on 18 April, CalTrans staff set up sound level meters placed at two locations along Highway 1: one was approximately 700 m north of the blast site; and one was about 530 m south of the blast site (G. Kinoshita, CalTrans, pers. comm.).

The blasts on 18 April were similar in magnitude and were by far the largest. Sounds levels (Lmax) recorded at the north meter were 109.9, 103.6, and 110.8 dBA, respectively, and 91.3, 87.0, and 94.6 dBA at the south meter, respectively. The first blast (1246 h) flushed almost the entire Devil's Slide colony from the rock. All murres (at least 586 birds) and most (about 400) Brandt's Cormorants were flushed by this initial blast, including many cormorants that were courting and nesting-building. Some of the cormorants that remained raided nest material from vacated nests. The murres did not return for the rest of the day, although a few (< 10) occasionally visited the rock for short periods later in the day. Most cormorants that were involved in nest-building as well as many roosting birds returned within five minutes. Subsequent blasts at 1555 h and 1707 h flushed about 2/3 to 3/4 (115 and 200 birds, respectively) of the cormorants present. Like the initial blast, most birds returned within 10-15 minutes. The following morning, murres and cormorants were present in high numbers and the colony appeared to be "normal".

The blasts on 21 April and 28 July were much smaller in magnitude than on 18 April, and these flushed fewer seabirds. Two blasts on 21 April flushed two murres and 71 cormorants and no murres and 17 cormorants, respectively. The final blast on 28 July flushed 60 roosting murres and 20 roosting cormorants from DSR as well as another 100 roosting cormorants from the lower mainland cliffs. No birds attending eggs or chicks were observed to be displaced or flushed.

Castle/Hurricane Colony Complex

Only two boats (0.004/hr) and two planes (25 total overflights; 0.047/hr) were observed at CHCC in 2006 (Table 8); none caused any disturbance. A CDFG aircraft made 24 overflights conducting seabird colony surveys. In 2005, three planes and two helicopters caused disturbances (McChesney et al. 2006).

Point Reyes

Seven aircraft (0.018/hr) and 49 watercraft (0.126/hr) were observed at PRH (Table 9). Most motor vessels were involved in recreational fishing. Two aircraft (0.005/hr) and four watercraft (0.01/hr) caused flushing or displacement of seabirds. If alarm behaviors are included, an additional three watercraft disturbances occurred. Aircraft overflight activity was 64% lower than in 2005 but watercraft activity increased 80%. The increase in boat activity in 2006 may have been associated with anecdotal reports of good fishing off Point Reyes and extended periods of calm seas that permitted small recreational boats to access the area from distant launch sites.

One plane overflight at about 600 feet ASL over the Lighthouse area on 22 June caused 300 murres to flush from the mainland cliffs. Other disturbances affected Brown Pelicans, Brandt's or Pelagic cormorants, and/or Western or Heermann's (*Larus heermanni*) gulls. One event on 22 July involved two kayakers paddling between Miwok and Chip rocks (east-central headlands). In the process they were chased by about 30 Western Gulls they had flushed. They also flushed 30 Brandt's Cormorants from several roosting areas and displaced over 20 fledgling Brandt's Cormorants that retreated from the intertidal area where they had been creching. In another event on 29 July, a recreational fishing vessel spent 45 minutes fishing just north of the lighthouse, often within 40 m of the rocks and cliffs. This caused 50 Brandt's Cormorants, 15 Pelagic Cormorants, and 50 Heermann's Gulls to flush, and agitated about another 30 Brandt's Cormorants.

Drakes Bay Colony Complex

Two aircraft, both helicopters (0.046/hr), and eight watercraft (0.182/hr) were recorded at all DBCC colonies combined (Table 10). One helicopter and three boats caused flushing of murres, cormorants, or pelicans. On 27 May, a U.S. Coast Guard helicopter flew ~500 feet over the DPR causing 20 murres and five Brandt's Cormorants to flush from Stormy Stack. The largest disturbance (8 July) involved a recreational fishing vessel that came within 50 m of Stormy Stack and flushed 400 Brandt's Cormorants and 20 Brown Pelicans. Another large disturbance on 15 July was caused by a chartered fishing vessel that resulted in 50 Brandt's Cormorants flushing at Miller's Point South Rock. In turn, these birds caused all birds roosting on the surrounding rocks to flush, including 100 Brandt's Cormorants, 10 Brown Pelicans, and 10 Western Gulls.

Non-Anthropogenic Disturbance

Devil's Slide Rock and Mainland

Only one minor non-anthropogenic disturbance to murres, by a Brandt's Cormorant, was recorded at DSR in 2006. On DSM, nesting Brandt's Cormorants on April's Finger and Upper Mainland South experienced major disturbance and predation, most likely from a nocturnal predator (see Brandt's Cormorant nest surveys and productivity, above). In late May, a pair of Common Ravens fledged two chicks from a cliff-ledge nest on the south side of Turtlehead Cove. Despite the nest's close proximity to cormorant and murre nesting areas on the mainland, no raven disturbances were observed.

Castle/Hurricane Colony Complex

Now typical for this colony, Brown Pelicans were responsible for a large number of disturbances to murres, with at least 38 recorded flushing events in 2006. Many pelican disturbances were caused by migrating flocks that passed low overhead of the rocks, flushing murres. The only other disturbance was from a Peregrine Falcon that flushed 200 murres.

The most severe disturbance resulted from a single juvenile pelican that visited the colony from 27-29 June. This bird spent the majority of its time flying from rock to rock (subcolonies CRM-02, CRM-04, and CRM-07), roosting and walking among the nesting murres. Frantic murres flushed off the rocks and chicks scattered into hiding places when the pelican flew nearby, landed in the colony, or approached on foot. Many flushed murres circled the rocks and eventually returned in small groups, only to be flushed again by the pelican's movements. Any eggs in the affected areas were lost, and it was difficult for adults to attend and feed chicks. One murre chick was observed to be taken by a Western Gull on CRM-04, and many other chicks perished as well. Of the 94 breeding sites monitored on CRM-04, 35 eggs and 18 chicks were lost during this period (also see Common Murre Productivity, above). Many other sites were lost on affected subcolonies, resulting in low breeding success and premature abandonment of the rocks.

Point Reyes

Sixty-six non-anthropogenic disturbance events to seabirds were recorded at PRH. Most (65%) involved Common Ravens, which affected both murres and cormorants. However, this value is an underestimate because the frequency of raven disturbances was too high to record every event. Western Gulls and Brown Pelicans caused nine (13.6%) and eight (12.1%) disturbances, respectively. Other species involved in disturbances were Turkey Vulture (*Cathartes aura*; n = 2), Peregrine Falcon (n = 1), and California Sea Lion (n = 2). Most major disturbances were recorded during the pre-egg laying period at Aalge Ledge, when flying ravens and gulls often flushed groups of roosting murres. Five murre eggs were observed taken by ravens.

In addition to observed events, abandonment by Brandt's Cormorants and murres from certain mainland nesting areas suggested mammalian or other predation. The Pebble Point (subcolony 05) area was mostly abandoned between 7 and 13 June, and subcolonies 06E and 06F (in Sea Lion Cove) were abandoned between 19 and 30 June. All of these areas are on broad rocky ledges at the bottom of steep slopes that are probably accessible to mammalian predators. At Spine Point, several cormorant chicks were killed by an unknown, possibly avian predator in early to mid-July (also see Brandt's Cormorant Nest Surveys and Productivity, above).

Drakes Bay Colony Complex

At PRS, a pair of Common Ravens was observed harassing and flushing murres and smaller numbers of cormorants on two different days. In each case, they succeeded in taking one murre egg. The only other documented occurrence was an immature pelican that landed on the top of Stormy Stack (DPR), flushing 25 murres and 20 Brandt's Cormorants. No raven disturbance was observed at MPR, although ravens were observed harassing murres and other seabirds there in 2005 (McChesney et al. 2006).

Common Raven Surveys

Castle/Hurricane Colony Complex
A total of 156 raven surveys (2584 km) were conducted in the northern survey area (Point Lobos and CRM Pullout) and 65 surveys (594.8 km) were conducted in the southern survey area (CRM Pullout and Point Sur). In the northern area, 94 raven detections were recorded, or 0.596 ravens per survey (0.036/km). In the southern area, 37 raven detections were recorded, or 0.567 ravens per survey (0.062/km).

Of 131 total raven detections, 25 (19%) were close to the Soberanes Point trailhead, 13 (9.9%) were in the Point Sur vicinity, 12 (9.2%) were near the BM-227X colony, 11 (8.3%) were close to Hurricane Point, and 10 (7.6%) were around the Garrapata State Beach parking pull-out. The remaining 60 (45.8%) detections were at various other locations (Figure 26). As in 2005, the highest concentration was observed between Yankee Point and Soberanes Point. Between Hurricane Point and Point Sur, higher numbers were observed in 2006 (35 detections) than in 2005 (9 detections). Pairs of ravens were consistently seen at three locations throughout the breeding season: the Garrapata Beach area, the Hurricane Point pullout, and the vicinity of the Soberanes Point trailhead. Additional raven observations incidentally recorded during other monitoring activities were not included in the above numbers. Despite the increasing numbers of ravens along this portion of the coast, no nesting pairs were evident near the Castle Rocks and Mainland colony and no ravens were observed disturbing the seabird colonies as occurred in 2004 and 2005.

DISCUSSION

The 2006 breeding season marked the eleventh consecutive year of seabird restoration and monitoring efforts in central California by the Common Murre Restoration Project. Efforts have focused on reestablishing breeding and increasing population size at the formerly extirpated murre colony at DSR using social attraction techniques, assessing the status of other murre colonies, and identifying other methods to restore the nearshore portion of the central California murre population following large declines in the 1980s, including reduction of gill-net mortality and reductions of human and avian disturbance (e.g., USFWS 1995; Carter et al. 2003; Parker et al. 2007). In particular, past monitoring indicated that human and avian disturbance appeared to hinder recovery of certain colonies, such as at CHCC (e.g., Rojek et al. 2007; McChesney et al. 2004, 2005), and additional efforts have focused on documenting and reducing these impacts. Reduction of human disturbance to help restore colonies is the major goal of the Seabird Colony Protection Program (USFWS et al. 2004).

The success of murre restoration efforts on DSR continued in 2006. An exciting milestone was cessation of social attraction techniques on DSR following several years of reduced equipment use. Following initial colony growth after the first few years of restoration efforts, fewer and fewer decoys were deployed each year (Parker et al. 2007) and in 2005 decoys were deployed only on the west portion of the rock (McChesney et al. 2006). The estimate of 361 breeding pairs in 2006 was the highest recorded since the colony was reestablished in 1996, and was 120% higher than in 2005 and 90% higher than the previous peak in 2004. We believe the DSR colony is now well-established and no longer requires social attraction techniques to attract birds to the colony or to keep birds at the colony. Sufficient numbers of live birds now attend the colony in the pre-breeding and breeding seasons to perform these functions. By gradually phasing out social attraction efforts, we further avoided possible complications (e.g., colony abandonment) that may have resulted from an otherwise rapid withdrawal of efforts and equipment. Also, space use by decoys and other equipment were preventing denser nesting in many parts of the colony. In 2006, murres responded to the additional space by increasing densities in areas formerly occupied by decoys. However, the DSR colony is still only about 25% of its pre-decline level of about 1,500 breeding pairs (Sowls et al. 1980, Briggs et al. 1983).

An exciting extension of the Devil's Slide restoration project has been the natural establishment of new murre breeding groups on DSM. These murres have been associated with nesting Brandt's Cormorants, a well-known natural facilitator of new murre breeding colonies (McChesney et al. 1998, 1999; Carter et al. 2001; Capitolo et al. 2005; Parker et al. 2007). Four pairs first bred on the mainland in 2005, fledging one chick (McChesney et al. 2006). Breeding within the same two areas for the second consecutive year in 2006, along with several more territorial sites, is encouraging for continued breeding and colony growth. If mainland (24 pairs) and DSR breeders are combined, 385 pairs of murres bred at DSRM in 2006. However, it is uncertain if mainland breeding will persist in the future.

A major change associated with high colony growth on DSR was the establishment of plots to monitor murre productivity in 2006. As the colony has grown in size and density, closely monitoring every breeding site has become impossible even with the assistance of remote video cameras. Three plots were established during winter 2005-06 to monitor murre breeding phenology and success for a large proportion of the DSR colony. Periodic assessments of murres over the entire visible part of the rock also allowed us to estimate the total number of breeding and territorial sites and compare birds within and outside of plots. Comparisons demonstrated that productivity and phenology in the two groups were similar, indicating that plots were a reasonable representation of the whole colony. This is especially important for estimating the numbers of chicks fledged and for various comparisons to other years. Most importantly, use of plots has made it feasible to continue monitoring numbers of breeding birds and breeding success into the future.

Colony growth at DSR also reflected high murre attendance at other central California colonies in 2006. In particular, aerial surveys at the North and South Farallon Islands as well as PRH showed continued increases at those colonies. Increases at PRH were also evident from weekly land-based surveys. Numbers are increasing throughout established breeding areas along the headlands and the colony appears to be expanding eastward. High attendance at clubs adjacent to the largest subcolony at Lighthouse Rock, as well as other parts of the headlands, suggest a large subadult population at PRH and likely other colonies as well. Large-scale use of clubs was evident at PRH in 1979-1982 but was dramatically reduced after the colony declined between 1982 and 1985 (McChesney et al. 1998). High murre numbers at the South Farallon Islands was also indicated by incomplete land-based surveys by PRBO Conservation Science (Warzybok et al. 2006). While DSR showed similar colony growth patterns as other central California colonies, growth occurred to a greater relative extent at DSR. We believe that DSR grew at a greater relative rate because it is still in the early stages of colony growth, following recent recolonization. Other colonies are recovering from past reductions but at a lower relative rate.

Murre aerial photographic counts also increased substantially (69%) at CHCC, with higher counts at all colonies (and most subcolonies) within the complex. After slow but relatively steady increase in the 1990s to early 2000s, growth at this colony complex appeared to have slowed or reversed in more recent years. High colony growth in 2006 is somewhat surprising given the large-scale disruption of breeding activities and low breeding success in recent years, largely due to Brown Pelican disturbance and Common Raven disturbance and predation. Similar to the previous two years (McChesney et al. 2005, 2006), large-scale pelican disturbance resulted in high nest abandonment, low breeding success, and early colony departure for most CRM birds in 2006. The major increase in 2006 may reflect reduced gill-net and oil spill mortalities in recent years. But without sufficient future recruitment, and possible abandonment by breeding pairs, we expect future decline and possible colony loss if pelican and raven impacts continue.

At Devil's Slide, murre breeding success was extremely low for the second consecutive year although breeding was not as late as in 2005. Murre productivity at Southeast Farallon Island was similar to DSR in 2006, with other similar patterns (e.g., early stage chick loss; Warzybok et al. 2006), suggesting that broad-scale environmental factors were responsible. Similar to 2005, the spring season along the central California coast was characterized by exceptionally stormy weather, low upwelling, and elevated sea surface temperatures (e.g., Peterson et al. 2006; http://coastwatch.pfel.noaa.gov/cgi-bin/elnino.cgi). This had a large impact on the California Current upwelling system, with reduced marine productivity and reduced prey availability for most seabirds. Low co-attendance patterns by murre breeding pairs at DSR also indicated poor foraging conditions, as birds likely spent more time foraging to satisfy the energy requirements of both themselves and the nestling (Parker 2005).

Although earlier than in 2005, breeding by murres was also later than normal at both PRH and CRM. Productivity was higher than average at PRH and indications were of the same at CRM before the large-scale pelican disturbance there led to below average breeding success. At both colonies, late breeding likely reflected poor local conditions early on but adequate prey levels for successful breeding must have become available later in the season. Anecdotal reports indicated the Point Reyes area was one of the better and more consistent sport fishing areas in the region in spring/summer 2006. Thus, prey resources likely were more abundant in this area.

For Brandt's Cormorants and other seabirds, the re-establishment of productivity monitoring at other colonies is helping us to further assess factors affecting colony growth in murres, document the impacts of disturbance, and evaluate environmental factors affecting seabirds in the region. In 2006, Brandt's Cormorant breeding phenology at DSR was close to the long-term average and, unlike many murre colonies, productivity (1.8-2.5 fledglings/pair) was near average where birds were not impacted by disturbance and predation. Compared to 2005, productivity at Devil's Slide was similar (excluding areas impacted by disturbance) but breeding was as late (McChesney et al. 2006). Large-scale abandonment and nest predation was evident on the upper mainland cliffs at DSM and at multiple locations at PRH. At DSM and Spine Point at PRH, large numbers of cormorant chick carcasses suggested possible mammalian and/or avian predation. Mammalian tracks and scat, probably from fox, were observed near the top of the Devil's Slide promontory, and a bobcat was also observed in the area. Closure of Highway 1 at Devil's Slide for repairs, which lasted from mid-April to mid-August, may have provided easier mammalian access to the mainland colonies. However, it was difficult to explain how many nests farther from inland access points were abandoned while those closer to access points were left apparently unaffected (at least initially). The latter group included nests along narrow ridges that a mammalian predator would have to cross to access nests farther out. Thus, avian predation (possibly owl) was possibly more plausible, at least at DSM and Spine Point.

Similar to murres, Brandt's and Double-crested Cormorants increased substantially at monitored colonies in central California and numbers rivaled the highest recorded in the last four decades (e.g., Sowls et al. 1980; Ainley and Boekelheide 1990; Carter et al. 1992; Capitolo et al. 2004; Knechtel et al. 2003; McChesney et al. 2004, 2005, 2006). The high nesting effort in 2006 and high breeding success of Brandt's Cormorants in 2005-2006 contrasted somewhat with murres and several other species in the region (e.g., Warzybok et al. 2005, 2006; McChesney et al. 2006; Peterson et al. 2006).

Productivity of other species in 2006 showed mixed results. Based on long-term averages at the South Farallon Islands (Warzybok et al. 2006), productivity of Pelagic Cormorants and Western Gulls was near average at PRH but was very low at CHCC. At DSRM, breeding success of Pelagic Cormorants near average but was very low for Western Gulls.

Compared to 2005, rates of anthropogenic disturbance to seabirds in 2006 increased at both DSRM and PRH. Most events only caused agitation behaviors but several events resulted in flushed or displaced birds. At DSRM, low-flying aircraft caused most disturbances whereas motor vessels caused most disturbance at PRH. The number of planes observed at DSRM increased 58% from 2005 despite the cancellation of the Half Moon Bay Dream Machines event, an indication of increasing aircraft traffic associated with the nearby Half Moon Bay Airport. At PRH, motor vessel traffic continued the increasing trend observed in 2005 (McChesney et al. 2006), apparently due to calm weather and good sport fishing in the area. Aircraft and boat traffic remained at low levels at CHCC, although boat traffic further offshore was frequently observed.

Assessing impacts of anthropogenic disturbance in 2006 is difficult given poor foraging conditions. Although no birds were observed to be flushed or displaced from eggs or chicks, elevated stress levels associated with frequent disturbance may have resulted in some birds abandoning nests, especially at DSRM (Beale and Monaghan 2004). Fortunately, the high level of disturbance caused by explosives at Devil's Slide in late April occurred prior to the start of egg laying. If breeding had already begun, many birds almost certainly would have abandoned nests. Impacts of pre-breeding season disturbance is not well understood, but may cause some prospecting birds to abandon the colony or fail to establish a breeding site (Rojek et al. 2007).

LITERATURE CITED

Ainley, D. G., and R. J. Boekelheide [Eds.]. 1990. Seabirds of the Farallon Islands: ecology, dynamics, and structure in an upwelling-system community. Stanford University Press, Stanford, California.

