RESTORATION OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2008

REPORT TO THE

COMMAND TRUSTEE COUNCIL

Gerard J. McChesney[1], Deasy N. Lontoh[2], Sandra J. Rhoades[2], Kim A. Borg[2], Erica L. Donnelly[2], Morgan E. Gilmour[2], Peter J. Kappes[1], Lisa E. Eigner[2], Richard T. Golightly[2]

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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EXECUTIVE SUMMARY

This report summarizes the 13th year of seabird restoration and associated monitoring in central California conducted by the Common Murre Restoration Project (CMRP) in 2008. These efforts began in 1996 to restore breeding colonies of seabirds, especially Common Murres (*Uria aalge*), harmed by the 1986 *Apex Houston* and 1998 *Command* oil spills, gill net fishing, human disturbance, and other factors. From 1995 to 2005, our primary goal was to restore the previously extirpated Devil's Slide Rock colony using social attraction techniques and to assess restoration needs at other central California colonies. Since 2005, efforts have been redirected to surveillance of human disturbance to murre colonies, assessing the impacts of that disturbance, and assessing other factors affecting growth of colonies; additionally, we still monitor progress of the initial restoration efforts. This information is then used to guide outreach and education efforts conducted by the Gulf of the Farallones National Marine Sanctuary and to assess the success of those efforts. The goal of this program is to restore affected breeding colonies mainly through reduction of human disturbance. Surveillance and monitoring were conducted almost daily from mid-April to late July at the following Common Murre colonies in central California: Point Reyes; Devil's Slide Rock and Mainland; and the Castle/Hurricane Colony Complex (including Bench Mark-227X, Castle Rocks and Mainland, and Hurricane Point Rocks). Another four colonies were surveyed weekly including three in the Drakes Bay area (Point Resistance, Millers Point Rocks, Double Point Rocks) and San Pedro Rock. In addition to human disturbance, we measured breeding population size, seasonal attendance patterns, reproductive performance, and/or adult co-attendance patterns of Common Murres and up to five other seabird species. Periodic surveys were also conducted at Bird Island, Lobos Rock and Land's End, Seal Rocks, and San Pedro Rock to examine potential murre attendance and breeding.

For aircraft, activity rates were measured as the number of fixed-wing planes and helicopters observed per hour that flew $\leq$ 1000 ft (305 m) over colonies. Boat activity was measured as the number of vessels observed per hour that approached within 1500 ft (457 m) of colonies. Aircraft, boat and other anthropogenic disturbance rates were measured as the number of disturbance events per hour. At Point Reyes, combined aircraft and boat activity in 2008 declined 51% from 2007 but overall disturbance rates were similar to 2007. Helicopter disturbance increased 100% and boat disturbance decreased 43% from the long-term means. In the Drakes Bay area, little aircraft or boat activity was observed at Point Resistance and Miller's Point Rocks; at Double Point Rocks, activity rates declined from 2007 but disturbance rates increased for planes and boats. At Devil's Slide Rock and Mainland, aircraft and boat activity and disturbance rates were the greatest of all colonies that are monitored almost daily. However, combined aircraft and boat activity rates declined 40% from 2007, including declines of 44% for planes and 34% for helicopters with little change for boats. However, disturbance rates were higher than the long-term means for planes (129%), helicopters (43%), and boats (75%). At the Castle/Hurricane Colony Complex, combined activity rates increased 184% from 2007, including a 1000% increase for boats. The combined disturbance rate increased 1775%. Disturbance rates were much higher than long-term means, including 2700% for planes, 213% for helicopters, and 1800% for boats.

On Devil's Slide Rock in 2008, a new high count of 961 Common Murres was established since

the colony was recolonized in 1996. However, the number of breeding pairs within monitored plots was similar to 2007. Breeding success of a sample of 138 nest sites was 0.50 chicks per pair, which is less than the long-term mean (0.62) but similar to 2007. Murres also bred on the Devil's Slide Mainland (67 pairs) for the fourth consecutive year and fledged 0.16 chicks per pair. Low productivity was largely a result of Brown Pelican (*Pelecanus occidentalis*) disturbance. Murre breeding success at Point Reyes (0.66 chicks/pair) and Castle Rocks and Mainland (0.57 chicks/pair) was above the long-term averages. For Brandt's Cormorants, there was a reduced breeding effort and breeding success was very low at all three colonies. While numbers of breeding Pelagic Cormorants and Western Gulls generally increased from 2007, productivity for both species was low.

Common Ravens (*Corvus corax*) caused frequent murre flushing events and at least occasional nest predation at Point Reyes, Point Resistance, Miller's Point Rocks, and Double Point Rocks. Total breeding failure at Miller's Point Rocks appears to have been mainly from raven disturbance. Brown Pelicans caused major disturbances to murres at Point Reyes, Double Point Rocks, Devil's Slide Rock and Mainland, and Hurricane Point Rocks. For the first time in several years, no major pelican disturbances were observed at the Castle Rocks and Mainland colony. Except for Devil's Slide Rock murres, counts from aerial photographic surveys of murres, Brandt's Cormorants and Double-crested Cormorants were not conducted for standardized assessment of population size changes due to a lack of funds.

INTRODUCTION

Common Murre (*Uria aalge*) breeding colonies in central California occur on certain nearshore rocks and adjacent mainland cliffs between Marin and Monterey counties as well as the North and South Farallon Islands, 20 to 40 km offshore of San Francisco (Carter et al. 1992, 2001). A steep decline in the central California population between 1980 and 1986 was 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 about 3,000 breeding murres on Devil's Slide Rock in northern San Mateo County was extirpated by these mortality factors. Nearby San Pedro Rock was extirpated in the early 20th century primarily by commercial egg harvesters (Ray 1909; Carter et al. 2001). Since 1995, the Common Murre Restoration Project (CMRP) has sought to restore these and other central California colonies using social attraction and other techniques. Social attraction techniques were utilized at Devil's Slide Rock beginning in 1996 (Parker et al. 2007). Murres quickly recolonized the rock and reached a 10-year restoration goal of 100 breeding pairs in only five years. Social attraction was discontinued following the 2005 breeding season because the colony appeared to be well established (McChesney et al. 2006). At San Pedro Rock, social attraction techniques for murres were utilized from 1998 to 2004 but were discontinued because of limited murre visitation, difficult working conditions, and reduced funds. Restoration efforts at other colonies in central California, especially the Castle/Hurricane Colony Complex in Monterey County, have focused mainly on documenting impacts to colonies and working with other agencies and the public to reduce disturbances and other impacts such as gill-net mortality.

Small to moderate increases in the central California murre population occurred in the early 1990s, apparently due to partial restrictions on gill-net fishing and reduced oil pollution (Carter et al. 2001). However, Devil's Slide Rock was not recolonized by 1995 and most other colonies remained in a reduced state compared to the early 1980s. Extensive gill-net mortality of murres redeveloped in the mid-1990s and continued to at least 2000 (Forney et al. 2001). To halt the large-scale mortality of seabirds and marine mammals, the California Department of Fish and Game (CDFG) enacted an emergency closure of this gill-net fishery in September 2000, and a permanent closure on gill-net fishing in waters <60 fathoms depth from Point Reyes to Point Arguello was enacted in September 2002. In addition, extensive oil pollution (e.g., 1998 *Command* Oil Spill and the series of oil releases from the sunken vessel *S.S. Jacob Luckenbach* from the early 1990s to early 2000s) continued to kill thousands of murres in central California (Carter 2003; Carter and Golightly 2003; Hampton et al. 2003; Roletto et al. 2003). Anthropogenic and avian disturbances have affected colonies as well (Rojek et al. 2007; USFWS, unpubl. data).