Ainley, D. G., and T. J. Lewis. 1974. The history of Farallon Islands marine bird populations, 1854-1972. Condor 76:432-446.

Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Birkhead, T. R. 1977. The effect of habitat and density on breeding success in the Common Guillemot (*Uria aalge*). Journal of Animal Ecology 46:751-764.

Birkhead, T.R., and D.N. Nettleship. 1980. Census methods for murres, *Uria* species: a unified approach. Canadian Wildlife Service Occasional Paper Number 43. 25 pp.

Capitolo, P. J., H.R. Carter, and M. W. Parker. 2002. Protocol for identification of areas used for counting seabirds from aerial photographs at South Farallon Islands, California. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Capitolo, P. J., H. R. Carter, G. J. McChesney, and M. W. Parker. 2005. Common Murres prospecting within cormorant colonies in Del Norte and Humboldt counties, California, 1996-2004. Northwestern Naturalist 86:144-150.

Capitolo, P. J., H.R. Carter, R. J. Young, G. J. McChesney, R. T. Golightly, and F. Gress. 2004. Changes in population size of Brandt's and Double-crested Cormorants in California, 1975-2003. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Capitolo, P. J., G. J. McChesney, H. R. Carter, M. W. Parker, J. N. Hall, R. J. Young, and R. T. Golightly. 2006. Whole-colony counts of Common Murres, Brandt's Cormorants and Double-crested Cormorants at sample colonies in northern and central California, 1996-2004. Unpublished report, Department of Wildlife, Humboldt State University, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Carter, H.R. 2003. Oil and California's seabirds: an overview. Marine Ornithology 31:1-7.

Carter, H.R., and R. T. Golightly [Eds.]. 2003. Seabird injuries from the 1997-1998 Point Reyes Tarball Incidents. Unpublished Report, Humboldt State University, Department of Wildlife, Arcata, California.

Carter, H.R. and K. A. Hobson. 1988. Creching behavior of Brandt's Cormorant chicks. Condor 90:395-400.

Carter, H.R., G. J. McChesney, D. L. Jaques, C. S. Strong, M. W. Parker, J. E. Takekawa, D.L. Jory, and D.L. Whitworth. 1992. Breeding populations of seabirds in California, 1989-1991. Vols. 1 and 2. Unpublished draft report, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Dixon, California.

Carter, H.R., G.J. McChesney, J. E. Takekawa, L. K. Ochikubo, D. L. Whitworth, T. W. Keeney, W.R. McIver, and C. S. Strong. 1996. Population monitoring of seabirds in California: 1993-1995 aerial photographic surveys of breeding colonies of Common Murres, Brandt's Cormorants, and Double-crested Cormorants. Unpublished final report, U.S. Geological Survey, Biological Resources Division, California Science Center, Dixon,

California. 213 pp.
Carter, H.R., U. W. Wilson, R.W. Lowe, D.A. Manuwal, M.S. Rodway, J.E. Takekawa, and J.L. Yee. 2001. Population trends of the Common Murre (*Uria aalge californica*). Pp. 33-133 *in* Manuwal, D.A., H.R. Carter, T.S. Zimmerman, and D.L. Orthmeyer (Eds.). Biology and conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural History and population trends. U.S. Geological Survey, Information and Technology Report, USGS/BRD/ITR-2000-0012, Washington, D.C.
Carter, H. R., V. A. Lee, G. W. Page, M. W. Parker, R.G. Ford, G. Swartzman, S.W. Kress, B.R. Siskin, S.W. Singer, and D.M. Fry. 2003. The 1986 *Apex Houston* oil spill in central California: seabird injury assessments and litigation process. Marine Ornithology 31:9-19.
Emerson, W. O. 1904. The Farallon Islands revisited, 1887-1903. Condor 6:61-68.
Forney, K. A., S. R. Benson, and G. A. Cameron. 2001. Central California gillnet effort and bycatch of sensitive species, 1990-98. In (E. F. Melvin and J. K. Parrish, eds.), Seabird bycatch: trends, roadblocks, and solutions. University of Alaska Sea Grant, Fairbanks, Alaska.
Hampton, S., R. G. Ford, H.R. Carter, C. Abraham and D. Humple. 2003. Chronic oiling and seabird mortality from the sunken vessel *S.S. Jacob Luckenbach* in central California. Marine Ornithology 31:35-41.
Knechtel, H. A., N. M. Jones, M. Murphy, A. H., Robinson, K. Vickers, G. J. McChesney, H. R. Carter, S. W. Kress, R. T. Golightly, J. Buffa, and M. W. Parker. 2003. Restoration of Common Murre Colonies in Central Coastal California: Annual Report 2002. Unpublished Report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.
Kress, S. W. 1983. The use of decoys, sound recordings, and gull control in reestablishing a tern colony in Maine. Colonial Waterbirds 6:185-196.
Kress, S. W. and Nettleship. 1988. Reestablishment of Atlantic Puffins at a former breeding site in the Gulf of Maine. Journal of Field Ornithology 59:161-169.
McChesney, G. J. 1997. Breeding biology of the Brandt's Cormorants on San Nicolas Island, California. Unpublished M.S. thesis, California State University, Sacramento, California.
McChesney, G. J., H.R. Carter, M. W. Parker, J. E. Takekawa and J. L. Yee. 1998. Population trends and subcolony use of Common Murres and Brandt's Cormorants at Point Reyes Headlands, California, 1979-1997. Unpublished report, U.S. Geological Survey, Biological Resources Division, Western Ecological Research Center, Dixon, California; Humboldt State University, Department of Wildlife, Arcata, California; and U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.
McChesney, G. J, H. R. Carter, M. W. Parker, P. J. Capitolo, J. E. Takekawa, and J. L. Yee. 1999. Population trends and subcolony use of Common Murres and Brandt's Cormorants at the Castle/Hurricane Colony Complex, California 1979-1997. Unpublished final report, U. S. Geological Survey, Biological Resources Division, Western Ecological Research Center, Dixon, California; Department of Wildlife, Humboldt State University, Arcata, California; and U. S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California. 65 pp.
McChesney, G. J., A. H. Robinson, J. S. Koepke, H. A. Knechtel, N. M. Jones, C. M. Caurant, R. T. Golightly, H. R. Carter, S. W. Kress, and J. Stankiewizc. 2004. Restoration of

Common Murre colonies in central coastal California: annual report 2003. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G. J., N. M. Jones, T. B. Poitras, K. J. Vickers, L. E. Eigner, H. R. Carter, R. T. Golightly, S. W. Kress, M. W. Parker, K. Studnicki, P. J. Capitolo, and J. N. Hall. 2005. Restoration of Common Murre colonies in central California: annual report 2004. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

McChesney, G. J., L. E. Eigner, T. B. Poitras, P. J. Kappes, D. Le Fer, L. T. Nason, P. J. Capitolo, H. Beeler, C. E. Fitzpatrick, R. T. Golightly, K. S. Bixler, H. R. Carter, S. W. Kress, and M. W. Parker. 2006. Restoration of Common Murre colonies in central California: annual report 2005. Unpublished report, U. S. Fish and Wildlife Servive, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Page, G. W., H.R. Carter, and R. G. Ford. 1990. Numbers of seabirds killed or debilitated in the 1986 *Apex Houston* oil spill in central California. Pp. 164-174. *In* Sealy, S.G. (Ed.), Auks at sea. Studies in Avian Biology 14.

Parker, M. W. 2005. Comparison of breeding performance, co-attendance, and chick provisioning rates of breeding Common Murres (Uria aalge) as early indicators for ecological monitoring. Unpublished M.S. Thesis, Humboldt State University, Arcata, California.

Parker, M. W., E. B. McClaren, S. E. Schubel, J. A. Boyce, P. J. Capitolo, M.A. Ortwerth, S. W. Kress, H.R. Carter, and A. Hutzel. 1997. Restoration of Common Murre Colonies in Central California: Annual Report 1996. Unpublished report, U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M. W., E. B. McClaren, J. A. Boyce, V. Collins, D. A. Nothhelfer, R. J. Young, S. W. Kress, H. R. Carter, and A. M. Hutzel. 1998. Restoration Common Murre Colonies in Central Coastal California: Annual Report 1997. Unpublished Report, U. S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, Newark, California.

Parker, M. W., S. W. Kress, R. T. Golightly, H. R. Carter, E.B. Parsons, S. E. Schubel, J. A. Boyce, G. J. McChesney, and S.M. Wisely. 2007. Assessment of social attraction techniques used to restore a Common Murre colony in central California. Waterbirds 30:17-28.

Peterson, W. T., R. Emmett, R. Goericke, E. Venrick, A. Mantyla, S. J. Bograd, F. B. Schwing, R. Hewitt, N. Lo, W. Watson, J. Barlow, M. Lowry, S. Ralston, K. A. Forney, B. E. Lavaniegos, W. J. Sydeman, D. Hyrenbach, R. W. Bradley, P. Warzybok, F. Chavez, K. Hunter, S. Benson, M. Woese, and J. Harvey. 2006. The state of the California Current, 2005-2006: warm in the north, cool in the south. California Cooperative Fisheries Investigations Reports 47:30-74.

Podolsky, R. H. 1985. Colony formation and attraction of the Laysan Albatross and Leach's Storm-Petrel. Unpublished Ph.D. dissertation, University of Michigan, Ann Arbor, Michigan.

Podolsky, R. H., and S. W. Kress. 1989. Factors affecting colony formation in Leach's Storm-Petrel. Auk 106:332-336.

Podolsky, R. H., and S. W. Kress. 1991. Attraction of the endangered Dark-rumped Petrel to recorded vocalizations in the Galapagos Islands. Condor 94:448-453.

Ray, M. S. 1909. The passing of the Pedro Island seabird rookery. Condor 11:94-96.

Roletto, J., J. Mortenson, I. Harrald, J. Hall, and L. Grella. 2003. Beached bird surveys and chronic oil pollution in central California. Marine Ornithology 31:21-28.

Rojek, N. A., M. W. Parker, H.R. Carter, and G.J. McChesney. 2007. Aircraft and vessel disturbances to Common Murres at breeding colonies in central California, 1997-1999. Marine Ornithology 35:67-75.

Saenz, B.L., J.A Thayer, W.J. Sydeman, and D.A. Hatch. 2006. An urban success story: breeding seabirds on Alcatraz Island, California, 1990–2002. *Marine Ornithology* 34: 43–49.

Schubel, S. E. 1993. A Common Murre attraction project on a Maine island. Unpublished report, National Audubon Society, Ithaca, New York.

Sowls, A. L., A.R. DeGange, J. W. Nelson, and G. S. Lester. 1980. Catalog of California seabird colonies. U.S. Department of Interior, Fish and Wildl. Serv., Biol. Serv. Prog. FWS/OBS 37/80.

Takekawa, J. E., H.R. Carter, and T.E. Harvey. 1990. Decline of the Common Murre in Central California 1980-1986. Pp. 149-163. *In* Sealy, S.G. (Ed.), Auks at sea. Studies in Avian Biology 14.

U.S. Fish and Wildlife Service. 1995. Notice of availability, final *Apex Houston* oil spill restoration plan. Federal Register 60(81):20739-20749.

U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, California Department of Fish and Game, California Department of Parks and Recreation, and California State Lands Commission. 2004. Command Oil Spill Final Restoration Plan and Environmental Assessment.

Warzybok, P. M., R.W. Bradley, and W. J. Sydeman. 2005. Population size and reproductive performance of seabirds on Southeast Farallon Island, 2005. Unpublished report, PRBO Conservation Science, Stinson Beach, California.

Warzybok, P. M., R.W. Bradley, and W. J. Sydeman. 2006. Population size and reproductive performance of seabirds on Southeast Farallon Island, 2006. Unpublished report, PRBO Conservation Science, Petaluma, California.

Table 1. Productivity and breeding phenology of Common Murres in monitored plots on Devil's Slide Rock, 2006.

Plot	# of Sites Monitored	# of Breeding Sites	# of Territorial Sites	# of Chicks Fledged	Chicks Fledged per Pair	Mean Egg Lay Date[1]	Mean Hatch Date[2]	Mean Fledge Date[2]
A	102	98	4	30	0.31	22 May	24 June	17 July
B	70	62	8	20	0.32	26 May	28 June	21 July
C	24	16	8	1	0.06	02 June	29 June	21 July
Combined	196	176	20	51	0.29	24 May	26 June	19 July

[1]First clutches only.
[2]First and replacement clutches.

Table 2. Common Murre productivity at Devil's Slide Rock (DSR; 3 plots combined), Devil's Slide Mainland (DSM; 2 plots combined), Castle Rocks and Mainland (CRM), and Point Reyes (PRH) in 2006.

Colony/Plot	# of Sites Monitored	# of Egg Laying Sites	Mean Lay Date[1]	# of Eggs Laid	Mean Hatch Date	# of Eggs Hatched	Hatching Success[2]	Mean Fledge Date	# of Chicks Fledged	Fledging Success[3]	Chicks Fledged per Pair
DSR	196	176	24 May (5/5-7/4)	190	26 June (6/4-7/26)	98	51.6%	19 July (7/4-8/1)	51	52%	0.29
DSM	71	24	13 June (5/18-7/29)	24	5 July (6/16-7/20)	10	41.7%	31 July (7/11-8/7)	8	80%	0.33
CRM 04	117	94	22 May (5/8-6/17)	95	17 June (6/6-6/30)	48	50.5%	14 July (7/4-7/18)	29	60.4%	0.31
PRH Edge	56	51	1 June (5/22-6/26)	55	3 July (6/28-7/18)	35[4]	71.4%[4]	24 July (7/17-7/30)	32[4]	91.4%[4]	0.63
PRH Ledge	75	64	29 May (5/18-6/21)	66	30 June (6/19-7/16)	48	72.7%	23 July (7/12-8/7)	40	83.3%	0.63
PRH Edge & Ledge	131	115	30 May (5/18-6/26)	121	1 July (6/19-7/18)	83[4]	72.2%[4]	23 July (7/12-8/7)	72[4]	86.7%[4]	0.63

[1] Calculated using first eggs only; i.e., does not include replacement clutches.
[2] Hatching success is defined as the number of eggs hatched per eggs laid (includes both first and replacement clutches).
[3] Fledging success is defined as the number of chicks fledged per eggs hatched (includes both first and replacement clutches).
[4] Does not include six sites that were considered breeding but it was unknown if eggs hatched.

Table 3. Brandt's Cormorant breeding phenology and reproductive success at Devil's Slide Rock and Mainland, Point Reyes, and Castle Rocks and Mainland, 2006. Reported are means (range; n).

Colony/ Subcolony	# of Sites Monitored	Clutch Initiation Date[1]	Clutch Size[1]	Brood Size[2]	Hatching Success[2]	Fledging Success[2]	# of chicks fledged/pair[2]
Devil's Slide							
Devil's Slide Rock	103	6 May (22 April-19 July; 94)	3.4 (1-5; 88)	2.4 (0-4; 106)	72% (0-100%; 308)	92% (0-100%; 244)	2.2 (0-4; 101)
April's Finger	42	8 May (1 May-25 May; 42)	3.3 (2-4; 37)	0.0 (0; 42)	0% (0; 121)	0% (0; 0)	0.0 (0; 42)
Turtlehead	42	10 May (22 April-17 June; 38)	3.2 (1-4; 38)	2.3 (0-4; 43)	69% (0-100%; 124)	76% (0-100%; 97)	1.8 (0-4; 42)
Combined - Devil's Slide	187	8 May (22 April-19 July; 174)	3.3 (1-5; 163)	1.8 (0-4; 191)	56% (0-100%; 553)	87% (0-100%; 341)	1.6 (0-4; 185)
Point Reyes							
Spine Point	32	5 May (28 April-13 May; 26)	3.2 (2-4; 22)	2.6 (0-4; 33)	81% (0-100%; 70)	41% (0-100%; 81)	1.1 (0-4; 31)
Cone Rock	58	25 May (1 May-21 June; 38)	3.0 (2-4; 44)	2.3 (0-4; 58)	74% (0-100%; 133)	89% (0-100%; 133)	2.2 (0-3; 55)
Area B	17	7 May (3-13 May; 15)	3.2 (3-4; 11)	2.4 (0-3, 17)	84% (67-100%; 36)	90% (33-100%; 40)	2.2 (0-3; 16)
Border Rock	27	2 May (21 April-11 May; 26)	3.2 (2-4; 13)	2.6 (1-4; 27)	89% (67-100%; 41)	95% (0-100%; 71)	2.5 (0-4; 27)
Combined Pt. Reyes	135	11 May (21 April-21 June; 105)	3.1 (2-4; 90)	2.4 (0-4; 135)	80% (0-100%; 280)	79% (0-100%; 325)	2.0 (0-4; 129)
Castle Rocks & Mainland	34	24 April (4 April - 23 May; 30)	2.7 (1-4; 30)	2.1 (0-3; 33)	85.4% (0-100%; 70)	88.5% (0-100%; 62)	1.82 (0-3; 33)

[1] Includes first clutches only.

[2] Includes replacement clutches. See text for details.

Table 4. High counts of nests for Pelagic Cormorant (PECO), Black Oystercatcher (BLOY), and Western Gull (WEGU), and birds of Pigeon Guillemot (PIGU), obtained during land, boat, and combined land/boat counts (total), 2006. ND = No Data.

Species	Colony	Land[1]	Boat	Total Count[2]
PECO	Devil's Slide Rock & Mainland	1	19	19
	San Pedro Rock	ND	0	0
	Point San Pedro	ND	0	0
	Bench Mark-227X	0	ND	0
	Castle Rocks and Mainland	16	ND	16
	Hurricane Point Rocks	0	ND	0
	Point Reyes	32	145	173
	Point Resistance	0	ND	0
	Millers Point Rocks	5	ND	5
	Double Point Rocks	0	ND	0
BLOY	Devil's Slide Rock & Mainland	0	0	0
	San Pedro Rock	ND	0	0
	Point San Pedro	ND	0	0
	Bench Mark-227X	0	ND	0
	Castle Rocks and Mainland	0	ND	0
	Hurricane Point Rocks	0	ND	0
	Point Reyes	1	3	4
	Point Resistance	0	ND	0
	Millers Point Rocks	0	ND	0
	Double Point Rocks	1	ND	1
WEGU	Devil's Slide Rock & Mainland	7	20	20
	San Pedro Rock	ND	4	4
	Point San Pedro	ND	0	0
	Bench Mark-227X	3	ND	3
	Castle Rocks and Mainland	11	ND	11
	Hurricane Point Rocks	1	ND	1
	Point Reyes	104	109	187
	Point Resistance	1	ND	1
	Millers Point Rocks	6	ND	6
	Double Point Rocks	10	ND	10
PIGU	Devil's Slide Colony Complex	280	123	-
	Castle/Hurricane Colony Complex	38	ND	-
	Point Reyes	289	217	-
	Point Resistance	26	ND	-
	Millers Point Rocks	30	ND	-
	Double Point Rocks	40	ND	-

[1] Sum of high seasonal counts at each subcolony.
[2] Nests that may have been counted on both surveys were only included once towards the total nest count.

Table 5. Productivity of Pelagic Cormorant (PECO), Black Oystercatcher (BLOY), and Western Gull (WEGU) at Castle Rocks and Mainland, Devil's Slide Rock and Mainland, and Point Reyes in 2006.

	Castle Rocks & Mainland			Devil's Slide			Point Reyes		
Species	N	# of Chicks Fledged	# Chicks Fledged/ Pair	N	# of Chicks Fledged	# Chicks Fledged/ Pair	N	# of Chicks Fledged	# Chicks Fledged/ Pair
PECO	6	1	0.173[1]	4	6	1.5	19	21	1.11
BLOY	1	1	1	0	-	-	0	-	-
WEGU	10	1	0.1	7	4	0.57	25	33	1.32

[1] Does not include second clutch (3 eggs, failed) laid at nest that fledged chick. See text for details.

Table 6. Summary of aerial photograph counts of Common Murres (COMU), Brandt's Cormorants, and Double-crested Cormorants at sample central California breeding colonies, 2006.

Colony Name	CCN[1]	USFWSCN[2]	Date	COMU	Brandt's Cormorant			Double-crested Cormorant		
				Birds	Nests	Sites	Birds	Nests	Sites	Birds
Point Reyes	MA-374-01	429-001	20 June	36899	923	137	1697	0	0	0
Point Resistance	MA-374-03	429-024	7 June	4315	0	0	14	0	0	0
Millers Point Rocks	MA-374-04	429-002	7 June	895	185	8	313	0	0	0
Double Point Rocks	MA-374-05	429-003	7 June	10422	186	5	328	0	0	0
North Farallon Islands	SF-FAI-01	429-051	7 June	61529	48	2	86	0	0	0
South Farallon Islands	SF-FAI-02	429-052	7 June	115864	11739	978	15746	607	4	647
Alcatraz Island	SFB-SF-11	429-036	7 June	0	1173	38	1643	0	0	0
Lobos Rock & Land's End	SF-374-02	429-029	7 June	0	160	10	416	0	0	0
Seal Rocks	SF-374-03	429-009	7 June	0	20	11	244	0	0	0
Devil's Slide Rock & Mainland	SM-372-03	429-014	7 June	675	525	79	1265	0	0	0
Año Nuevo Island	SM-370-04	429-023	2 June	0	2479	148	2856	0	0	0
Bench Mark-227X	MO-362-18	454-029	30 May	457	223	29	296	0	0	0
Castle Rocks & Mainland	MO-362-19	454-010	30 May	2395	156	1	173	0	0	0
Hurricane Point Rocks	MO-362-20	454-011	30 May	935	0	0	3	0	0	0
TOTAL				**234386**	**17817**	**1446**	**25080**	**607**	**4**	**647**

[1] CCN = California Colony Number.
[2] USFWSCN = U.S. Fish and Wildlife Service Colony Number.

Table 7. Numbers of observed boats, aircraft, and explosives, and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at Devil's Slide Rock and Mainland, 2006. Includes total numbers observed and numbers per observer hour.

Source	Total Observ-ations	# Obs/hr	# Disturbance Events: Total[1]	# Disturbance Events: Flush or Displace	# Disturbance Events/hr: Total/hr[1]	# Disturbance Events/hr: Flush or Displace/ hr	Mean # Seabirds Disturbed (range)	COMU Disturbance: # Events	COMU Disturbance: Mean # COMU Dist. (range)	BRCO Disturbance: # Events	BRCO Disturbance: Mean # BRCO Dist. (range)	BRPE Disturbance: # Events	BRPE Disturbance: Mean # BRPE Dist. (range)
Motor vessel	26	0.050	8	0	0.015	0	0	0	0	0	0	0	0
Jet Ski	6	0.011	5	4	0.010	0.008	107 (27-206)	2	4 (3-4)	4	105 (24-206)	0	0
Kayak	2	0.004	1	1	0.002	0.002	40 (40)	0	0	1	40 (40)	0	0
Plane	206	0.394	50	1	0.096	0.002	30 (30)	0	0	1	30 (30)	0	0
Helicopter	43	0.082	33	10	0.063	0.019	45 (1-200)	6	4 (1-10)	8	53 (1-200)	0	0
Explosives	6	0.011	6	6	0.011	0.011	264 (17-1001)	5	109 (2-586)	6	173 (17-415)	0	0
Total	-	-	103	22	0.197	0.042	120[2] (2-1001)	13[3]	52[2] (1-586)	20[3]	98[2] (1-415)	0	0

[1] Includes events where birds exhibited agitation/alarm behaviors (e.g., head-bobbing in murres, alert postures or wing-flapping in cormorants), flushing, or displacement.

[2] Excluding the explosives events, average totals would be: 4 COMU per event, 65 BRCO per event, and 59 seabirds per event.

[3] Excluding the explosives events, total numbers would be: 8 COMU disturbances and 14 BRCO disturbances.

Table 8. Numbers of observed boats and aircraft, and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at the Castle/Hurricane Colony Complex, 2006. Includes total numbers observed and numbers per observer hour.

			# Disturbance Events		# Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Observ-ations	# Obs/hr	Total[1]	Flush or Displace	Total/hr[1]	Flush or Displace/ hr	Mean # Seabirds Disturbed (range)	# Events	Mean # COMU Dist. (range)	# Events	Mean # BRCO Dist. (range)	# Events	Mean # BRPE Dist. (range)
Motor vessel	2	0	0	0	0	0	0	0	0	0	0	0	0
Plane	25	0.047	0	0	0	0	0	0	0	0	0	0	0
Total	27	0.051	0	0	0	0	0	0	0	0	0	0	0

[1] Includes events where birds exhibited agitation/alarm behaviors (e.g., head-bobbing in murres, alert postures or wing-flapping in cormorants), flushing, or displacement.

Table 9. Numbers of observed boats and aircraft, and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at Point Reyes, 2006. Includes total numbers observed and numbers per observer hour.

			# Disturbance Events		# Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Observ-ations	# Obs/hr	Total[1]	Flush or Displace	Total/hr[1]	Flush or Displace/ hr	Mean # Seabirds Disturbed (range)	# Events	Mean # COMU Dist. (range)	# Events	Mean # BRCO Dist. (range)	# Events	Mean # BRPE Dist. (range)
Motor vessel	47	0.121	6	3	0.002	0.008	21 (2-60)	0	0	1	60	2	2
Jet Ski	1	0.003	0	0	0	0	0	0	0	0	0	0	0
Kayak	1	0.003	1	1	0.003	0.003	40	0	0	1	40	0	0
Plane	6	0.015	1	1	0.003	0.003	300	1	300	0	0	0	0
Helicopter	1	0.003	1	1	0.003	0.003	3	0	0	1	3	0	0
Total	-	-	9	6	0.023	0.015	68 (2-300)	1	300	3	34 (3-60)	2	2

[1] Includes events where birds exhibited agitation/alarm behaviors (e.g., head-bobbing in murres, alert postures or wing-flapping in cormorants), flushing, or displacement.

Table 10. Numbers of observed boats and aircraft, and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at the Drakes Bay Colony Complex, 2006. Includes total numbers observed and numbers per observer hour.

			# Disturbance Events		# Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Observ-ations	# Obs/hr	Total[1]	Flush or Displace	Total/hr[1]	Flush or Displace/ hr	Mean # Seabirds Disturbed (range)	# Events	Mean # COMU Dist. (range)	# Events	Mean # BRCO Dist. (range)	# Events	Mean # BRPE Dist. (range)
Motor vessel	8	0.182	3	3	0.068	0.068	330 (10-400)	0	0	3	190 (20-400)	2	205 (10-400)
Helicopter	2	0.046	1	1	0.023	0.023	25	1	20	1	5	0	0
Total	-	-	4	4	0.091	0.091	254 (5-400)	1	20	3	144 (5-400)	2	205 (10-400)

[1] Includes events where birds exhibited agitation/alarm behaviors (e.g., head-bobbing in murres, alert postures or wing-flapping in cormorants), flushing, or displacement.

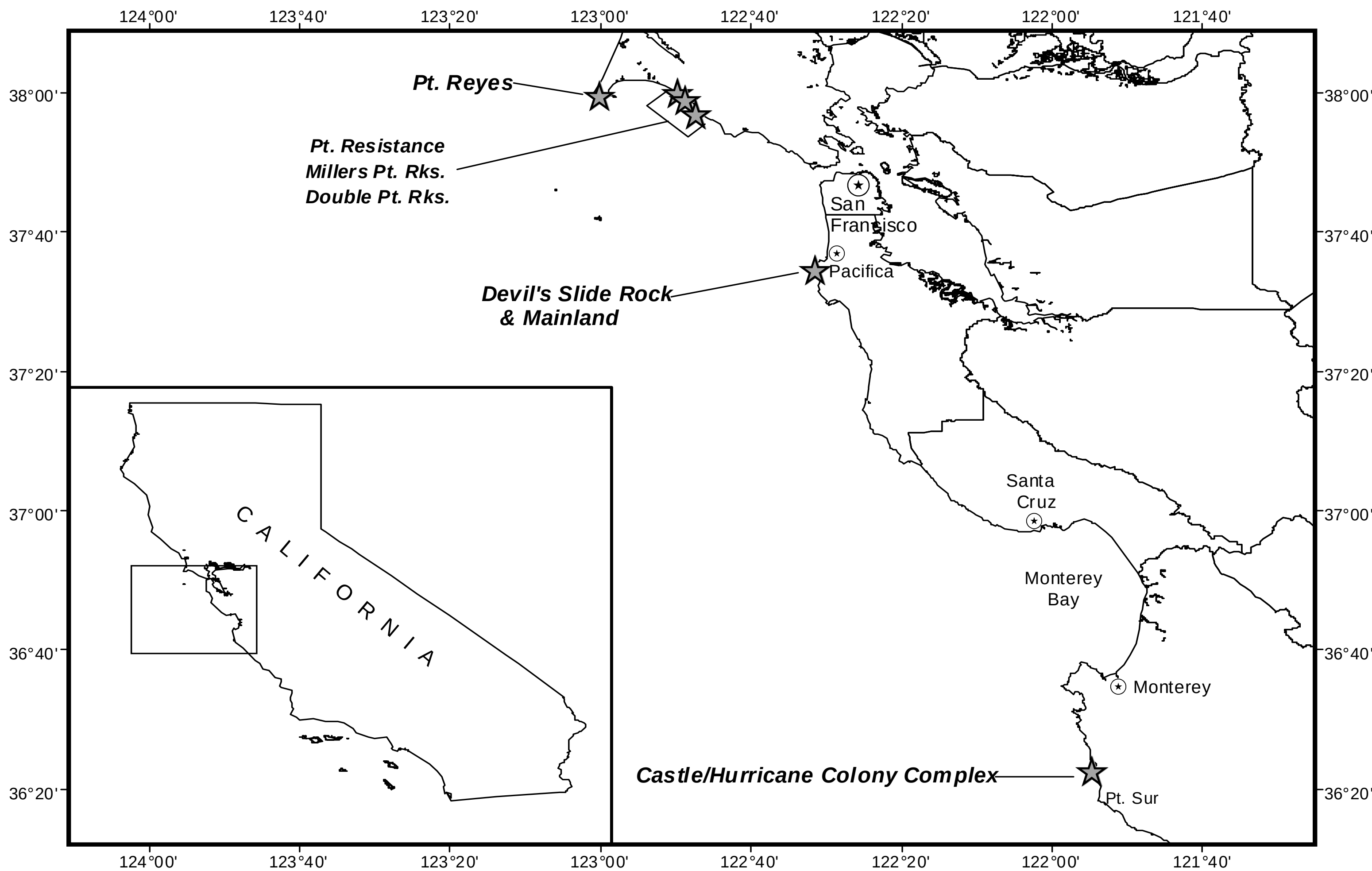


Figure 1. Map of the study area showing locations of study colonies. Point Resistance, Millers Point Rocks, and Double Point Rocks are within the Drakes Bay Colony Complex.

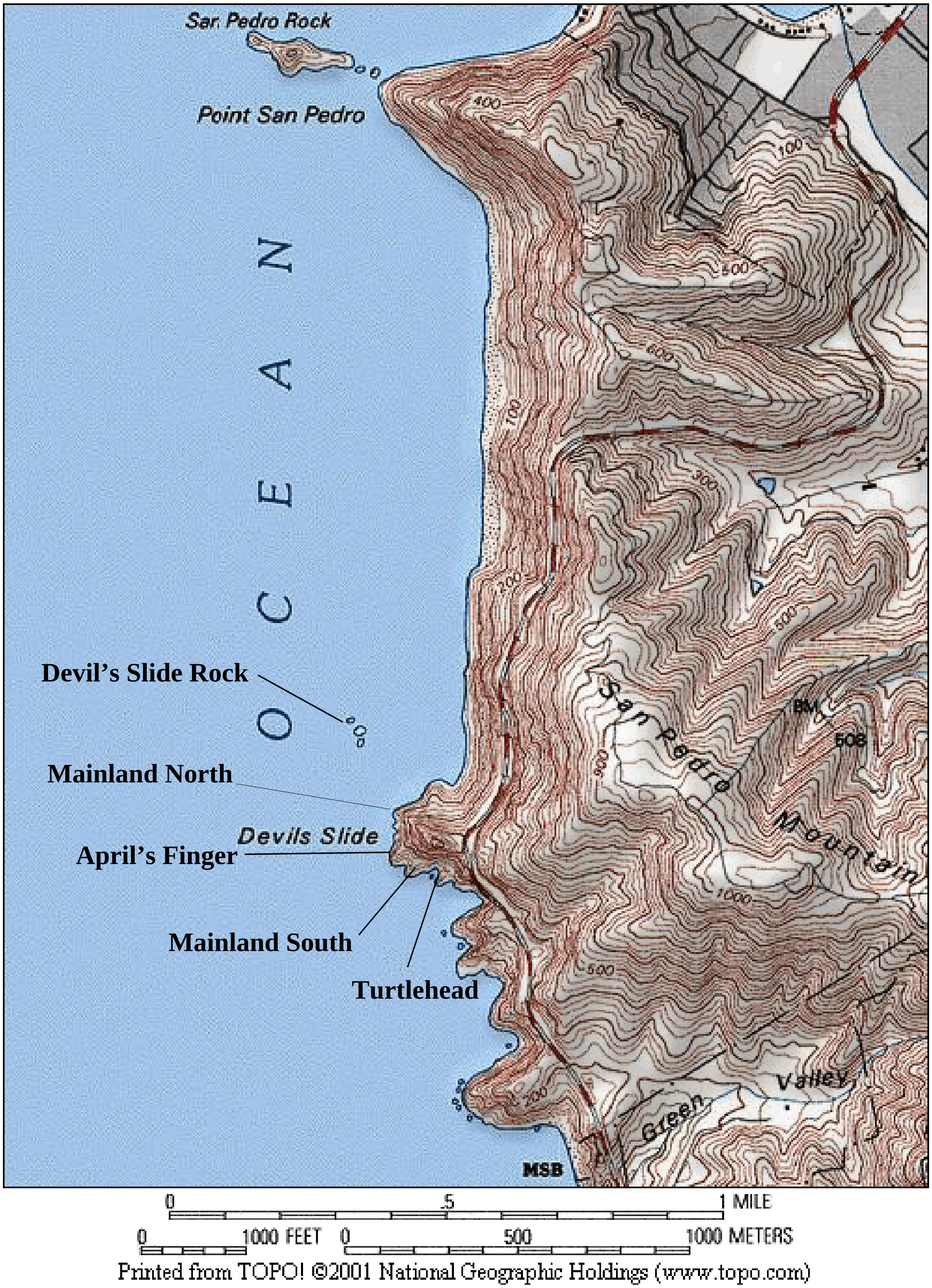


Figure 2. Devil's Slide Colony Complex including colonies and subcolonies monitored.

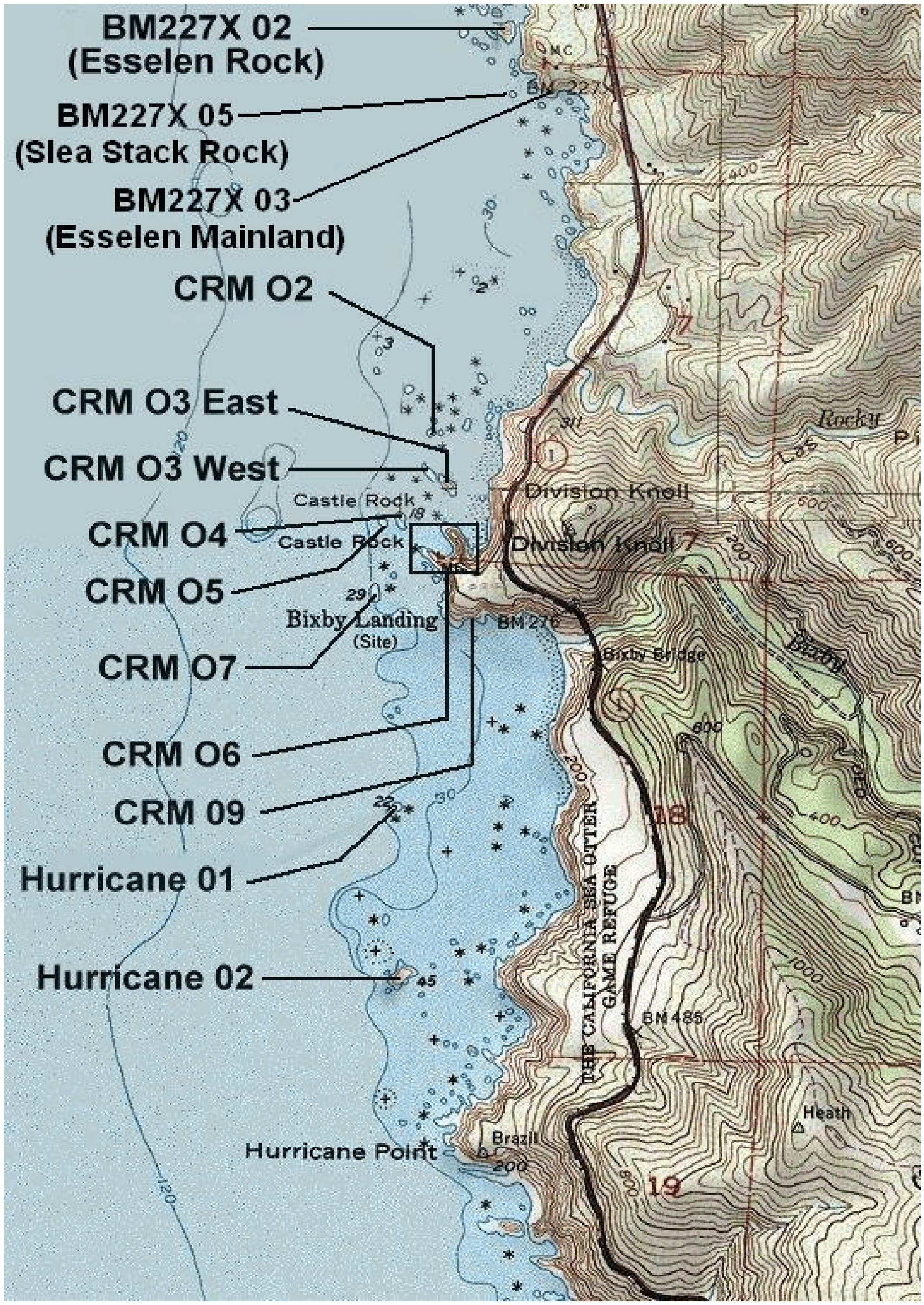


Figure 3. Castle/Hurricane Colony Complex, including Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (Hurricane).