Reduced mortality and high recruitment since the late 1990s led to large population increases in recent years at most colonies (McChesney et al. 2007; USFWS, unpubl. data). By 2007, the Devil's Slide Rock colony had increased to 394 breeding pairs, with an additional 50 pairs on the adjacent mainland. However, some colonies, such as Devil's Slide and the Castle/Hurricane Colony Complex, remain below historical population levels and continue to be impacted by both human and "natural" factors, such as aircraft and boat disturbance, disturbance from Common Ravens (*Corvus corax*) and Brown Pelicans (*Pelecanus occidentalis*), and changing ocean and prey conditions (e.g., McChesney et al. 2007).

The *Command* Oil Spill

Shortly after departing San Francisco bound for Panama on 26 September 1998, the T/V *Command* spilled approximately 3,000 gallons of Intermediate Bunker Fuel (IBF) 380 off the San Francisco and San Mateo county coasts (USFWS et al. 2004). 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), now known as the Seabird Protection Network (SPN), 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 colony surveillance and monitoring component of the SPN. 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. Data collected from surveillance and monitoring are utilized to guide education and outreach efforts and to assess the success of those efforts.

Colony surveillance and monitoring efforts are focused at three colonies or colony complexes established as Common Murre restoration or reference sites in 1996 as part of the *Apex Houston* oil spill restoration plan: Point Reyes; Devil's Slide Rock and Mainland/San Pedro Rock complex; and the Castle/Hurricane Colony Complex. Since 2005, less intensive surveys have been conducted at three colonies within Drakes Bay: Point Resistance; Millers Point Rocks; and Double Point Rocks. In 2008, surveys also were conducted about once per week at seabird colonies at the mouth of the Golden Gate: Bird Island (off Point Bonita), Lobos Rock and Land's End, and Seal Rocks. In 2007 at Bird Island and Seal Rocks, Common Murres were recorded for the first time ever during the breeding season, mainly in July, among colonies of Brandt's Cormorants. Surveys at these colonies in 2008 aimed to document murre attendance and breeding at these new sites.

This report summarizes colony surveillance and monitoring efforts conducted at central California nearshore murre colonies in 2008. Similar to other years, data were gathered on: aircraft, boat and other disturbances to seabirds; Common Murre population sizes, seasonal attendance patterns, reproductive performance, and adult co-attendance patterns; Brandt's Cormorant (*Phalacrocorax penicillatus*) breeding population size and reproductive performance; population surveys and/or productivity of Pelagic Cormorants (*P. pelagicus*), Black Oystercatchers (*Haematopus bachmani*), Western Gulls (*Larus occidentalis*), and Pigeon Guillemots (*Cepphus columba*); and Common Raven surveys conducted near the Castle/Hurricane Colony Complex.

METHODS

Study Sites

The CMRP conducted colony surveillance and monitoring at six colonies or colony complexes in 2008 (Figure 1). From north to south, these are: Point Reyes (PRH; Marin County; Figure 2); Point Resistance (PRS); Millers Point Rocks (MPR); Double Point Rocks (DPR; this and previous two in Marin County; Figure 3); Devil's Slide Rock and Mainland (DSRM; San Mateo County; Figure 4); and the Castle/Hurricane Colony Complex (CHCC; Monterey County; Figure 5). CHCC included the Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (HPR) colonies. PRS, MPR, and DPR are collectively known as the Drakes Bay, or Point Resistance-Double, Colony Complex (DBCC). In addition, four other colonies were surveyed about once per week. Three of these colonies are at the mouth of the Golden Gate: Bird Island (Marin County); Lobos Rock and Lands End; and Seal Rocks (latter two in San Francisco County; Figure 6). The other, San Pedro Rock (San Mateo County), is considered to be within the Devil's Slide Colony Complex (DSCC; Figure 4). At each colony, individual rocks and mainland cliffs with nesting seabirds were identified by their recognized subcolony (SC) number, subcolony name, or subarea.

Field site monitoring was conducted mainly by: S. Rhoades and M. Gilmour (PRH and DBCC); D. Lontoh and E. Donnelly (DSCC and Golden Gate colonies); and K. Borg (CHCC), all with assistance from P. Kappes and G. McChesney.

Disturbance

All observed anthropogenic disturbance events affecting murres and other seabirds at study colonies were recorded. Significant non-anthropogenic (e.g, avian) disturbances also were recorded. A disturbance event was defined as an event where adult birds were alarmed or agitated (e.g, head-bobbing in murres, raised head or wing flapping in cormorants), flushed (i.e., birds flew from rock) or otherwise displaced (i.e., birds moved from nest site or roosting site). The numbers of adults flushed or displaced and the numbers of eggs or chicks exposed, displaced, or depredated were recorded. For anthropogenic disturbances, numbers of disturbance events and numbers of disturbance events per observation hour during the "breeding season" (15 April until end of August) are reported for comparisons between sites and years. Monitoring effort was calculated for each colony and colony complex (Table 1). Data from 2008 were then compared to long-term means for PRH (2001-2002, 2005-2007), DSRM (2001-2007), and CHCC (2001-2007). For non-anthropogenic disturbances, we report the species that caused disturbances and summarize major events.

In addition to events causing disturbance, all aircraft flying at or below about 1,000 feet (305 m) above sea level (ASL) and boats within about 1,500 feet (460 m) of the nearest seabird nesting or roosting area were recorded to examine use patterns of potential sources of anthropogenic disturbance. Information recorded included: aircraft or boat type, identification number or name, direction of travel, activity, and distance from the nearest seabird nesting or roosting area.

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. For each survey, three consecutive counts were performed and a mean was determined, except for certain subcolonies at PRH (see below). Seasonal attendance data were collected at all active subcolonies periodically during the "pre-breeding season" (before 15 April) at DSRM and CHCC and regularly at all colonies throughout the "breeding season" (15 April until all chicks fledged and adult attendance ceased). Non-breeding season counts were conducted between 0700-1100 h when murres were more likely to be present. Breeding season counts were conducted during a standardized period between 1000-1400 h.

Point Reyes

Seasonal attendance patterns of Common Murres were determined for all murre subcolonies visible from mainland observation sites from 22 April to 5 August (Figure 2). In 2008, 16 mainland and 27 nearshore subcolonies were monitored from 10 standardized observation locations at least once per week. Attendance was recorded at established "Type II" index plots (see Birkhead and Nettleship 1980) on Lighthouse (Ledge, Edge, and Dugout plots), Boulder, Flattop, Middle, and Cone Rocks. Counts of index plots on Lighthouse, Boulder, and Cone Rocks were conducted three times and the means reported. Other subcolonies were counted once per survey of entire visible areas.

Drakes Bay Colony Complex

Murre attendance was monitored about once per week at PRS, MPR (both 23 April to 23 July), and DPR (24 April to 2 August; Figure 3). Type II index plots were established at PRS and Stormy Stack (DPR) because of the large numbers of murres attending these colonies. Four index plots (Club, Grotto Ledge, Lower Ledge, and Cup Plots) were used at PRS and five plots (Lower Left, Lower Right, Crack Pot, Pond, and Cliff Plots) on Stormy Stack.

Bird Island, Lobos Rock and Land's End, Seal Rocks

In 2007, murres were recorded for the first time ever attending Bird Island and Seal Rocks, among nesting Brandt's Cormorants (McChesney et al. 2008). In 2008, surveys of these colonies and nearby Lobos Rock and Land's End were conducted weekly during the breeding season in an effort to document murre attendance and possible breeding (Figure 6). From 24 April to 6 June, counts were conducted between 0700-1100 hours when prospecting murres were more likely to be present. To be more standardized with other colonies, counts were conducted between 1000-1400 h from 11 June to 29 July after murre breeding was confirmed at Bird Island. Counts were suspended between 8 June and 18 July at Seal Rocks and Lobos Rock and Land's End because no murre attendance or cormorant breeding was observed. Counts resumed on 19 July to document potential late season attendance of prospecting murres.

The north and south sides of Bird Island were observed from separate locations. Observations of the north side initially were conducted from a location near the center of Rodeo Beach, about 680 m from the rock. Starting on 7 June, observations were conducted from a bluff at the north end of Rodeo Beach ("Rodeo Bluff"), about 940 m away. Although this was a more distant vantage point, Rodeo Bluff provided a more complete view of this side of the rock, especially the northwest slope where murres and cormorants were most concentrated. The south side of Bird Island was viewed from the Bird Island overlook at the end of Mendell Road, 330 m from the rock.

Lobos Rock and Land's End was observed from the USS San Francisco Memorial overlook, just downstairs from the memorial parking area. Counts of Seal Rocks were conducted from four different viewing locations: 1) Upper Sutro, a small bluff north of the historic Sutro Baths for view of subcolony 01; 2) Lower Sutro, downstairs from Upper Sutro for views of the north sides of subcolonies 02 and 03; 3) Cliff House, at the northwest corner of the Cliff House, lower level, for view of subcolony 01 south side, west sides of subcolonies 02 and 03, and small roost rocks east of subcolony 02; and 4) South Cliff House, located approximately 50 m south of Cliff House along Point Lobos Avenue for views of the south sides of subcolonies 02 and 03.

Devil's Slide Rock and Mainland, San Pedro Rock
Pre-breeding season attendance was monitored sporadically from 7 November 2007 to 11 April 2008, with observations on one to four days per month. Breeding season (21 April to 12 August) counts were conducted every other day (weather permitting).

On Devil's Slide Mainland (DSM), attendance patterns were determined for six subareas (Figure 4): April's Finger (SC05); Mainland North (SC07), Upper Mainland South (SC05), Lower Mainland South (SC05), Mainland South Roost (SC05), and Turtlehead (SC05). At Turtlehead, attendance in 2008 was on top of a large boulder a few meters from the north base of Turtlehead proper. Mainland South subareas and Turtlehead were viewed from two locations: Turtlehead Cove overlook and Peregrine Falcon Point (or, "PEFA Pt."). PEFA Pt. was first utilized in 2006 to avoid disturbance of nesting Peregrine Falcons (*Falco peregrinus*). Counts were conducted once per week.

For SPR, colony counts were conducted once per week throughout the breeding season from Pipe Pullout.

Castle/Hurricane Colony Complex
Seasonal attendance patterns of murres were determined for 11 subcolonies at BM227X, CRM, and HPR (Figure 5). Counts were conducted twice per week during the breeding season from 18 April to 26 July. At three subcolonies, separate subarea counts also were obtained: CRM-04 (productivity plot and entire rock); CRM-06 South (north and south sides); and HPR-02 (Ledge and Hump plots).

Common Murre Productivity

As in prior years, productivity of Common Murres was monitored at PRH, DSRM, and CHCC every two to three days at minimum (weather permitting) from standardized mainland vantage points using either 65-130x or 15-60x spotting scopes. At PRH and CRM, locations of returning or new breeding and territorial sites were identified using maps and photographs updated from the 2007 breeding season. At DSR, 2008 sites were newly identified because of the prevalance of new sites growing and movement of sites between years which has increased the difficulty of re-identifying sites from the previous year. A breeding site was defined as a site where an egg was confirmed or inferred based on adult behaviors. A territorial site was defined as a location with attendance greater than or equal to 15% of monitored days but where an egg was not confirmed or inferred based on adult behaviors. Some territorial sites likely were breeding sites where eggs were lost at or shortly after laying without our detection. A sporadic site was defined as a location attended on at least two days but on less than 15% of monitored days. Many possible sporadic sites were not identified 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 perish afterwards. Data from 2008 were then compared to the previous long-term weighted means for DSR and CRM, (1996-2007; 12 years), and PRH (1996-2002 and 2005-2007; ten years).

Point Reyes

Murre productivity was monitored at PRH within two established Type I plots on Lighthouse Rock (LHR). Ledge Plot and Edge Plot were located within the center and on the edge of the colony, respectively.

Devil's Slide Rock and Mainland

Due to widespread colony growth and increasing difficulty monitoring the entire colony, three Type I plots (A, B and C) were established on DSR in 2006 (McChesney et al. 2006; Figure 7). Boundary adjustments were made to plots A and C in 2007 and the same plots (A, B, and C) were utilized for monitoring in 2008. At DSM, all visible sites were monitored within each of three active subareas: Upper Mainland South, Lower Mainland South, and Turtlehead. Birds at Turtlehead were on the boulder described above in Seasonal Attendance Patterns.

Castle/Hurricane Colony Complex

All active murre nesting sites were monitored within a productivity plot on CRM-04 (established in 1996) beginning 21 April. The ephemeral subcolony CRM-03East hosted breeding murres this season for the first time since 2005. All active sites on the rock were monitored beginning with the discovery of the first egg of 2008 on 9 May.

Common Murre Coattendance and Chick Provisioning

Coattendance and chick provisioning observations were conducted at DSR after approximately 66% of breeding sites had chicks. Observations were conducted from sunrise to sunset on 8 July, 11 July, and 14 July following standardized methods (see Parker 2005, McChesney et al.

2006). Twelve to 15 breeding sites with chicks were monitored each day, resulting in a total of 42 site-days. High powered spotting scopes (65-130X) were used to conduct observations. Adult arrivals, departures, and food deliveries to chicks (including prey type, size, and fate) at each monitored site were recorded to the nearest minute. In addition, the number of birds at each site was recorded every 15 minutes throughout the entire survey to check for possible missed arrivals or departures.

Nest Surveys

To assess breeding population sizes, nest and bird counts of Brandt's Cormorants, Pelagic Cormorants, Black Oystercatchers, and Western Gulls were conducted weekly during the breeding season at all colonies. For Brandt's Cormorants, nest and territorial sites were counted. Nests and territorial sites were classified into five groups that roughly described nesting stages: 1) site with little or no nesting material; 2) poorly built nest; 3) fairly built nest; 4) well-built nest; and 5) nests with brooded chicks. In addition, large cormorant chicks (ca. >30 days old; often outside of nests) were counted. See McChesney et al. (2007) for more detailed descriptions of nest categories.

To provide more complete colony coverage, nest surveys from mainland vantage points were augmented with boat surveys conducted at the CHCC on 29 May, DSCC on 30 May, and PRH, PRS, MPR and DPR on 21 June.

Brandt's Cormorant Productivity

Breeding phenology and reproductive success (clutch sizes, brood sizes and chicks fledged per pair) of Brandt's Cormorants were monitored at PRH, DSRM, and CHCC. At PRH, Brandt's Cormorants were monitored at Area C (PRH-06C), PRH-14A, Area B Mainland and Islet (PRH-14B), Border Rock (PRH-14C), and PRH-14E. At DSRM, all nesting in 2008 occurred on the mainland. However, monitoring of the main Brandt's Cormorant nesting group at Upper Mainland South could not be conducted due to the potential of disturbing nearby nesting Peregrine Falcons. Monitoring of a sample of late nests in other subareas was conducted but results are not considered to be comparable to past years. At CHCC, monitoring was conducted at CRM-03East and CRM-03West.