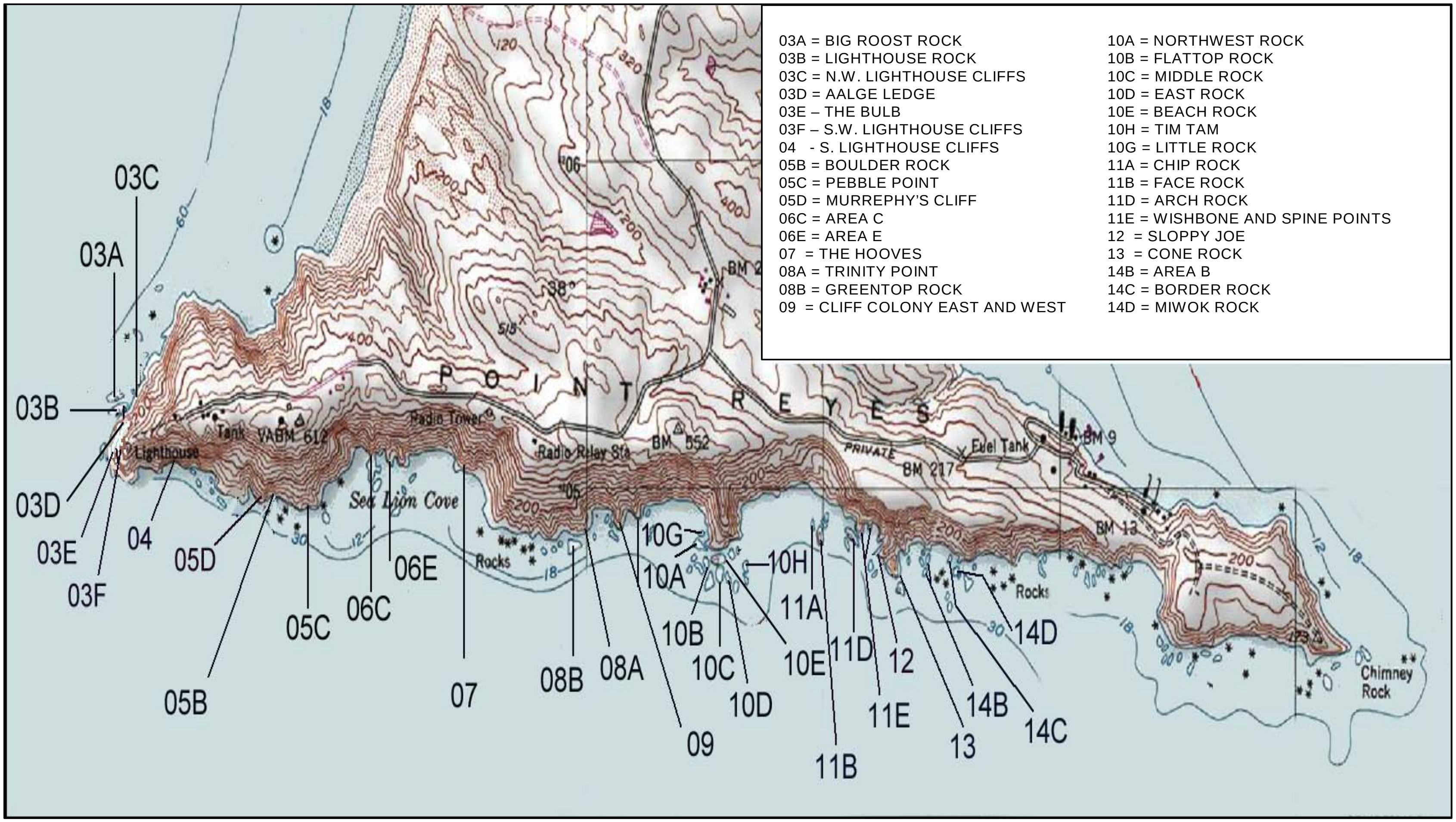


Figure 4. Point Reyes, including subcolonies mentioned in this report.

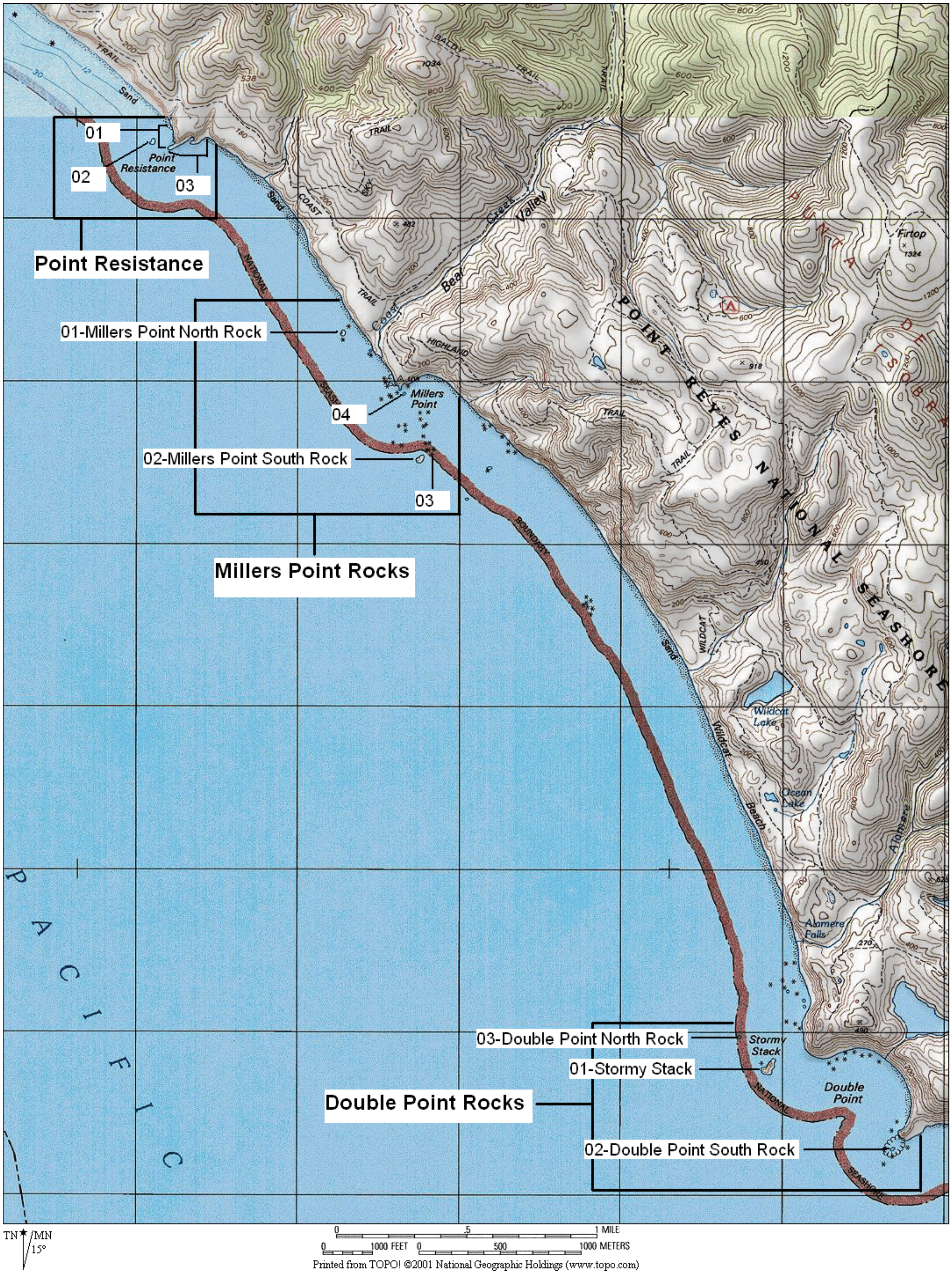


Figure 5. Drakes Bay Colony Complex, including colonies and subcolonies.

Figure 6. Views of Devil's Slide Mainland (Subcolony 05) subareas: Turtlehead (upper left); ("Upper") Mainland South (upper right); Mainland South Roost (lower left); and Lower Mainland South (lower right).

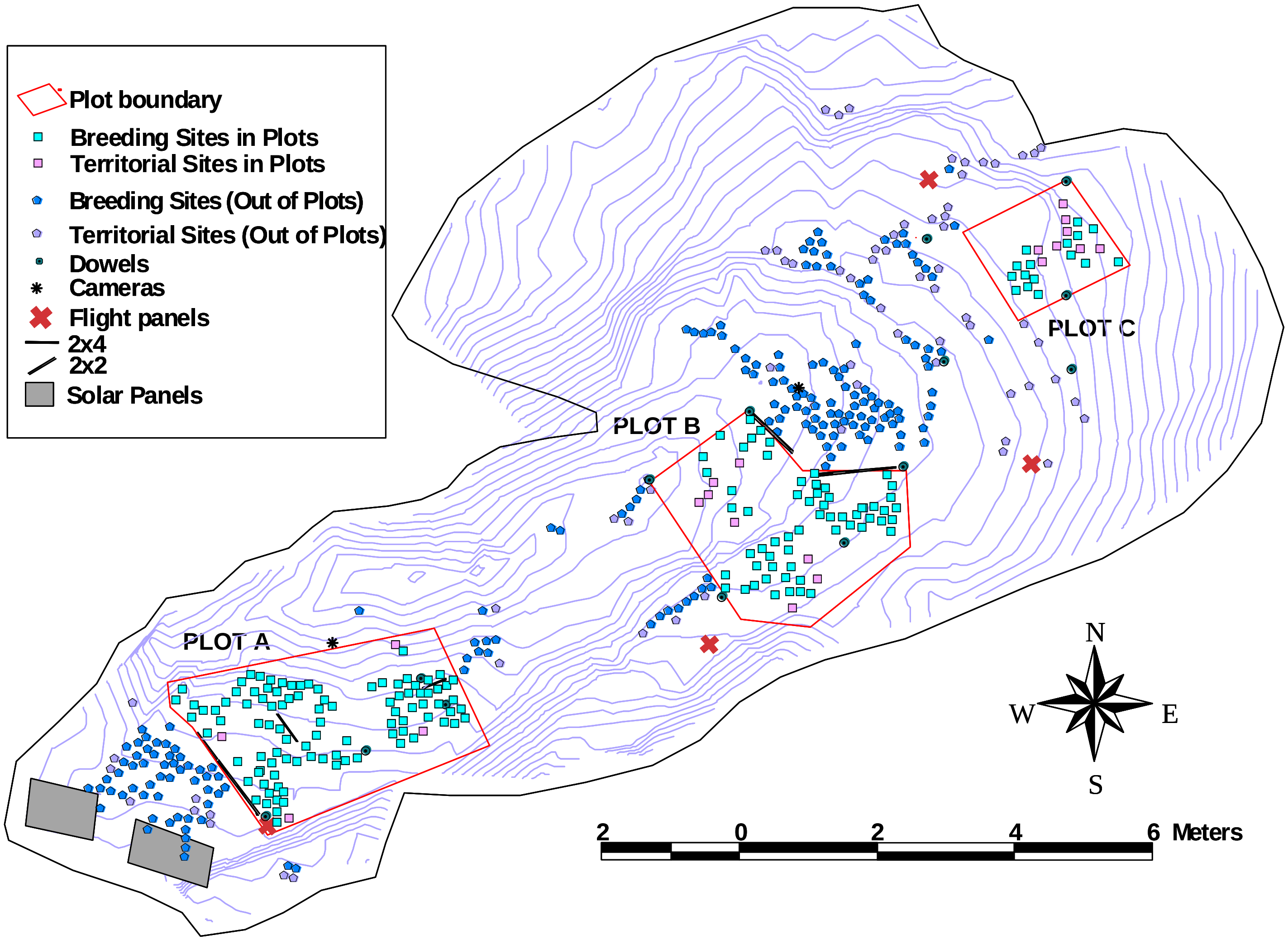


Figure 7. GIS map of Devil's Slide Rock, 2006. Common Murre breeding and territorial sites are shown as well as markers and other equipment.

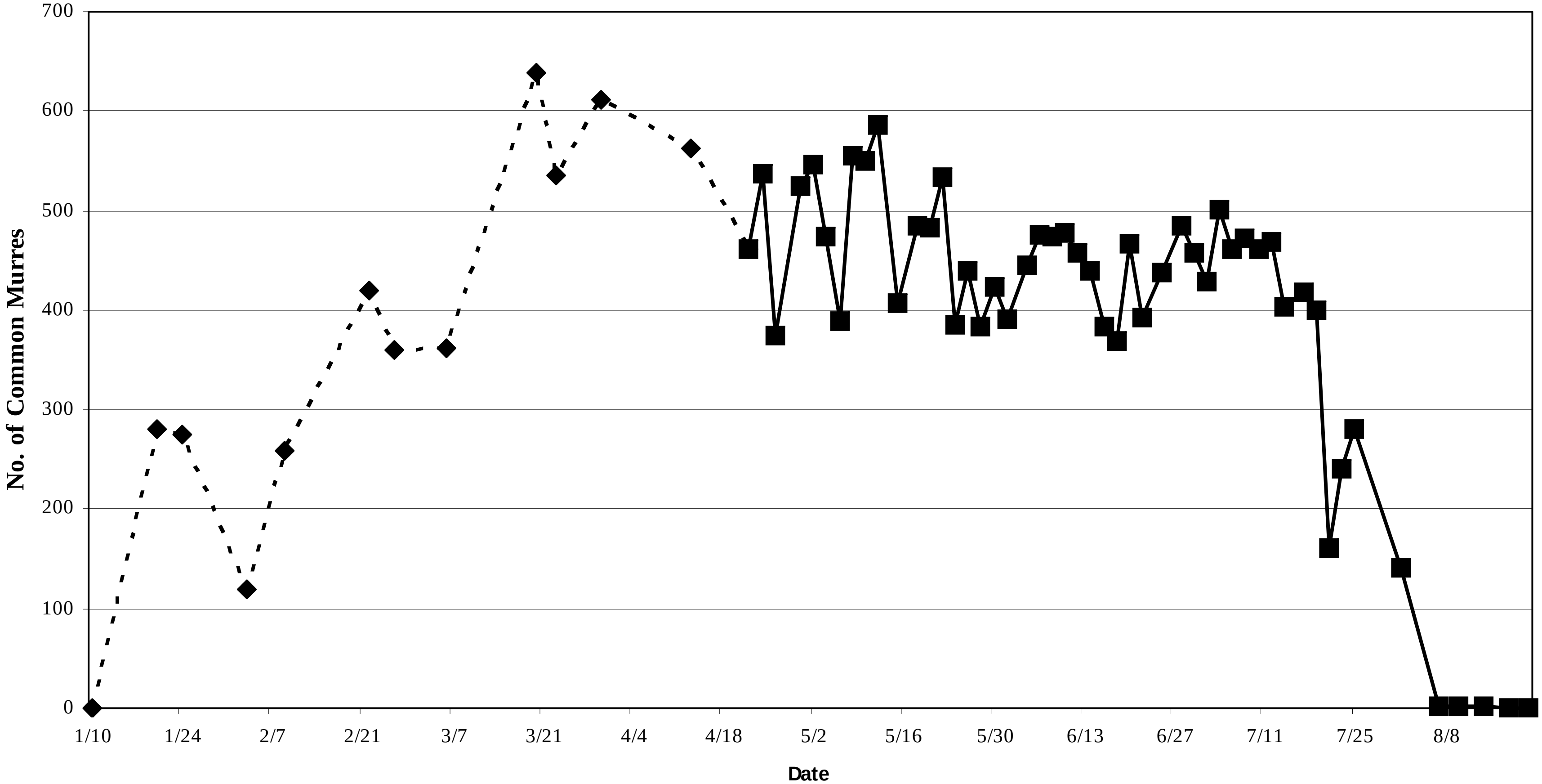


Figure 8. Seasonal attendance of Common Murres at Devil's Slide Rock, 10 January to 21 August, 2006. Daily attendance reported is an average of three consecutive counts. Dashed line represents pre-breeding season counts; solid line represents standardized regular season counts.

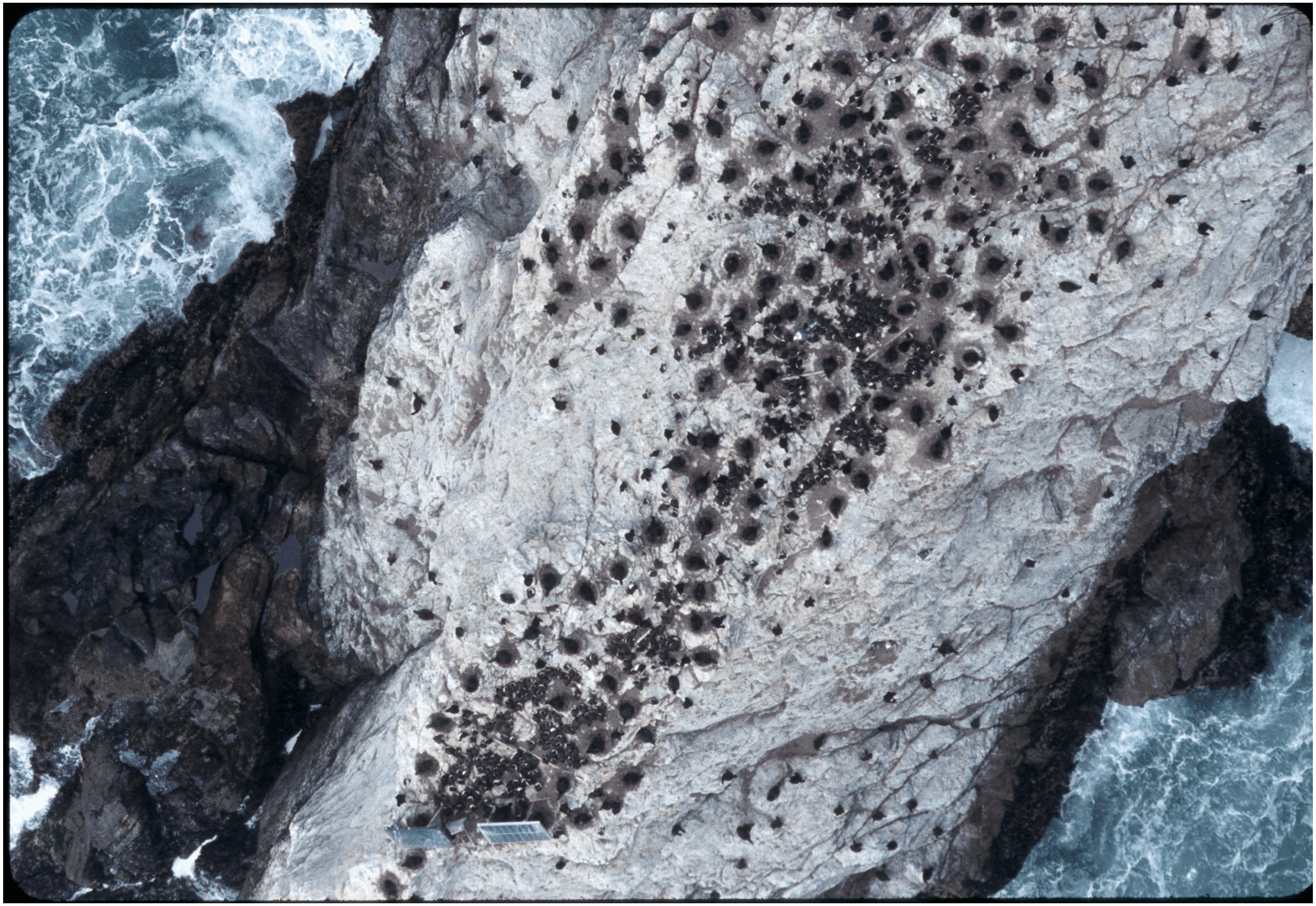


Figure 9. Aerial photograph of Devil's Slide Rock, 7 June 2006, showing the distribution of the Common Murre and Brandt's Cormorant breeding colony.