Monitored nests were checked every 2-7 days from mainland vantage points using binoculars and spotting scopes. Chicks were considered to have fledged if they survived to at least 30 days of age. After that age, chicks begin to wander from their nests and become impossible to associate with specific nests without marking (Carter and Hobson 1988, McChesney 1997). Data from 2008 were then compared to prior long-term weighted means for DSRM (1997-2007; 11 years); and CHCC and PRH (1997-2001 and 2007; seven years).

Pelagic Cormorant, Black Oystercatcher, and Western Gull Productivity

Productivity (chicks fledged per pair only) of Pelagic Cormorants, Western Gulls and Black Oystercatchers was determined opportunistically at select nests that were easily visible from mainland vantage points at, PRH, DSRM, and CHCC. Nests were checked at least once per week. Chicks were considered to have fledged if they survived to at least 30 days of age and were not known to perish afterwards.

Pigeon Guillemot Surveys

To assess population status and seasonal attendance patterns, weekly standardized counts were conducted of birds rafting on the water and roosting on land (intertidal and nesting areas) at PRH, DSCC, and CHCC. Surveys were conducted twice per week from mid-April to 5 May, when numbers often peak, and approximately once per week thereafter, between one-half hour after sunrise and 0830 h. Because of the large size of the PRH colony area, weekly counts there were conducted from just one location (Lighthouse) although a single land-based survey of the entire PRH colony was conducted on 10 May. At DSCC, the entire area from the south side of San Pedro Rock to the south end of the DSRM colony boundary was surveyed. At CHCC, the entire area from Rocky Point to the south end of the HPR colony boundary was surveyed. At PRS, MPR, and DPR, guillemots were also counted upon arrival (range 0920-1400 h) for weekly colony surveys. Pigeon Guillemots were also counted during boat surveys of colonies.

Common Raven Surveys – Big Sur

Common Raven surveys were conducted between Point Lobos and Point Sur to assess relative distribution and abundance near CHCC. Surveys were conducted while driving approximately 60 km/hr along a 26.4 km stretch of California State Highway 1 between Point Lobos and Point Sur. Two morning (before 1000 h) and two afternoon (after 1300 h) surveys were conducted weekly from 19 April to 4 August. Morning surveys traveled south from Point Lobos, while afternoon surveys traveled north from Point Sur. Each individual raven observed was considered a "detection". Locations were recorded on a Garmin Etrex GPS unit and plotted on National Geographic Topo mapping software. For comparisons to previous years, the number of raven detections/km and per survey were calculated for the entire survey route and also for two sections of the survey area: 1) a 16.6 km segment from Point Lobos to Bixby Landing; and 2) a 9.2 km segment from Bixby Landing to Point Sur.

RESULTS

In this report, colonies are ordered north to south within each section.

Anthropogenic Disturbance

Point Reyes

Sixteen aircraft overflights (0.030/hr; including 14 by planes and 2 by helicopters) and 21 boat observations (0.040/hr) were documented at PRH in 2008 (Tables 2, 3; Appendixes 1, 2). Eleven (69%) of the overflights resulted from the annual aerial photographic survey. Most observations of watercraft were small recreational boats that were fishing just off the headlands. The peak boating period occurred during June and July during very calm sea conditions. However, none of those boats caused noticeable disturbance.

One helicopter overflight (0.002/hr), representing 6.3% of all overflights and 50% of helicopter overflights, caused some form of disturbance (flushing). This helicopter was flying about 500 ft ASL and 100 m horizontally from the colony. One boat disturbance was caused by two kayaks that approached Tim Tam (PRH-10H) within 15 m, causing 40 murres, three Brandt's Cormorants and one Pelagic Cormorant to flush. In addition, during our colony-wide survey from a small inflatable boat on 21 June, 10 roosting Brandt's Cormorants were flushed when we approached within 100 m of Rock 3 (PRH-02A). One case of disturbance by humans on foot was recorded when three men climbed onto Chimney Rock during a very low tide and flushed six Western Gulls and 20 Pigeon Guillemots.

The combined aircraft and boat observation rate (0.070/hr) declined 51% from 2007 due to a 79% decline in the helicopter rate and a 55% decline in the boat observation rate. The plane overflight rate was essentially unchanged. Compared to long-term means, observation rates were 21% lower for planes (long-term mean = 0.033/hr), 50% lower for helicopters (long-term mean = 0.004/hr), and 41% lower for boats (long-term mean = 0.068/hr; Figure 8). Disturbance rates for helicopters were 100% higher than the long-term mean of 0.001/hr but 43% lower for boats (long-term mean = 0.007/hr; Figure 9).

Drakes Bay Colony Complex

Point Resistance – During standardized monitoring in 2008, there was one aircraft overflight (helicopter; 0.049/hr) that caused no discernable disturbance and no boat observations (Table 4, Appendix 3). This compares to rates of 0.183/hr for both aircraft (two helicopters) and boats in 2007. In addition, during our boat survey of the colony on 21 June, our small inflatable flushed 100 murres and 50 Brandt's Cormorants from about 125 m from the rock.

Millers Point Rocks - There were no observations of aircraft or boats in 2008. In 2007, observation rates were 0.056/hr each for planes and helicopters and 0.565/hr for boats, with no disturbances.

Double Point Rocks – In 2008, there was a total of five aircraft overflights (0.102/hr; all planes) and four boat observations (0.082/hr) (Table 5; Appendixes 4, 5). Three (60%) of the overflights caused murres to headbob. One small private boat fishing within 15 m of DPR-03 caused 50 roosting Brandt's Cormorants and 10 roosting Brown Pelicans to flush. This compares to rates of 0.180 aircraft/hr (plane) and 0.212 boats/hr in 2007, when no disturbances were observed.

Bird Island, Lobos Rock and Land's End, Seal Rocks

At Bird Island, one helicopter overflight (0.042/hr) and four boats (0.167/hr) were recorded in 2008 (Table 6; Appendixes 6, 7). On 29 July, a small recreational boat fishing within 200 m of Bird Island caused 550 roosting cormorants to flush and 250 others to displace. At Seal Rocks, one plane overflight (0.154/hr), one helicopter overflight (0.154/hr), one boat (0.154/hr), and a group of surfers (0.154/hr) were recorded (Tables 7, 8; Appendixes 8, 9). The plane, flying about 75 ft ASL and 100 m horizontally from Seal Rocks subcolony 02, caused ten Western Gulls to flush. No aircraft or boats were observed while observing the Lobos Rock and Land's End colony.

Devil's Slide Rock and Mainland, San Pedro Rock

At DSR, 267 aircraft overflights (0.468/hr; including 224 planes and 43 helicopters) and 32 boat observations (0.056/hr) were documented in 2008 (Tables 9, 10; Appendixes 10, 11). Six aircraft overflights resulted from the annual aerial photographic survey of the colony. Seventy-eight (29.2%) aircraft overflights were recorded on 27 April 2008 during the Pacific Coast Dream Machines event at the Half Moon Bay Airport.

A total of 105 (39%) aircraft overflights caused some form of disturbance, including 71 by planes (32% of planes) and 34 by helicopters (79% of helicopters). Sixteen boat observations (50%) caused disturbance. Eight (3.0%) overflights and ten (31%) boat observations caused flushing of one or more seabirds. One event in which a boat approached at the same time as a plane transited caused roosting Brandt's Cormorants to be displaced. Low-flying (i.e., <1,000 ft) helicopters accounted for 100% of aircraft flushing events.

Two military helicopters flying at approximately 500 ft ASL on 17 April flushed 80 murres; only four of these birds returned. A helicopter flushed 70 cormorants and 2 oystercatchers on 23 June while flying at approximately 200-300 ft ASL, 100 m horizontal from the colony; only ten cormorants returned. Three flushing events were caused by kayaks and seven by small (<25 ft) private/recreational fishing vessels. On Memorial Day, seven kayaks traveling between DSR and the mainland (Bunker Hill) caused 295 roosting cormorants to flush from DSR and nearby roost sites. They also flushed 40 cormorants (roosting birds and mates of birds on nests) from Mainland South and displaced 10 cormorants from April's Finger. No cormorant nests were left unattended, but eggs in five nests were exposed because birds stood in alert postures. In addition, one Peregrine Falcon was agitated.

Additional disturbance monitoring was associated with the continued construction by CalTrans of the Highway 1 Devil's Slide Tunnel. Explosives were used inside the tunnel at a distance of approximately 800 m from DSR and 400 m from DSM. Blasting occurred on 13 May and 19 June, but no seabird disturbance was observed.

The combined aircraft and boat observation rate declined 40% from 2007 mainly because of a 42% decrease in overflights, including declines of planes (44%) and helicopters (34%). The boat observation rate was essentially unchanged (Figure 8). In general, disturbance rates at DSRM have been increasing since disturbance monitoring became more standardized in 2001 (Figure 8). However, the overall disturbance rate (0.214/hr) and flush/displacement rate (0.035/hr) in 2008 decreased 9.7% and 36% from 2007, respectively, although boat disturbance rates increased 100% overall and 375% for flushing/displacement events. Compared to long-term means (including all behaviors), disturbance rates were 129% higher for planes (long-term mean = 0.054/hr), 43% higher for helicopters (long-term mean = 0.042/hr), and 75% higher for boats (long-term mean = 0.016/hr; Figure 9).

Because of the long distance from most vantage points, disturbance is difficult to document at SPR, and none was recorded in 2008.

Castle/Hurricane Colony Complex

A total of 26 aircraft (0.081/hr; including 18 by planes and eight by helicopters) overflights and 14 boat observations (0.044/hr) were recorded at CHCC in 2008 (Tables 11, 12; Appendix 12, 13). Ten of the 18 plane overflights were conducted during the annual aerial seabird colony survey.

Seventeen (65%) overflights (0.05/hr) caused some level of disturbance, including nine by planes (50% of planes) and eight by helicopters (100% of helicopters). Four (50%) helicopter overflights caused flushing of roosting seabirds. Six (43%) boat approaches caused some level of disturbance. Three boats (21%), each moving at high speeds about 100 m from a subcolony, caused flushing. All boats observed were fishing in the area, with most observed in mid- to late May and mid-June when very calm seas permitted boats to get close to the rocks.

Combined aircraft overflight and boat observation rates increased 184% from 2007, mainly because of a 1000% increase in boat observations (Figure 8). In general, disturbance rates at CHCC had been decreasing since 2003. However, rates in 2008 increased and were much higher than the long-term averages (Figure 9). The overall disturbance rate increased 1775% from 2007, including a 450% increase in the flushing/displacement rate. In 2007, only two helicopter disturbances (both flushing) were recorded. In 2008, disturbance rates were 2700% higher than the long-term mean for planes (0.001/hr), 213% higher for helicopters (long-term mean = 0.008/hr), and 1800% higher for boats (long-term mean = 0.001/hr).

The Basin Complex Fire that started 21 June 2008 and raged until the end of July produced heavy smoke and ash in the CHCC area. The effect of this poor air-quality on breeding seabirds is unknown. Helicopters picking up seawater and traveling inland to douse the fires were noted just south of CHCC and on 9 July, one of these fire-fighting helicopters was seen in Bixby Cove, just south of CRM-07. This helicopter caused no flushing of murres although head-bobbing was prevalent. Because monitoring efforts were affected by the fire, including a cessation of monitoring from 4-6 July during the peak of fire fighting activity near CHCC, it is uncertain exactly how frequently these helicopters were within the CHCC vicinity and whether or not they caused any additional disturbance.

Non-Anthropogenic Disturbance

Point Reyes
Avian disturbances were frequently observed at PRH. Of 37 recorded disturbances, most were observed at Lighthouse Rock and were caused by Common Ravens (59%) and Brown Pelicans (35%). All events impacted only murres. Five murre eggs were observed being taken by ravens, and one murre chick was taken by a Western Gull after a pelican disturbance.

Between 19 and 26 July, Brown Pelicans almost continually flushed and displaced murres on Lighthouse Rock. Most disturbances were caused by juvenile pelicans, sometimes several individuals at the same time on different parts of the rock, repeatedly walking through the colony from one spot to another and flushing and displacing adults and chicks. No egg loss was recorded since the disturbance occurred during the late chick-rearing period. Chick mortality was difficult to determine from these events. Many chicks disappeared from plots during this time, but most were old enough to depart the rock and may have done so. However, separation from parents during these events may have prevented many chicks from successfully fledging.

Drakes Bay Colony Complex
Point Resistance - At PRS, a pair of Common Ravens was observed harassing and flushing murres throughout the season. Five eggs were observed being taken (four by ravens and one by a Western Gull). Murre eggshells were also found regularly on the cliff top of the adjacent mainland. On 16 July, 88 pelicans and 6 vultures were recorded on the PRS colony. Only a small number of murres were present (see Seasonal Attendance Patterns, below), though it was unclear whether or not this was because of disturbance or if most adults had already departed with their chicks.

Millers Point Rocks - At the larger South Rock (MPR-02), two raven disturbances were observed on 11 June when one murre egg was observed being taken. Murre eggshells were found regularly on the mainland at Millers Point, suggesting relatively high disturbance and depredation rates.

Double Point Rocks – At Stormy Stack, ten disturbance events caused by Common Ravens (60%), Turkey Vultures (30%), Western Gulls (30%), and Brown Pelicans (30%) were recorded. Half of these disturbances involved more than one species. One disturbance caused by four vultures and four gulls flushed 2,000 murres and resulted in at least 13 murre eggs and 14 cormorant eggs being displaced or depredated. All disturbances from April to June involved ravens or vultures. The last three disturbances, in July, were all caused by pelicans.

Devil's Slide Rock and Mainland
Of 30 recorded disturbance events at DSRM, most resulted in flushing (n = 23). Displacement (n = 3) and agitation (n = 4) events also occurred. Brown Pelicans were responsible for 11 disturbances to murres on DSR and five on Lower Mainland South. Murres flushed as pelicans

tried to land or walked through the colony. A total of 58 eggs were exposed, 45 eggs were displaced (most rolled away from the breeding site), one egg was taken by a Western Gull, 11 chicks were exposed and six chicks were displaced (Figure 10). Pelican disturbances occurred throughout the breeding season and largely contributed to complete breeding failure of murres in Plot C on DSR and on Lower Mainland South. On 23 May, up to 33 pelicans were observed roosting on the east side of DSR from 0922 to 1142 h. Several individuals moved around and flushed 30 murres and displaced 100 murres. Twenty murre eggs were exposed and 15 displaced. On Lower Mainland South, the most severe disturbance occurred on 17 June, when up to 17 pelicans roosted in the nesting area from 0853-1415 h. Movements of several individuals and fighting among roosters flushed 17 murres, displaced 15 birds, exposed 13 eggs and displaced 9 eggs.