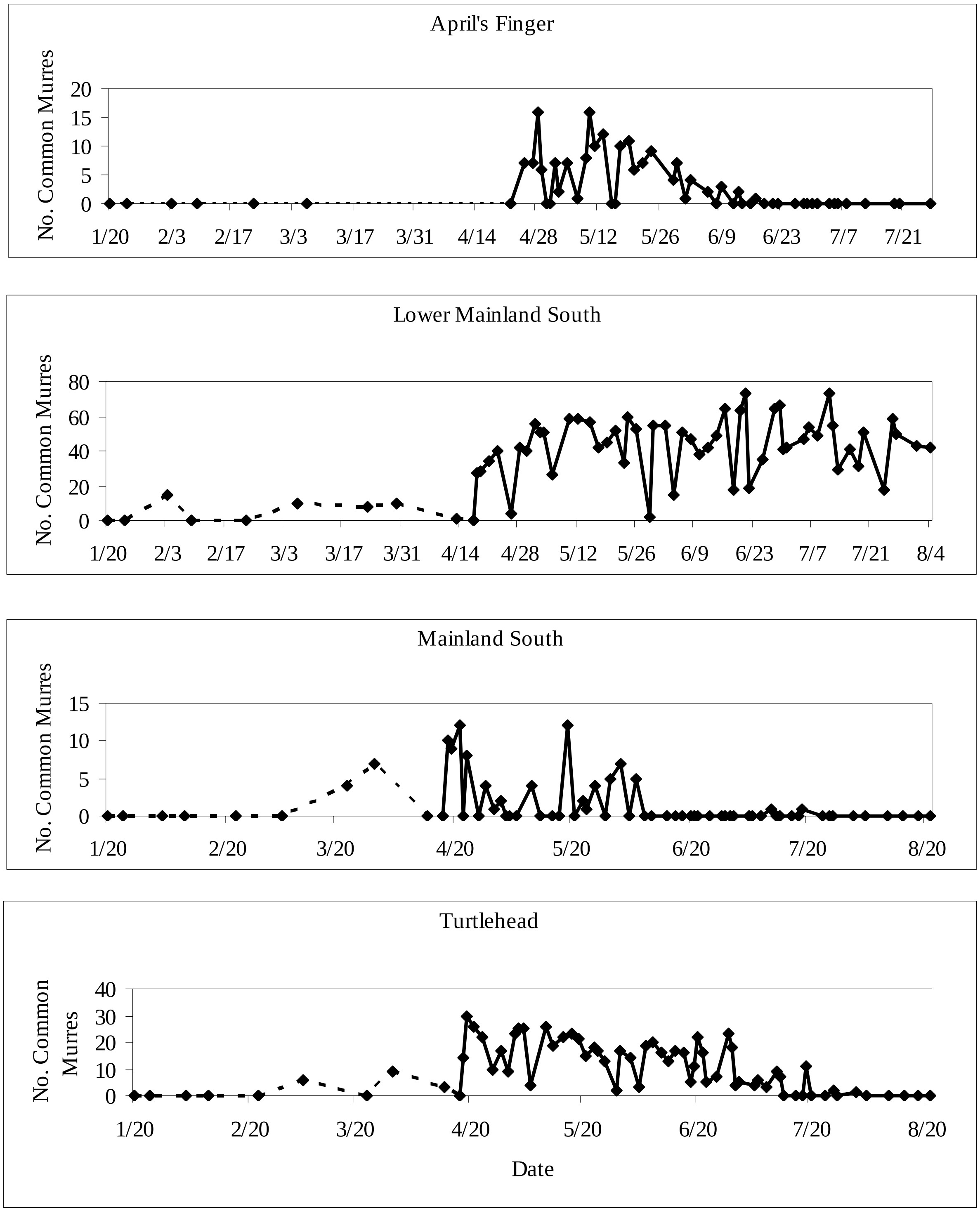


Figure 10. Seasonal attendance patterns of Common Murres at Devil's Slide Mainland subareas April's Finger, Lower Mainland South, Mainland South, and Turtlehead 20 January to 20 August 2006. Dashed line represents pre-breeding season counts; solid line represents standardized regular season counts.

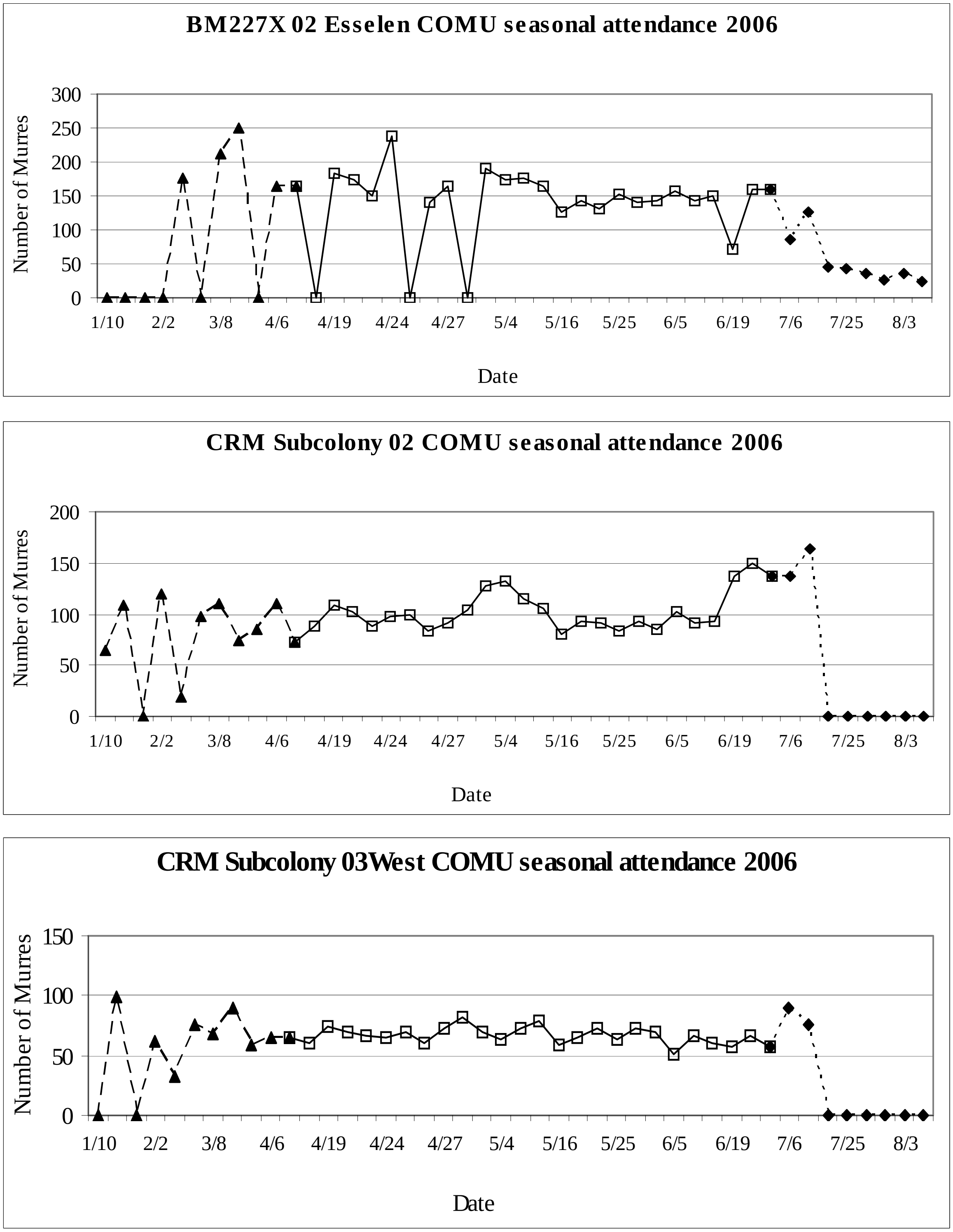
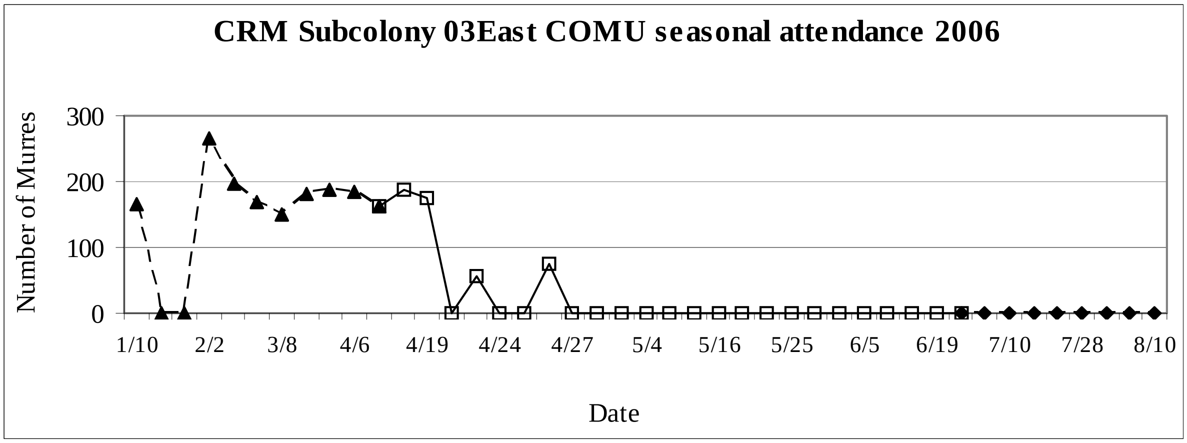
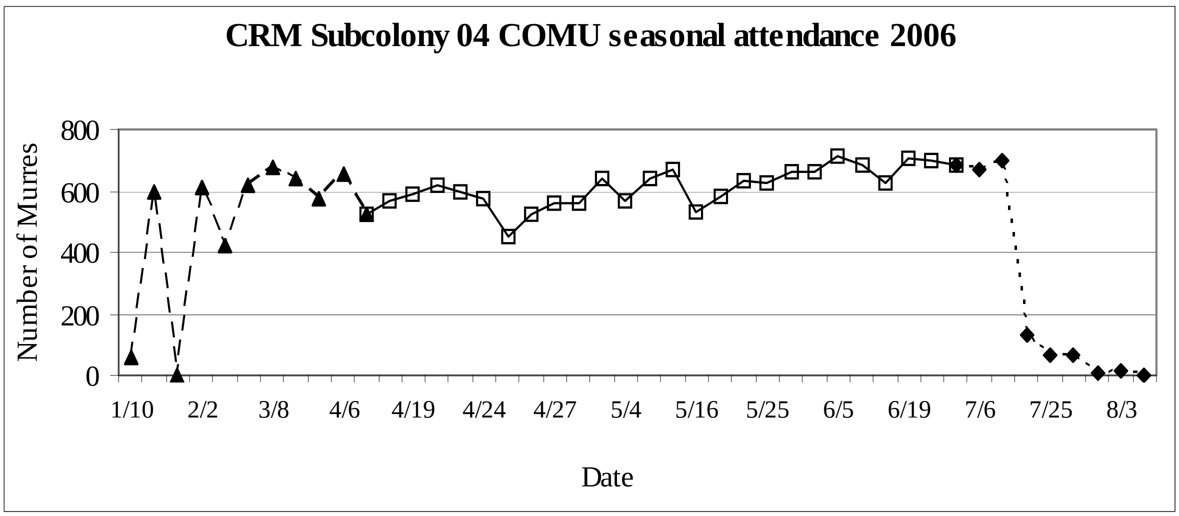


Figure 11. Seasonal attendance patterns of Common Murres at Bench Mark-227X (BM227X) subcolony 02, and Castle Rocks and Mainland subcolonies 02 and 03 West, 10 January to 10 August 2006. Dashed line indicates pre-season attendance and dotted line indicates attendance after the start (27 June) of large-scale disturbance by a juvenile Brown Pelican (see Disturbance).





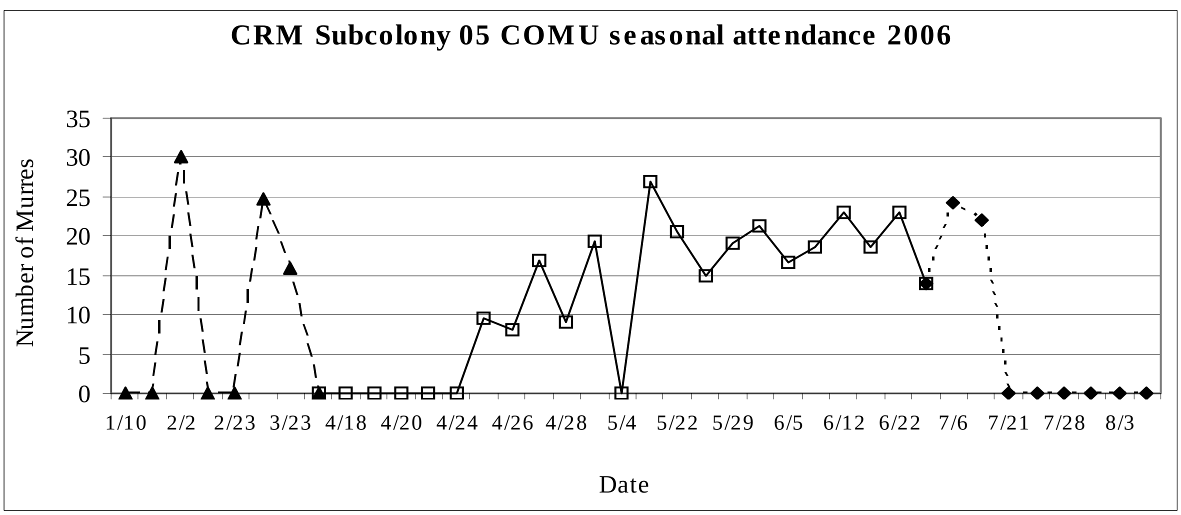
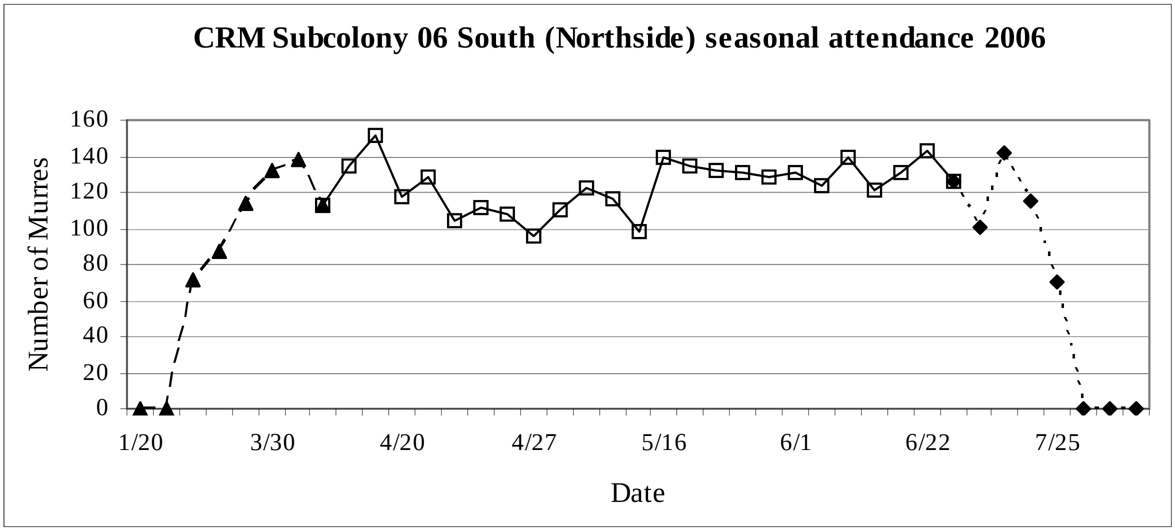


Figure 12. Seasonal attendance patterns of Common Murres at Castle Rocks and Mainland sub-colonies 03 East, 04, and 05, 10 January to 10 August 2006. See Figure 11 for chart description.



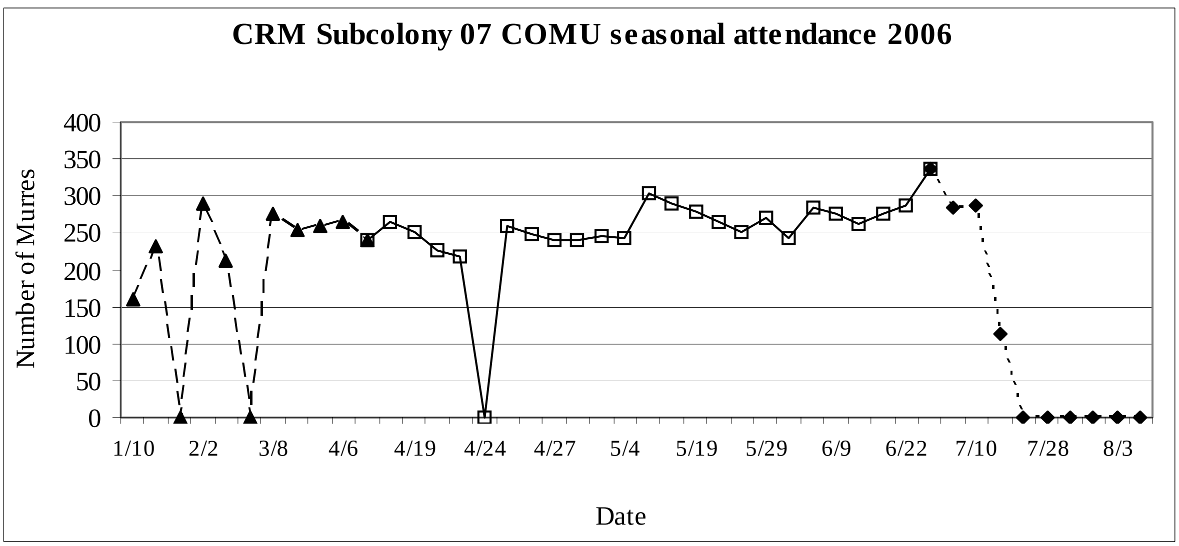


Figure 13. Seasonal attendance patterns of Common Murres at Castle Rocks and Mainland subcolonies 06 South (North side), and 07, 10 January to 10 August 2006. See Figure 11 for chart description.