Six disturbance events were caused by Peregrine Falcons on Lower Mainland South. In 2008, a pair of Great-horned Owls raised two chicks near the cliff top of Upper Mainland South, within the local Peregrine Falcon territory. Because of this, the falcons often engaged in aggressive protest flights, flying at high speeds towards the owl nest while screaming, kicking dirt at the nest entrance and diving. These diving flights sometimes caused murres and cormorants to flush. Four disturbance events recorded were due to these diving flights in April and May. The falcons' aggressive flights ceased following the owls departure in late May, but their own chicks were fledging and continued to cause disturbance. One flushing event was caused by a fledgling falcon attempting to capture a murre on Lower Mainland South, and another occurred during an aerial food exchange between the adult female and her fledglings. However, no seabird egg or chick loss was documented during these flushing events.

Castle/Hurricane Colony Complex

Eight Brown Pelican flushing events were recorded during standardized colony monitoring in 2008. Six of these events were caused by flocks of pelicans flying over, or close to, murre subcolonies. There were three observations of pelicans roosting within murre nesting areas. Roosting pelicans were in mixed age groups (adults, subadults and juveniles) and occurred in large numbers (58-148 birds). Pelican disturbances took place during the murre incubation period (mid- to end of May) and some resulting murre egg loss seemed likely, although none was confirmed.

In addition to land-based observations, during the complex-wide boat survey on 29 May, 45 pelicans were counted roosting on the 'Hump' subarea of HPR-02, including nine within the murre nesting area. Based on past observations, these pelicans must have caused a great deal of disturbance to nesting murres. High murre attendance later in the season indicated prolonged breeding on the Hump, suggesting that this pelican disturbance event caused egg loss and then birds renested (also see Common Murre Seasonal Attendance Patterns, below).

Compared with other recent years, Brown Pelican disturbance was still much lower in 2008 than other recent years. Large-scale disturbance to murres caused by single juvenile pelicans resulted in near complete breeding failure at CRM in 2004-2007 and at HPR in 2007.

Common Murre Seasonal Attendance Patterns

Point Reyes
All well-established nesting areas were active with confirmed breeding in 2008. Attendance patterns throughout most established subcolonies on the headlands were typical with highest counts early in the season (mid-April), low variability during the incubation and brooding periods, followed by declines from mid-July to early August as chicks fledged and birds left most breeding areas (Figures 11, 12). Exceptions to these patterns included LHR-Edge and Boulder Rock plots. Attendance patterns at Edge Plot were variable throughout the season, and the high count at Boulder Rock occurred in mid-May. Almost all birds were gone by the last colony count on 6 August; only 2 birds with chicks remained on Boulder and 13 birds at PRH-14B (probably clubbing birds). Of the "ephemeral" subcolonies, only PRH-14B was attended in 2008 but no breeding was recorded. At Aalge Ledge, no breeding was confirmed at this clubbing area in 2008 although small numbers bred in 2006.

Drakes Bay Colony Complex
Point Resistance - Attendance at PRS early in the season was lower than in 2007. Numbers began to increase in June and then declined in mid-July due to avian disturbance or chick departures (Figure 13). Frequent raven disturbance and predation was documented throughout the season. In addition, pelican and vulture disturbances were observed in July (see above).

Millers Point Rocks – At the North Rock (MPR-01), murres (n = 11) were observed on 28 May only (Figure 13). The larger South Rock (MPR-02) and nearby smaller islets (MPR-03 and MPR-05) were sporadically attended, but with lower numbers than in 2007. Successful breeding was not documented and raven-depredated murre eggs were seen regularly (and occasionally cormorant and gull eggs) on the mainland at Millers Point.

Double Point Rocks - Attendance at Stormy Stack was generally higher than in 2007 (Figure 13). Murres consistently attended DPR North Rock in 2008; this appeared to be a clubbing area and no breeding was confirmed.

Bird Island, Lobos Rock and Land's End, and Seal Rocks
Bird Island – Murres were first observed on 14 May among roosting Brandt's Cormorants (Figure 14). The arrival of murres on Bird Island coincided with attendance of hundreds of roosting cormorants. As the number of cormorants increased to over 6000 birds, the number of murres also increased. Murres were most concentrated around wooden structural remains of an abandoned U.S. Navy radio station on the northwest side of the island and among nesting Brandt's Cormorants (Figure 15). A high count of 652 birds was recorded on 26 June, three weeks after the first eggs were sighted (see below). Attendance declined dramatically in late July and the colony was not monitored after 29 July.

In 2008, murre breeding was documented on Bird Island for the first time. No historical breeding is known to have occurred at this colony (Carter et al. 2001). Eggs (n = 2) were first recorded on 7 June from the Bird Island overlook (south side), but were difficult to confirm among the larger aggregation on the northwest side of the rock due to more difficult viewing conditions. A high count of 14 eggs and 86 other birds in incubation postures (i.e., many likely had eggs) was recorded from all portions of the rock on 21 June. The first chick was observed on 12 July, and a high count of seven chicks (some at fledging age) was recorded on 26 July. Parent and chick pairs on the water were also seen on 26 July, suggesting that chicks had begun departing the rock although these birds could have come from other local colonies. A chick jumping off Bird Island was observed on 29 July.

Seal Rocks – Murres were not observed on Seal Rocks in 2008. However, a group of 17 murres was observed on the water near subcolony 01 on 28 May.

Lobos Rock and Land's End – Murres are not known to have occurred at this colony historically, and none were observed in 2008.

Devil's Slide Rock and Mainland, San Pedro Rock

Devil's Slide Rock - Murres were observed on all count days between 9 November 2007 and 8 August 2008 (Figure 16). As is typical, the greatest counts were recorded during the late pre-egg laying and early egg laying periods. The maximum count of 961 murres (11 May) was the highest recorded since CMRP monitoring began in 1996 (previous high, 740 on 28 April 2007). Murre counts were lower during the incubation and brooding periods, and were similar to or slightly higher than in 2007. Lower attendance in late May appeared to be due to multiple causes, including pelican disturbance and warm air temperatures. The count from the annual aerial photographic survey on 6 June 2008 was 595 murres (Figure 17). Murres (n = 26) were last observed on 8 August and were not recorded attending DSR after all remaining chicks fledged.

Devil's Slide Mainland - Common Murres were observed among nesting Brandt's Cormorants on Turtlehead, Lower Mainland South, and Upper Mainland South. All three subareas had consistent attendance throughout the pre-breeding and breeding seasons (Figure 18). High counts were: Lower Mainland South, 165 (11 April); Upper Mainland South, 33 (7 May); and Turtlehead, 35 (2 May). The greatest combined single day count for all subareas was 220 birds on 2 May. Lower Mainland South counts were similar to 2007. In contrast, attendance increased dramatically on Upper Mainland South and Turtlehead (average of 17.3 and 18.8 in 2008, respectively versus 3.8 and 1.5 in 2007), reflecting an increase in the number of breeding sites.

San Pedro Rock - Murres were not observed on San Pedro Rock in 2008.

Castle/Hurricane Colony Complex

The majority of CHCC subcolonies displayed similar attendance patterns, with peaks in attendance in mid-April (early egg-laying) and late June-early July (mid-chick period) with relatively stable attendance in-between, and declining numbers toward the end of the breeding season in mid-July (Figures 19-21). High spikes in attendance at some subcolonies in late June to mid-July were possibly due to visiting subadults. Exceptions to these patterns included the Bench Mark-227X subcolonies and HPR-02. At BM227X-02, murre numbers remained relatively stable through the month of May, then declined through mid- to late June, similar to the pattern seen in 2007 (McChesney et al. 2008). Breeding was not confirmed but birds were observed in incubation posture. While some chicks may have fledged, this subcolony appears to have been largely unsuccessful. Dead murres and gull chicks, likely from predation, were documented at BM227X-02 in 2005 (McChesney et al. 2006); predation or disturbance from a predator may also explain the abandonment observed in 2008.