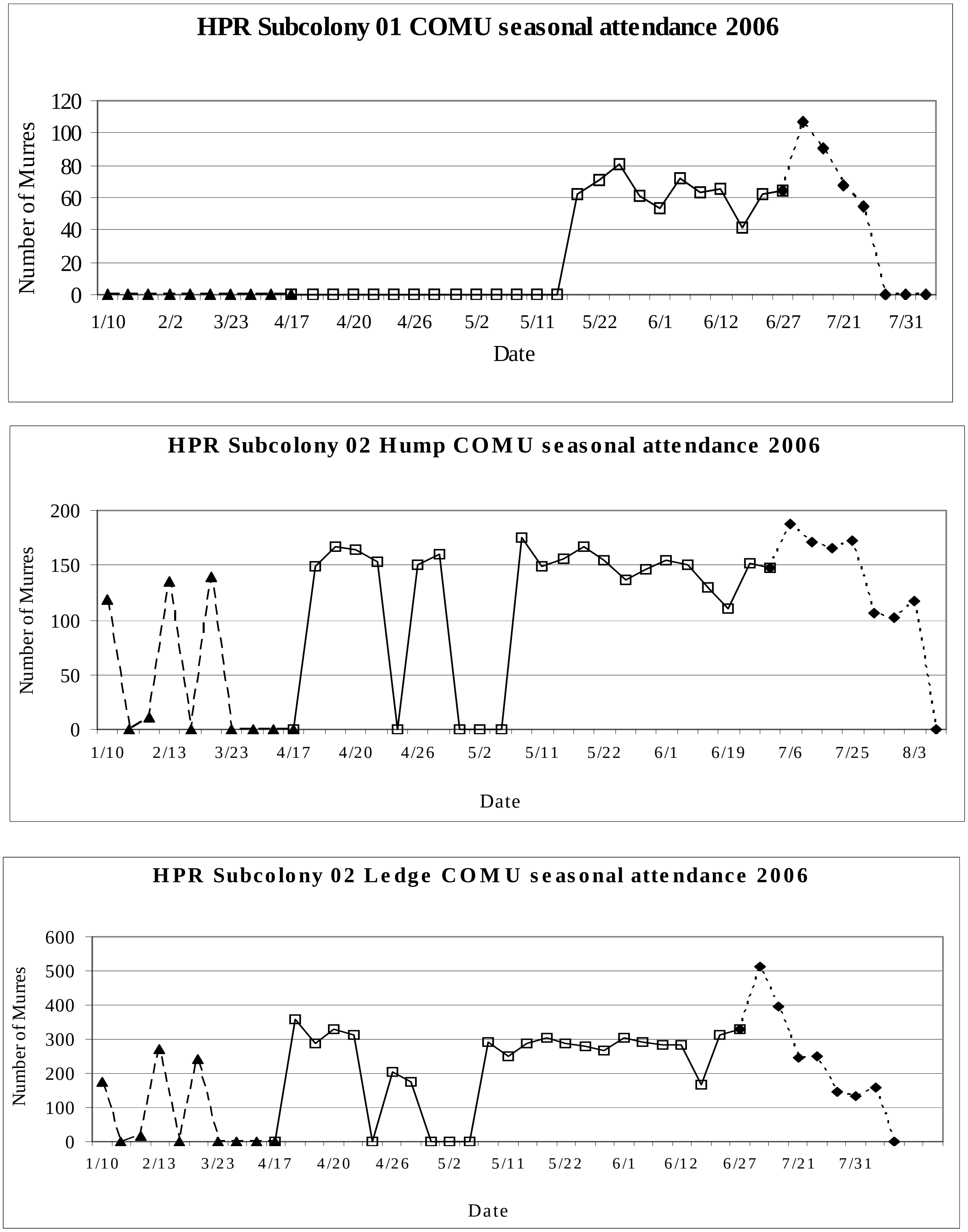


Figure 14. Seasonal attendance patterns of Common Murres at Hurricane Point Rocks subcolonies 01, 02 Hump, and 02 Ledge, 10 January to 10 August 2006. See Figure 11 for chart description.

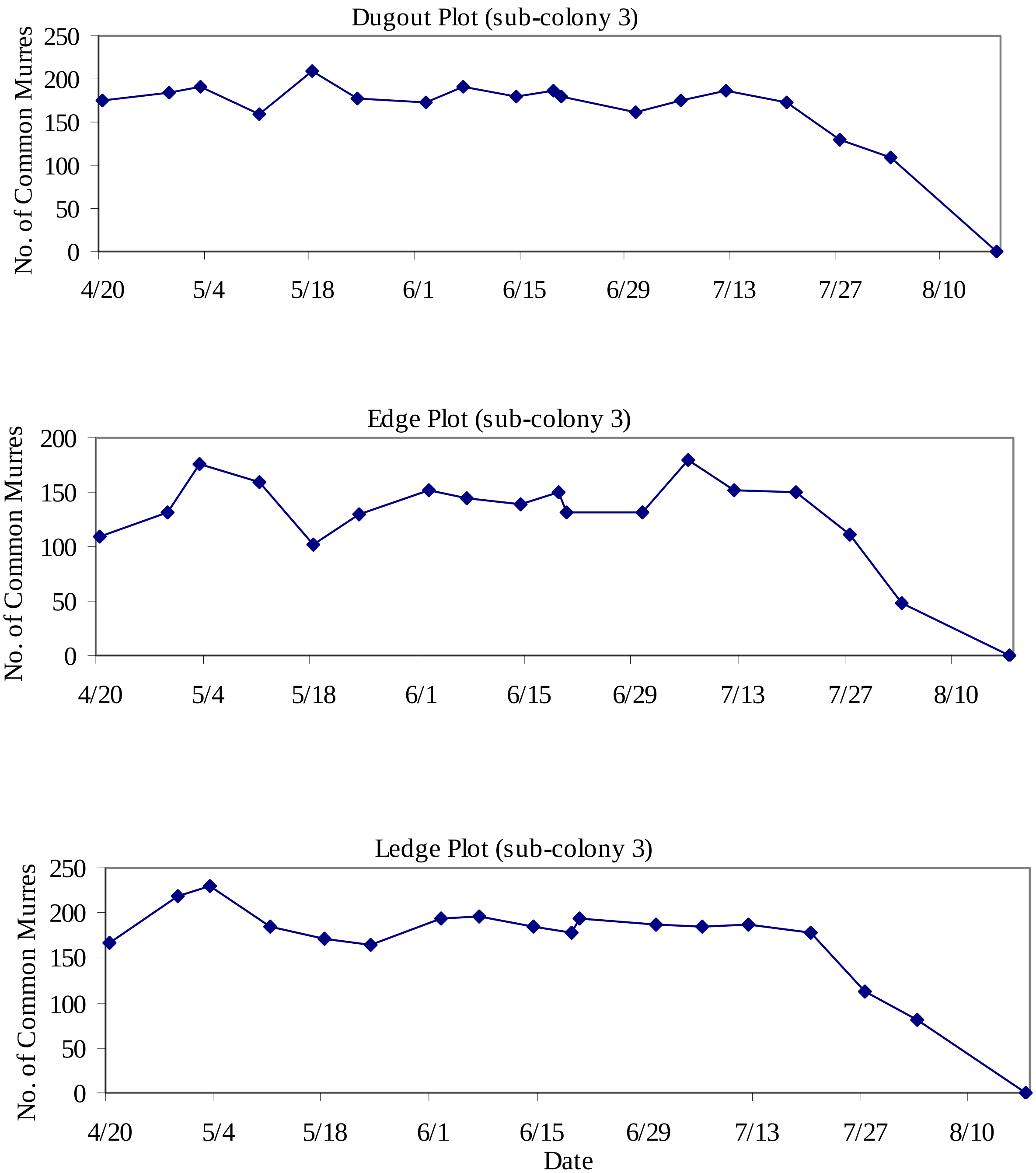


Figure 15. Seasonal attendance patterns of Common Murres at three index plots on Lighthouse Rock (subcolony 03), Point Reyes Headlands, 20 April to 17 August 2006.

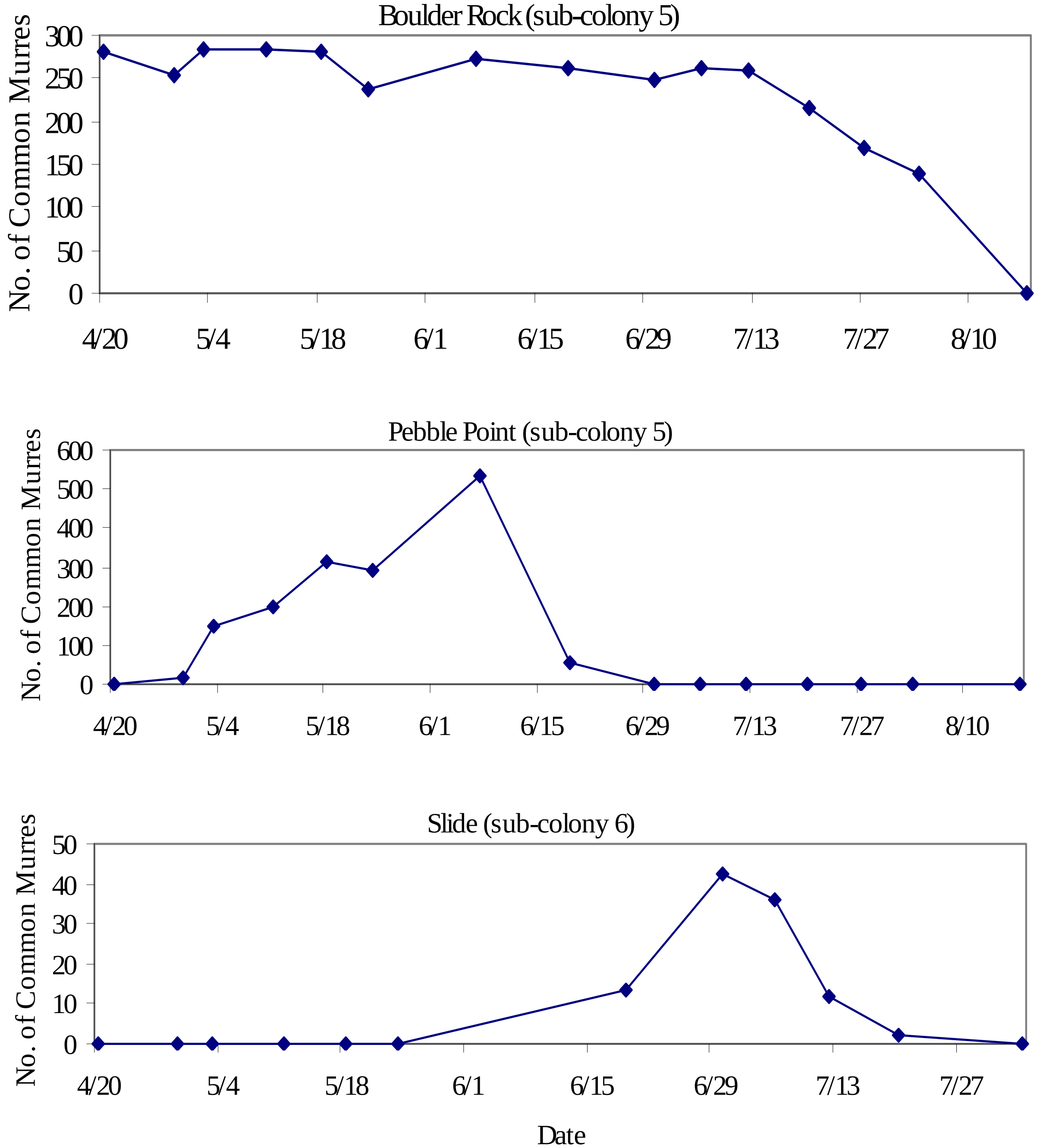


Figure 16. Seasonal attendance patterns of Common Murres at Boulder Rock (one index plot), Pebble Point, and Slide, Point Reyes Headlands, 20 April to 17 August 2006.

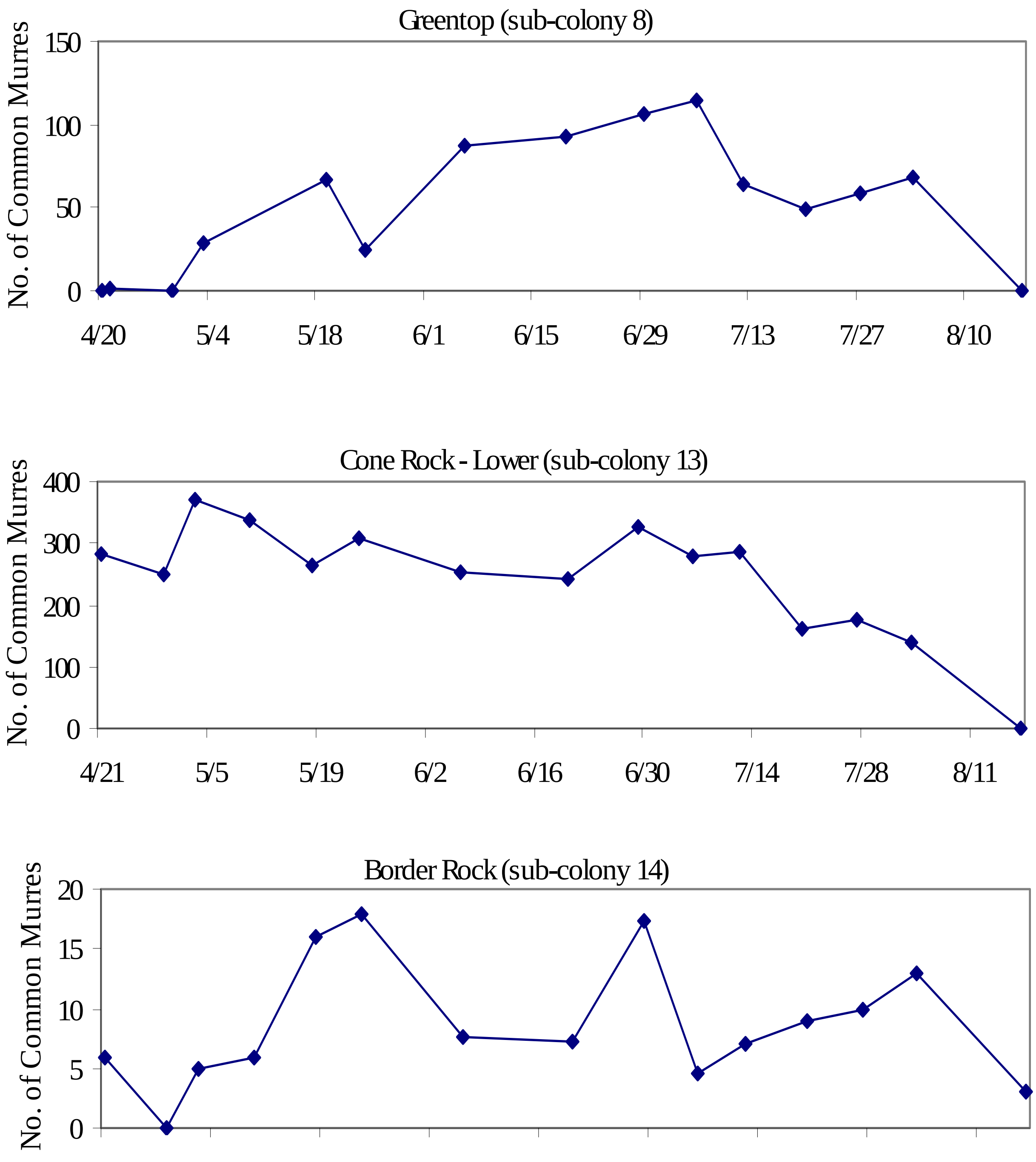


Figure 17. Seasonal attendance patterns of Common Murres at Greentop, Cone Rock-Lower (one index plot), and Border Rock, Point Reyes Headlands, 20 April to 17 August 2006.

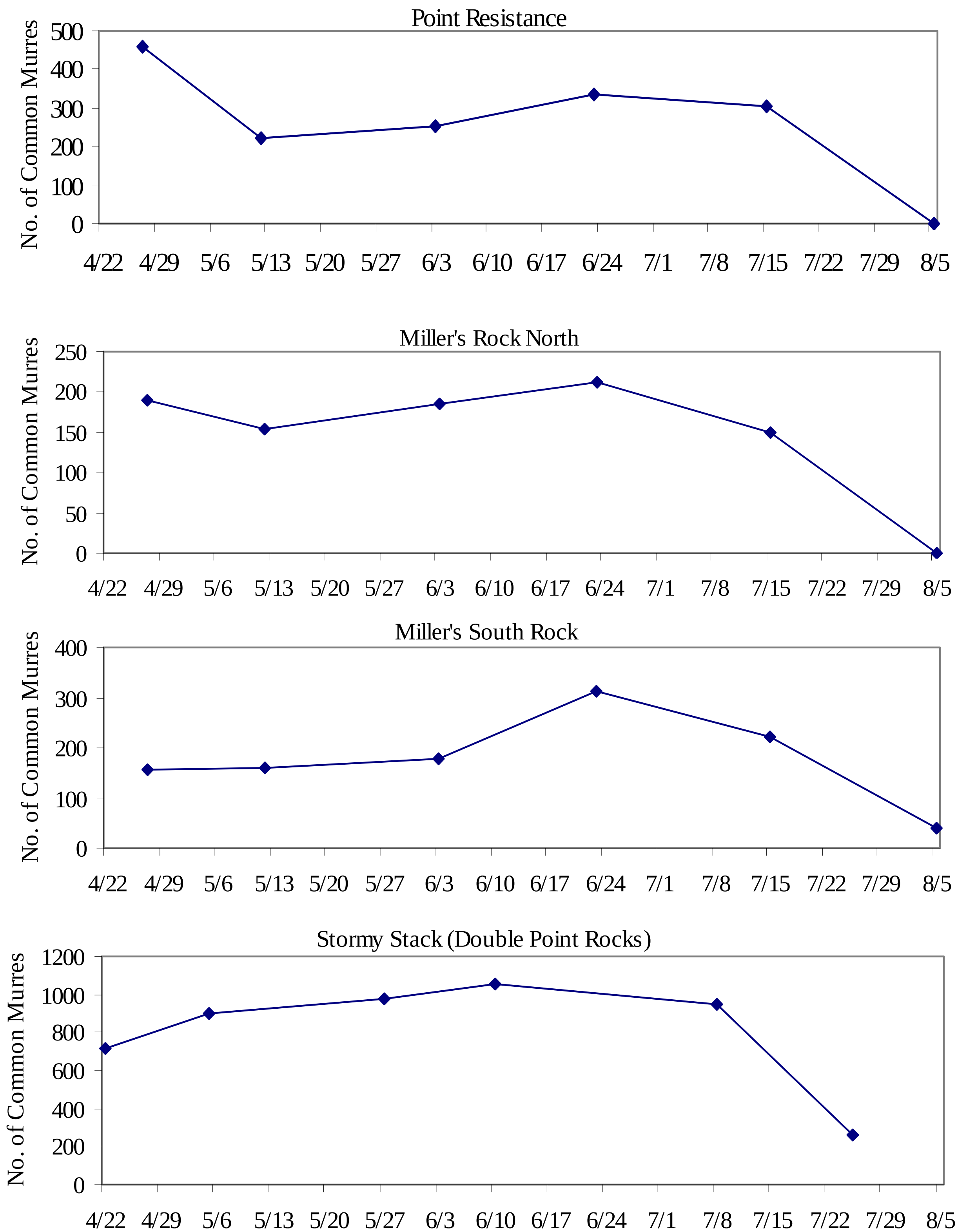


Figure 18. Seasonal attendance patterns of Common Murres at Point Resistance (four index plots), Miller's Point Rocks (North and South Rocks), and Stormy Stack (Double Point Rocks), 22 April to 5 August 2006.