For the second consecutive year, murres were observed attending the mainland of BM227X (subcolony 03) in 2008. Murre attendance on the mainland fluctuated during the first month of monitoring and the area was abandoned by 31 May for unknown reasons. Several birds on BM227X-03 were observed in incubation posture although breeding was not confirmed.

Prolonged murre attendance to the end of July was observed at HPR-02 'Hump'. This late attendance pattern may have been due to a high rate of second clutches. Pelican disturbances in late May likely disrupted breeding attempts on the 'Hump'. If second clutches were laid, brooding and fledging would have occurred at least into late July, and late stage chicks were observed on the 'Hump' as late as 26 July. The sudden drop in attendance on HPR-02 'Ledge' on 9 July was generally in sync with other subcolonies; however, there is a possibility that some form of disturbance caused adults to abandon early. The sporadic attendance of adults on 'Ledge' after 9 July may have been influenced by high attendance on the adjacent 'Hump'.

For the first time since 2005, CRM-03East hosted breeding murres. Attendance patterns at this "ephemeral" subcolony were similar to those at other CHCC subcolonies, although the rock was vacated slightly earlier in July. Murres were also recorded inside Funt Cove (CRM-06 North) during boat and aerial surveys, as they were in 2007. However, in contrast to last year, murres were not observed on CRM-08. These subareas are not visible from mainland vantage points.

Common Murre Productivity

Point Reyes
A total of 140 sites were monitored between Ledge (n = 80; 57.1%) and Edge (n = 60; 42.9%) plots on Lighthouse Rock. In Ledge Plot, 64 (80.0%) sites were egg-laying, 15 (18.8%) were territorial, and 1 was sporadic. The mean egg lay date for first eggs in Ledge Plot was 20 May (range = 3 May-9 June; n = 63; Table 13), two days earlier that the long-term average. Eight replacement eggs were laid, including one that appeared to be a third breeding attempt. The number of chicks fledged per breeding pair was 0.75, 21.0% higher than the long-term mean.

In Edge Plot, 49 (81.7%) sites were breeding, ten (16.7%) sites were territorial, and one was sporadic. The mean egg lay date for first eggs in Edge Plot was 25 May (range = 13 May-12 June; n = 39; Table 13), two days earlier than the long-term mean. Four replacement eggs were laid. The number of chicks fledged per breeding pair was 0.55, 5.8% higher than the long-term mean (0.52).

When Edge and Ledge plots are combined, the mean egg-laying date was 22 May (range = 3

May-12 June; n = 101), two days earlier than the long-term mean. Greater than average hatching and fledging success led to overall productivity of 0.66 chicks fledged per pair, 11.9% higher than the long-term average (0.59). Fledged chicks remained on the rock for an average of 22.7 days and 23.9 days in the Ledge and Edge plots, respectively. The last chicks observed in Edge and Ledge plots were seen on 25 and 26 July, respectively. At least some of the last chicks present on the rock were either lost or "forced fledged" (forced into the water with parent bird when old enough to fledge) by Brown Pelicans. Pelicans were first observed landing at the Lighthouse Rock subcolony on 16 July. On 20 July, two chicks were observed falling off the rock into the water during a pelican disturbance. Many monitored chicks were not seen after pelican disturbances. Some that were old enough to depart ("fledge") the colony were forced into the water, while three others disappeared when they were too young to have fledged.

Devil's Slide Rock and Mainland

Of 201 sites documented within DSR plots, 138 (68.7%) sites were breeding, 53 (26.4%) were territorial, and 10 (5.0%) were sporadic. At all sites combined, the mean egg-laying date of first eggs was 28 May (range = 5 May-27 June, n = 119; Table 13), four days later than the long-term average. A total of 172 eggs were laid, including 34 replacement eggs. Hatching success was low, but fledging success was high. An average of 0.50 chicks fledged per pair, 15.2% lower than the long-term average and 9.1% lower than in 2007. Chicks that fledged remained on the rock for an average of 23.8 days after hatching and the last chick was seen on 8 August.

On DSM, breeding murres were documented for the fourth consecutive year on the Lower Mainland South subarea. This was the first year breeding was confirmed on Upper Mainland South. Breeding sites on Upper Mainland South were located among nesting Brandt's Cormorants. This also was the first year murres were recorded breeding atop a large boulder near the base of Turtlehead ("Turtlehead Boulder"), where small numbers of murres sporadically attended among nesting Brandt's Cormorants in 2007 although no cormorants bred there in 2008.

Breeding sites on DSM increased 34% from 2007. Of 115 total sites monitored in the three subareas, 67 (58.3%) were breeding, 41 (35.7%) were territorial, and seven (6.1%) were sporadically attended. The mean egg-laying date was 30 May (range = 11 May-20 June, n = 44; Table 13). Hatching success was low but fledging success was fairly high. There were four replacement eggs recorded, one of which was considered a third replacement egg (third breeding attempt) but which could have been laid by a different female. The number of chicks fledged per pair was 0.16, 66.7% lower than in 2007. Eleven eggs were lost from Lower Mainland South due to Brown Pelican disturbances (see Non-Anthropogenic Disturbance, above). Chicks fledged at an average age of 21.8 days and the last chick was seen on 3 August.

Combining DSR plots and DSM, breeding success was 0.39 chicks per pair (n = 205).

Castle/Hurricane Colony Complex

Of 116 monitored sites in the CRM-04 plot in 2008, 83 (71.5%) were egg-laying and 33 (28.4%) were territorial (Table 13). The number of breeding sites decreased by 4% from 2007. The first eggs (n = 2) were already present on the first day of intensive productivity monitoring (21 April), which is the earliest lay date recorded at CRM-04 plot. The mean egg-laying date of 4 May (range = 21 April-20 June; n = 55) was 13 days earlier than the long-term average. There were three replacement eggs laid. This was the first year since 2003 that productivity on the CRM colony was not dramatically reduced by disturbances from Brown Pelicans. Greater than average hatching success (76.2%) and fledging success (75.8%) led to overall productivity of 0.57 chicks per pair for CRM-04. This was 24% higher than the long-term average of 0.46 chicks per pair and substantially higher than the previous two years when large scale breeding failure occurred, mainly due to pelican disturbance.

Of the 50 sites monitored on CRM-03East, 36 (72%) were breeding and 14 (28%) were territorial. Breeding was initiated about a week later than at CRM-04, but the mean egg lay date of 6 May (range = 27 April-31 May; n = 13; Table 13) was similar. Hatching success of 61.1% and fledging success of 81.8% led to productivity of 0.50 chicks per pair for this subcolony.

Common Murre Coattendance and Chick Provisioning

At DSR, mean percent of sampling period that pairs with chicks spent in coattendance was 13.0% (range = 3.5-23.3%; n = 15), which is 13.3% lower than the long-term (1999-2007) average. During coattendance observations, 213 mate arrivals were recorded. On average, mates arrived 0.34 times per site per hour (range = 0.23-0.49; n = 15). Of all mate arrivals seen, 53.0% were observed with prey, 33.8% had no prey, and 13.2% were undetermined whether or not they carried prey. Of prey deliveries, 97.3% were consumed by chicks and 2.7% were undetermined. The mean chick provisioning rate was 0.18 feedings per hour (range: 0.09-0.28; n = 15), 21.7% lower than the long-term average but similar to 2005-2007.