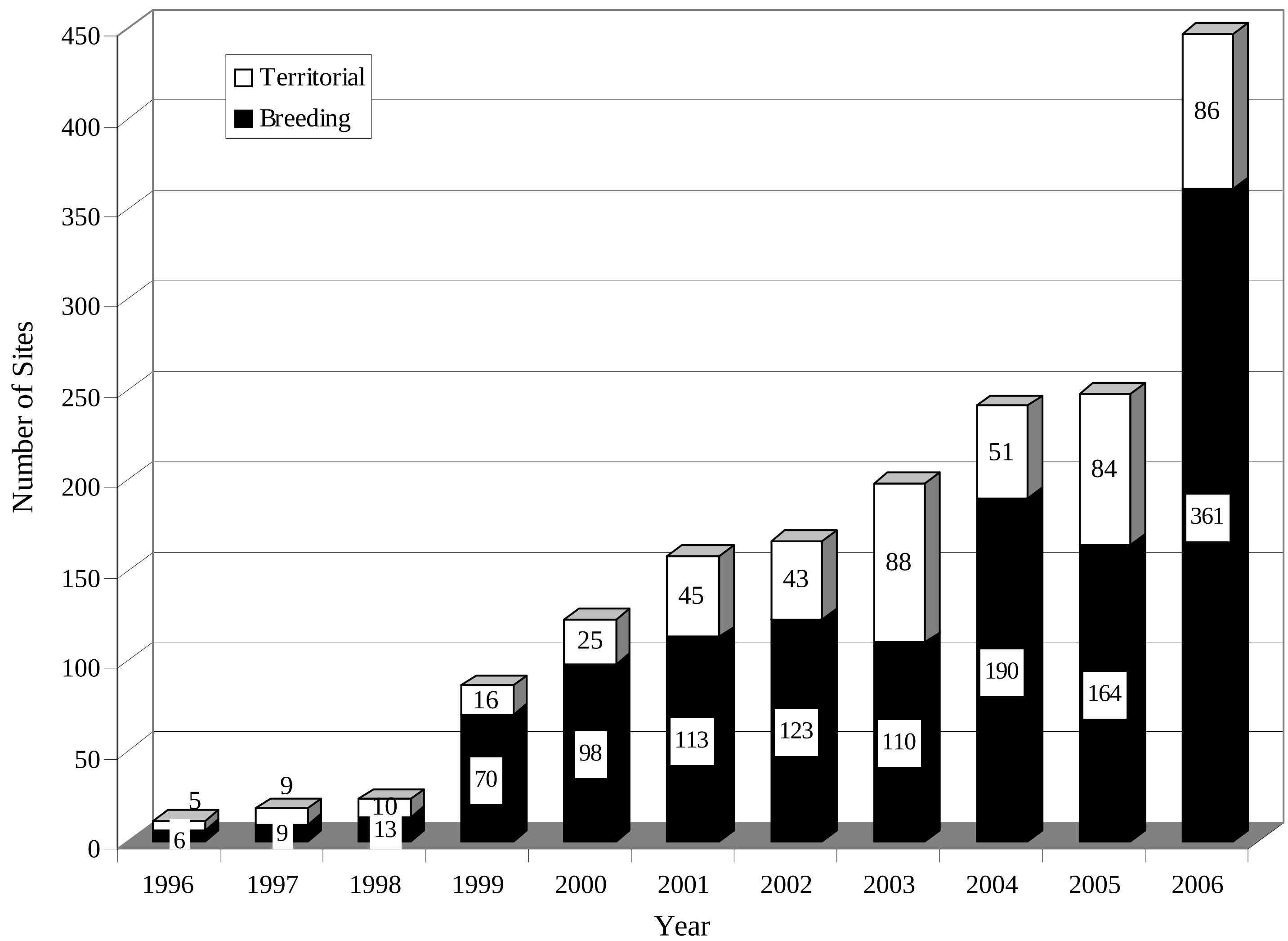


Figure 19. Numbers of Common Murre breeding and territorial sites on Devil's Slide Rock, 1996-2006.

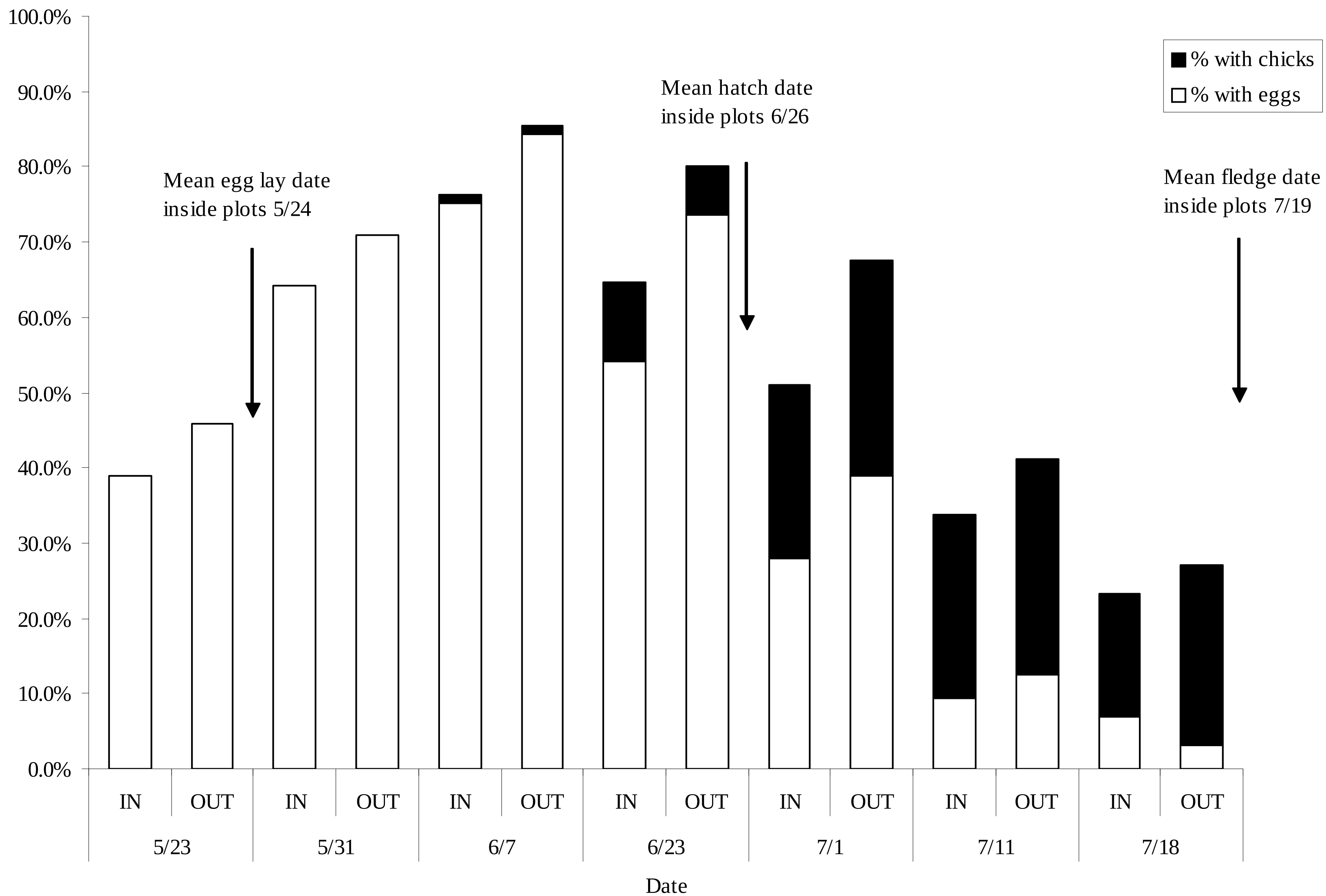


Figure 20. Comparison of cumulative percentages of Common Murre breeding sites with eggs and chicks both inside and outside of monitored plots, Devil's Slide Rock, 2006.

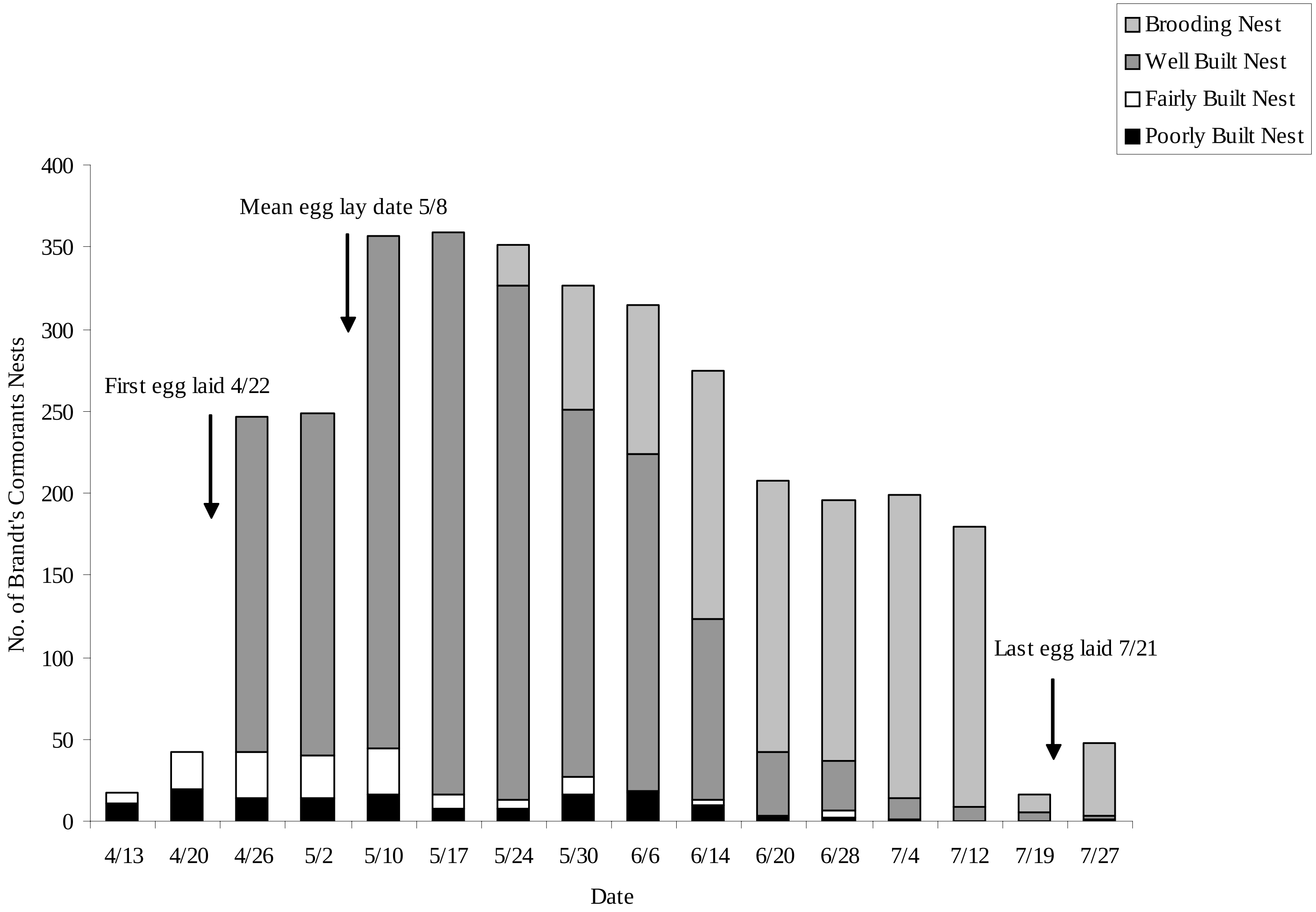


Figure 21. Numbers of poorly-built, fairly-built, well-built, and brooding Brandt's Cormorant nests counted at Devil's Slide Rock and Mainland, 13 April to 27 July 2006.

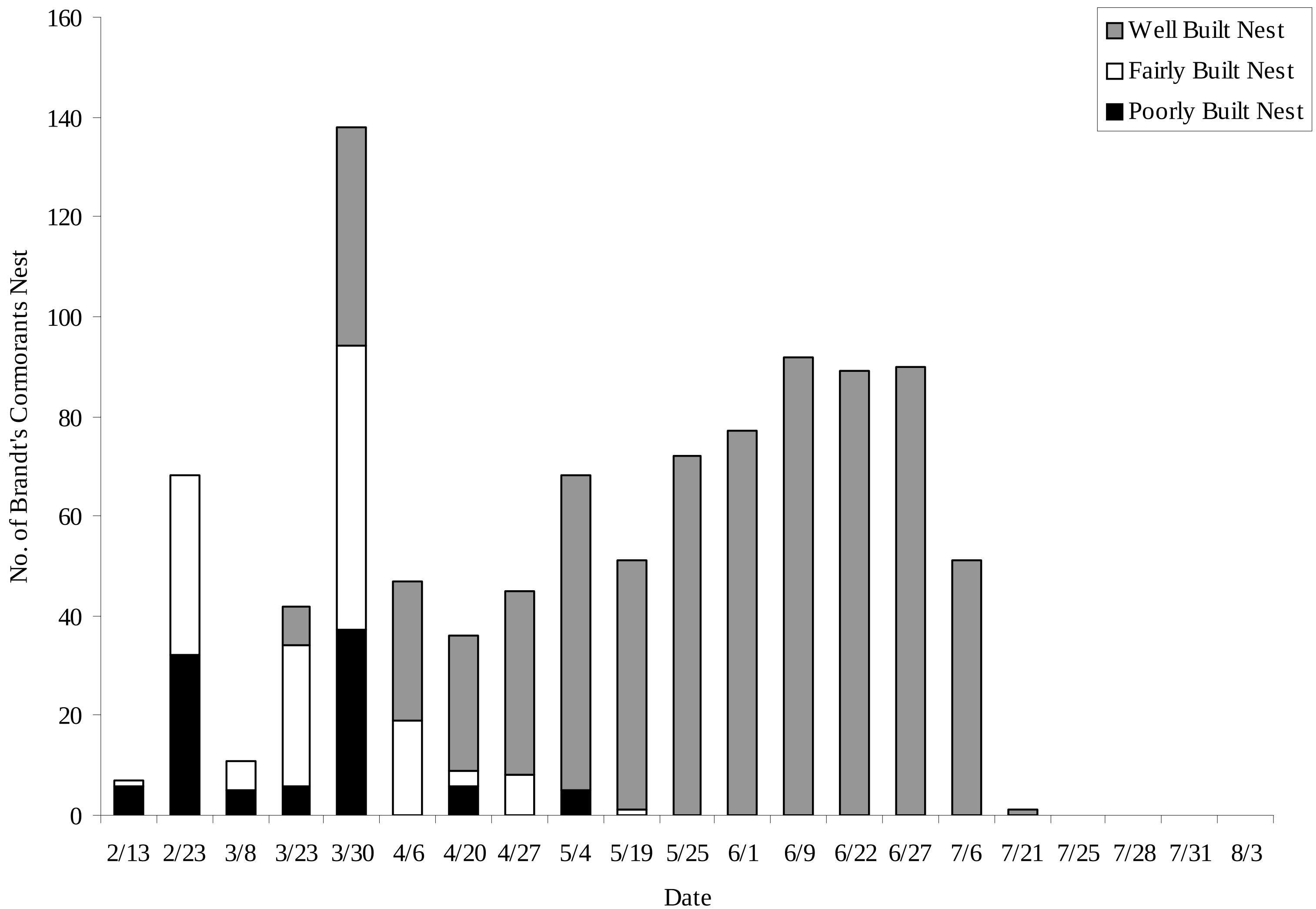


Figure 22. Numbers of Brandt's Cormorant poorly-built, fairly-built, and well-built nests counted at the Castle/Hurricane Colony Complex, 13 February to 8 August 2006. No active nests were observed after 21 July.

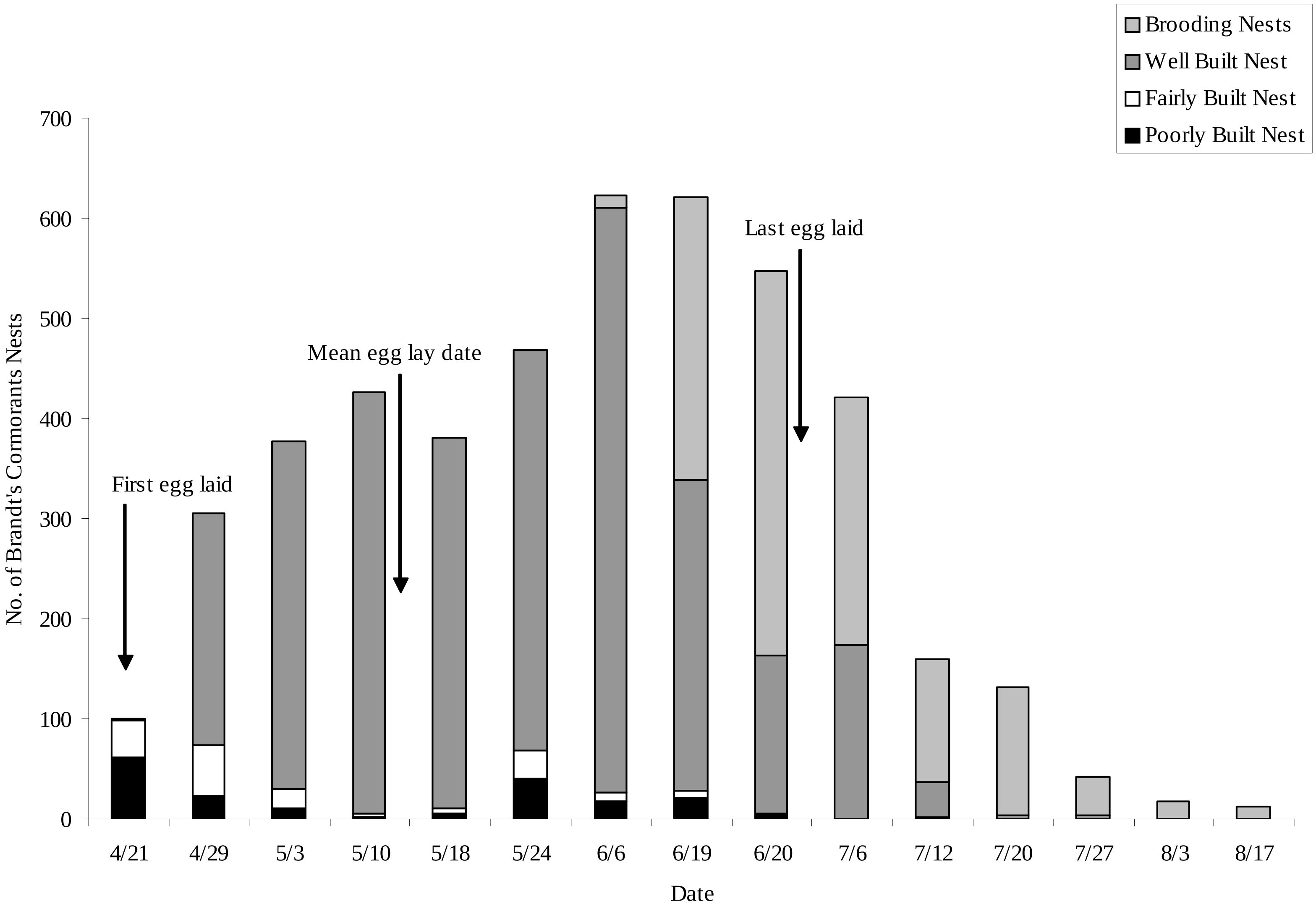


Figure 23. Number of Brandt's Cormorant poorly-built, fairly-built, and well-built nests counted weekly at Point Reyes Headlands, 20 April and 17 August 2006.

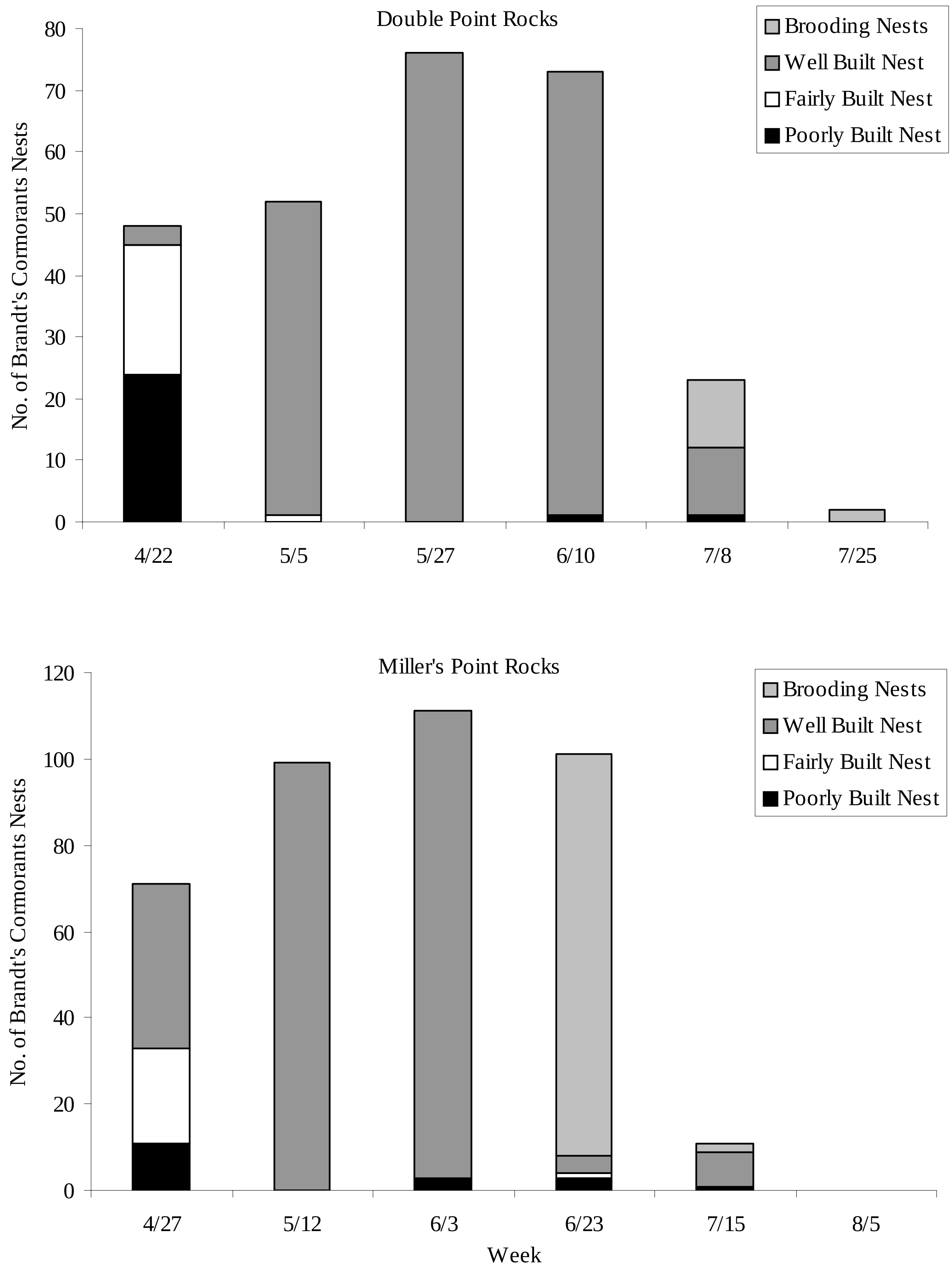


Figure 24. Numbers of Brandt's Cormorant poorly-built, fairly-built, and well-built Cormorant nests counted bi-weekly at Double Point Rocks and Miller's Point Rocks, 22 April and 5 August 2006.

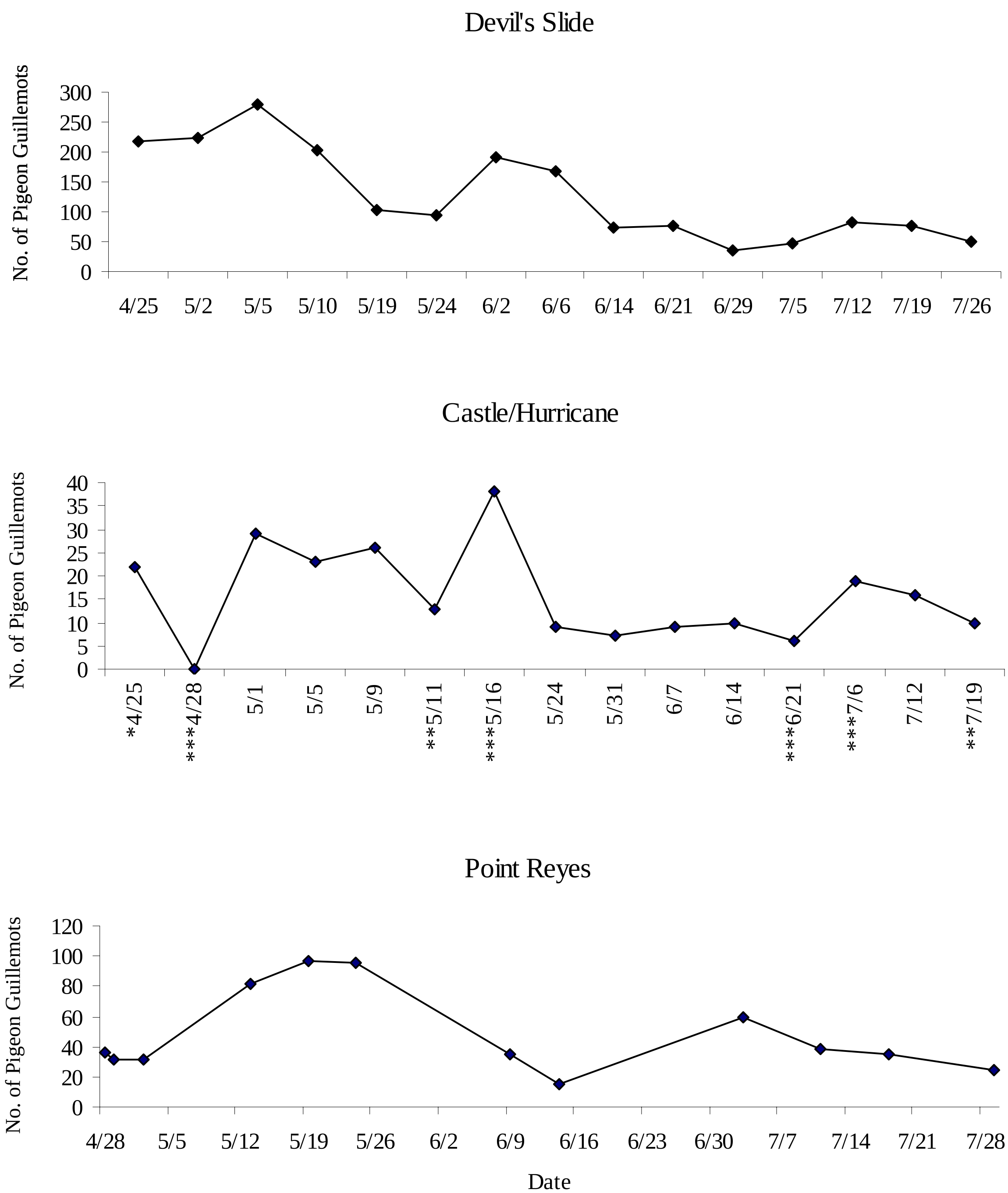


Figure 25. Numbers of Pigeon Guillemots counted in 2006 at Devil's Slide, Castle/Hurricane, and Point Reyes (Lighthouse area only). *Surveyed 3 of 7 areas. **Surveyed 4 of 7 areas. ***Surveyed 6 of 7 areas.

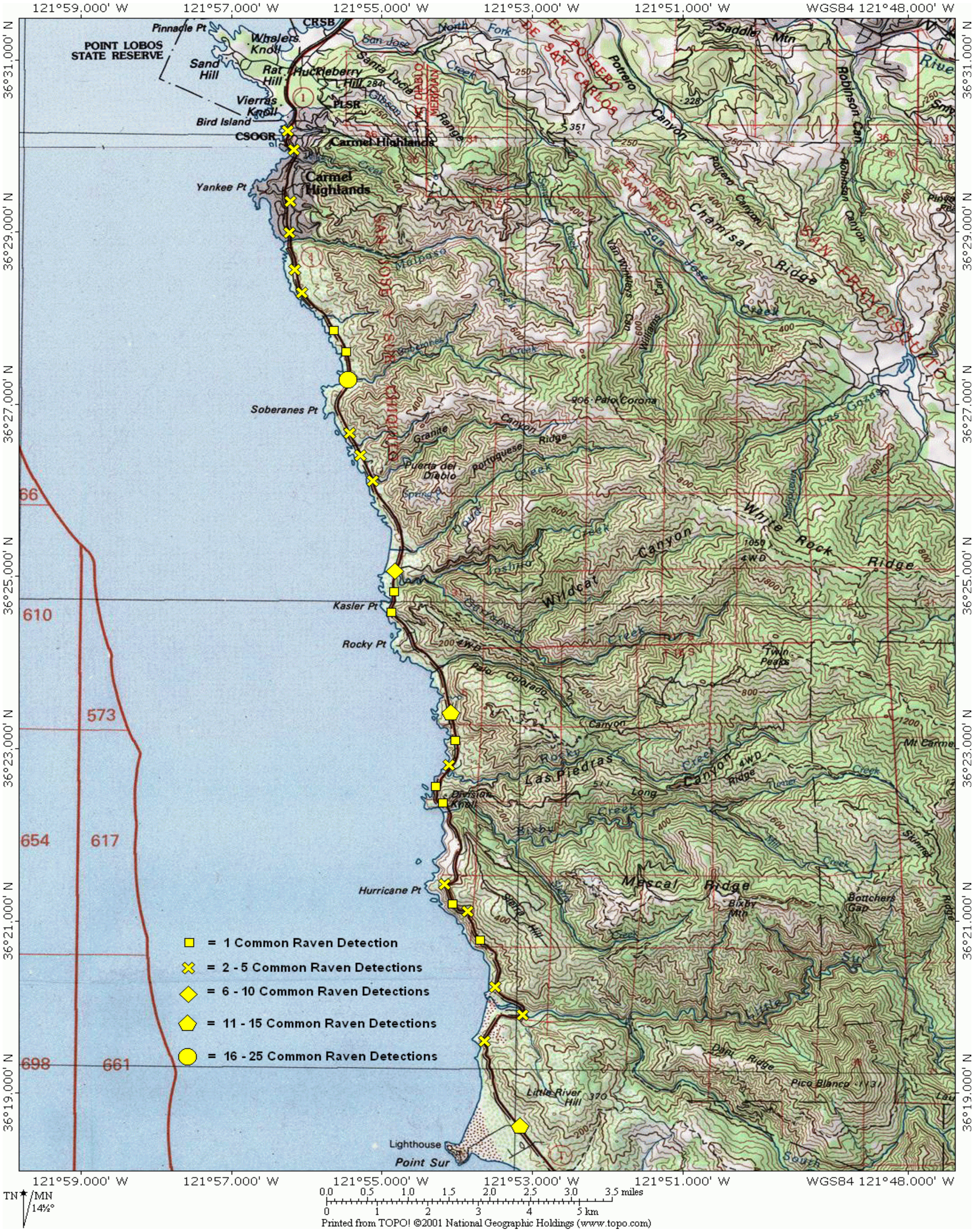


Figure 26. Topographic map showing locations of Common Raven detections between Point Lobos and Point Sur, California, 2006.

Appendix 1. Raw counts by subcolony of Common Murre birds and Brandt's and Double-crested Cormorant nests, sites, and birds from aerial photographic surveys of central California colonies, 2006. SC# = Subcolony Number.

Date	Colony Name	SC#	Subcolony Name	Common Murre	Brandt's Cormorant Nest	Brandt's Cormorant Site	Brandt's Cormorant Bird	Double-crested Cormorant Nest	Double-crested Cormorant Site	Double-crested Cormorant Bird
6/20/2006	Point Reyes	02A	Rock 2	731	0	0	22	0	0	0
6/20/2006	Point Reyes	02B	SC 02 Cliffs	292	0	0	0	0	0	0
6/20/2006	Point Reyes	03A	Big Roost Rock	87	0	0	0	0	0	0
6/20/2006	Point Reyes	03B	Lighthouse Rock	19283	0	0	0	0	0	0
6/20/2006	Point Reyes	03C	NW Lighthouse Cliffs	1332	0	0	0	0	0	0
6/20/2006	Point Reyes	03D	Aalge Ledge	1425	0	0	0	0	0	0
6/20/2006	Point Reyes	03E	The Bulb	417	0	0	0	0	0	0
6/20/2006	Point Reyes	03F	SW Lighthouse Cliffs	80	0	0	0	0	0	0
6/20/2006	Point Reyes	04	South Lighthouse Cliffs	644	0	0	0	0	0	0
6/20/2006	Point Reyes	05B	Boulder Rock	2711	0	0	0	0	0	0
6/20/2006	Point Reyes	05C	Pebble Point	1	14	0	9	0	0	0
6/20/2006	Point Reyes	06B	SC 06B	27	81	0	132	0	0	0
6/20/2006	Point Reyes	06C	SC 06C	1	18	2	39	0	0	0
6/20/2006	Point Reyes	06E	SC 06E	1	38	62	143	0	0	0
6/20/2006	Point Reyes	06F	SC 06F	238	175	67	360	0	0	0
6/20/2006	Point Reyes	07	The Hooves	1	19	0	19	0	0	0
6/20/2006	Point Reyes	08	Greentop	291	88	1	133	0	0	0
6/20/2006	Point Reyes	09B	Cliff Colony East	44	56	5	88	0	0	0
6/20/2006	Point Reyes	10A	Northwest Rock	251	22	0	35	0	0	0
6/20/2006	Point Reyes	10B	Flattop	1974	0	0	0	0	0	0
6/20/2006	Point Reyes	10C	Middle Rock	1136	0	0	0	0	0	0
6/20/2006	Point Reyes	10D	East Rock	360	0	0	30	0	0	0
6/20/2006	Point Reyes	10E	Beach Rock	404	0	0	0	0	0	0
6/20/2006	Point Reyes	10H	Tim Tam	186	0	0	4	0	0	0
6/20/2006	Point Reyes	11A	Chip Rock	3	17	0	21	0	0	0
6/20/2006	Point Reyes	11B	Face Rock	934	69	0	140	0	0	0
6/20/2006	Point Reyes	11D	Arch Rock	0	6	0	8	0	0	0
6/20/2006	Point Reyes	11E	Wishbone and Spine Points	27	95	0	136	0	0	0

Appendix 1 (continued).

Date	Colony Name	SC#	Subcolony Name	Common Murre	Brandt's Cormorant Nest	Brandt's Cormorant Site	Brandt's Cormorant Bird	Double-crested Cormorant Nest	Double-crested Cormorant Site	Double-crested Cormorant Bird
6/20/2006	Point Reyes	12	Sloppy Joe	0	0	0	0	0	0	0
6/20/2006	Point Reyes	13	Cone Rock	3959	204	0	329	0	0	0
6/22/2006	Point Reyes	14B	SC 14B	59	21	0	71	0	0	0
6/20/2006	Point Reyes	14C-E	Border, Miwok, Mainland	0	0	0	0	0	0	0
6/07/2006	Point Resistance	02	Point Resistance rock	4315	0	0	14	0	0	0
6/07/2006	Millers Point Rocks	01	North Rock	312	112	0	137	0	0	0
6/07/2006	Millers Point Rocks	02	South Rock	502	73	8	103	0	0	0
6/07/2006	Millers Point Rocks	03	SC 03	0	0	0	15	0	0	0
6/07/2006	Millers Point Rocks	05	SC 05	81	0	0	58	0	0	0
6/07/2006	Double Point Rocks	01	Stormy Stack	10199	186	5	313	0	0	0
6/07/2006	Double Point Rocks	03	Rock N. of Stormy Stack	223	0	0	15	0	0	0
6/07/2006	North Farallon Islands	01	North Islet	10502	0	0	8	0	0	0
6/07/2006	North Farallon Islands	02	West Islet	18735	35	1	59	0	0	0
6/07/2006	North Farallon Islands	03	East Islet	22043	13	1	19	0	0	0
6/07/2006	North Farallon Islands	04	South Islet	10249	0	0	0	0	0	0
6/07/2006	South Farallon Islands	01	Southeast Farallon Island	50627	8413	724	11349	0	0	0
6/07/2006	South Farallon Islands	02	West End Island	45137	3230	236	4074	607	4	646
6/07/2006	South Farallon Islands	03	The Islets	16821	96	18	173	0	0	0
6/07/2006	South Farallon Islands	04	Saddle Rock	3279	0	0	150	0	0	0
6/07/2006	Alcatraz Island	01	Alcatraz Island	0	1173	38	1643	0	0	0
6/07/2006	Lobos Rock and Land's End	04	Lobos Rock	0	66	5	210	0	0	0
6/07/2006	Lobos Rock and Land's End	06	Nearshore Rock	0	94	5	206	0	0	0
6/07/2006	Seal Rocks	01	SC 01	0	0	0	104	0	0	0
6/07/2006	Seal Rocks	02	SC 02	0	0	0	18	0	0	0
6/07/2006	Seal Rocks	03	SC 03	0	20	11	122	0	0	0
4/26/2006	Devil's Slide Rock & Mainland	01	Devil's Slide Rock	428	90	9	151	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	01	Devil's Slide Rock	618	118	14	299	0	0	0
4/26/2006	Devil's Slide Rock & Mainland	02	April's Finger	11	32	15	56	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	02	April's Finger	7	40	2	29	0	0	0

Appendix 1 (continued).

Date	Colony Name	SC#	Subcolony Name	Common Murre	Brandt's Cormorant Nest	Brandt's Cormorant Site	Brandt's Cormorant Bird	Double-crested Cormorant Nest	Double-crested Cormorant Site	Double-crested Cormorant Bird
6/07/2006	Devil's Slide Rock & Mainland	02	roost area	0	0	0	234	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	05A	Mainland South	39	301	25	490	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	05B	Turtlehead	11	60	36	168	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	05C	East of Turtlehead	0	6	2	9	0	0	0
6/07/2006	Devil's Slide Rock & Mainland	99	Elizabeth Rock	0	0	0	36	0	0	0
6/02/2006	Año Nuevo Island	01	Año Nuevo Island	0	2479	148	2856	0	0	0
5/30/2006	Bench Mark-227X	02	Esselen Rock	457	126	7	159	0	0	0
5/30/2006	Bench Mark-227X	03	Esselen Mainland	0	97	22	137	0	0	0
5/30/2006	Castle Rocks & Mainland	02	Rock 02	246	0	0	0	0	0	0
5/30/2006	Castle Rocks & Mainland	03A	Rock 03 West	109	0	0	0	0	0	0
5/30/2006	Castle Rocks & Mainland	03B	Rock 03 East	0	0	0	0	0	0	0
5/30/2006	Castle Rocks & Mainland	04	Rock 04	928	7	0	7	0	0	0
5/30/2006	Castle Rocks & Mainland	05	Rock 05	19	0	0	0	0	0	0
5/30/2006	Castle Rocks & Mainland	06A	Mainland 06 North	231	11	0	14	0	0	0
5/30/2006	Castle Rocks & Mainland	06B	Mainland 06 South	139	5	0	5	0	0	0
5/30/2006	Castle Rocks & Mainland	07	Rock 07	721	0	0	0	0	0	0
5/30/2006	Castle Rocks & Mainland	08	SC 08	2	76	0	84	0	0	0
5/30/2006	Castle Rocks & Mainland	09	SC 09	0	57	1	63	0	0	0
5/30/2006	Hurricane Point Rocks	01	Rock 01	170	0	0	0	0	0	0
5/30/2006	Hurricane Point Rocks	02	Rock 02	765	0	0	3	0	0	0
5/30/2006	Hurricane Point Rocks	04	Jen's Rock	0	0	0	0	0	0	0