Brandt’s Cormorant Nest Surveys and Productivity

Point Reyes

Nest surveys - Brandt’s Cormorant nest counts were conducted from 22 April to 29 July. In 2008, cormorants had a reduced nesting effort with a delayed and extended egg laying period. Well-built nests were recorded at Boulder Rock (PRH-05B), PRH-06C, Flattop (PRH-10B), Beach Rock (PRH-10E), PRH-14A, PRH-14B, and Border Rock (PRH-14C), and PRH-14E.

Few cormorants were even present before nest initiations began. Nest building was first observed on 30 April, and the first egg was recorded on 9 May. The peak total count of 120 well-built nests occurred during the week of 6 June, 81% below the peak of 628 nests in 2007. Eleven out of 12 active nests failed during or just after the heat wave of 15-16 May. Nest building continued until 28 June with some nests from PRH-06C laying replacement clutches but cormorants on Border Rock did not return. An unusually high number of birds laid eggs before nests reached the well-built stage, in some cases laying eggs on only small amounts of nest material. Many nests were abandoned during the chick hatching period.

Productivity - A total of 116 nests were monitored at five subareas. All clearly visible egg-laying sites in Area C (PRH-06C), PRH-14A, Area B (PRH-14B), Border Rock (PRH-14C), and PRH-14E were monitored. For all subareas combined, the average clutch initiation date of 11 June (range = 9 May-28 June; n = 87; Table 14) was 32 days later than the long-term mean (10 May). Clutch sizes averaged 2.4 eggs per nest (range = 1.7 on 14-E to 2.6 on Area B & Border Rock) and seven replacement clutches were recorded. Overall productivity of 0.61 chicks fledged per pair (subarea range = 0.0-1.69) was 70.9% lower than the long-term average of 2.1. Breeding success per nest of 0.38 chicks was much lower than average (0.92) and indicates a high rate of nest abandonment.

Drakes Bay Colony Complex
Nest surveys – No well-built nests or eggs were seen at PRS in 2008 (Table 15). Occasional partially built nests appeared and disappeared, with a peak of two fairly-built nests on 3 July, and indicated that breeding might have occurred but if so, failed quickly.

At MPR, the first well-built nest was observed 23 April on Blue Cheese (MPR-05). The peak count of 11 well-built nests on 6 June was 89% lower than the 2007 MPR peak of 98 nests.

At DPR, Brandt's Cormorants nested on Stormy Stack. The first well-built nests were recorded 24 April. The peak count of 38 nests on 17 May was 39% lower than the peak of 62 nests in 2007.

Bird Island, Lobos Rock and Land's End, Seal Rocks
Nest surveys - Although it's a major seabird roost site, Bird Island rarely hosts breeding Brandt's Cormorants. However, this was the second consecutive year Brandt's Cormorants nested on Bird Island. Prior to 2007, Brandt's Cormorants were last reported nesting at Bird Island in 1990 (Carter et al. 2000). Cormorants nested on the steep northwest side and along the flatter top of the rock. The first territories were observed on 14 May, and the first well-built nests and eggs were recorded on 7 June. A high count of 111 well-built nests was recorded on 26 June. The first chicks were seen on the same day, indicating that clutch initiation actually began in late May.

At Lobos Rock and Land's End, cormorants bred only on the nearshore rock (subcolony 06). A high count of 12 well-built nests was recorded on 20 May. The number of nests decreased (n = 7) by 28 May and only two nests (both brooding chicks) remained on 19 July.

At Seal Rocks, two cormorant territories were observed on 20 May but none bred in 2008.

Devil's Slide Rock and Mainland, San Pedro Rock
Nest surveys – At DSRM, Brandt's Cormorants bred at several mainland subcolonies and subareas, including typical subareas at April's Finger (DSRM-05AF), Upper Mainland South (DSRM-05A-Upper), and Turtlehead (DSRM-05B), and small numbers at atypical subcolonies 03 and 04. Nest and territorial sites were counted at all nesting areas between 22 April and 31 July. Brandt's Cormorants had a delayed and reduced nesting effort in 2008 and did not breed on DSR (DSRM-01) or Lower Mainland South (DSRM-05A-Lower) and only one unsuccessful nest was recorded on Turtlehead. Most nesting occurred on Upper Mainland South. Territorial

sites were first recorded on 22 April and the first well-built nests were recorded on 7 May. Peak counts of well-built nests (n = 77) for all subcolonies were recorded on 16 June, 76% lower than the 2007 peak counts of 322 well-built nests. Counts of well-built nests declined as chicks began to creche and nests were destroyed by heavy use. At subcolonies 03, 04, and part of 05, egg-laying did not occur until the second week of June.

San Pedro Rock did not host breeding Brandt's Cormorants in 2008. A few pairs bred there in 2007.

Productivity – Brandt's Cormorants essentially did not breed in typical monitored areas on DSR and Turtlehead. To avoid potential disturbance to nesting Peregrine Falcons, we could not effectively monitor the main 2008 nesting area on Upper Mainland South. However, 37 sites were monitored on DSR and DSM subcolonies 03, 04, and 05, of which only nine nests were recorded with eggs. Most of these nests were part of a later breeding effort and are not considered to be representative of the whole colony. Thus, 2008 data are not considered to be comparable to past years and are not reported in Table 14 but are reported here.

Of the nine egg-laying nests monitored, the mean clutch initiation date was 10 June (range = 10 May-28 June; n = 7). Clutch sizes averaged 2.25 eggs. No replacement clutches were recorded and only two nests fledged chicks. Overall productivity was 0.22 chicks per pair.

Castle/Hurricane Colony Complex

Nest surveys - Brandt's Cormorant nest surveys were conducted from 18 April to 31 July. Subcolonies with confirmed breeding in 2008 were CRM subcolonies 03East and 06South (North and South sides). The first well-built nest was observed on 18 April, 17 days before the first egg was recorded at monitored nests. A strong heat wave on 15-16 May at least partially explained the abandonment of 16 nests on CRM-03East between 15 and 31 May, most of which had eggs. In the beginning of June, a new wave of nest building occurred, with many nests in the same locations as previously failed nests. Because of poor viewing conditions, nest stages at CRM-06South could not be determined. The peak single-day count of 32 well-built nests on CRM-03East was on 11 May, three days before the mean clutch initiation date. The sum of the high counts for both subcolonies obtained from land was 54 nests (assuming birds sitting on nests at CRM-06South were on well-built nests). Inclusion of 11 additional nests recorded during the boat survey (not visible from land) raised the total 2008 nest count at CHCC to 63 nests (Table 15).

Productivity - Brandt's Cormorant productivity was monitored at 52 nests (32 were egg-laying) at CRM-03East (Table 14). The mean clutch initiation date of 14 May (range = 4 May-12 June, n = 30) was 12 days later than the long-term mean. Average clutch size was 2.5 eggs and no replacement clutches were recorded. However, five clutches that were initiated in newly-built nests on sites previously active but abandoned about one month prior were considered separate, first clutches. First chicks were observed on 5 June. Hatching success was low (36%), leading to low brood sizes. Overall productivity of 0.52 chicks per pair was much lower than the long-term average of 2.0 chicks per pair. Breeding success per nest of 0.33 chicks indicates a high rate of nest abandonment.

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

Nest and bird surveys

High weekly counts of nests (cormorant, gull, oystercatcher) or birds (guillemot) from land, single boat counts, and combined land/boat counts are summarized in Tables 15 and 16. Boat surveys were conducted mainly to survey areas not visible from mainland vantage points. The high land nest count is the sum of high seasonal counts at each subcolony or subarea, and the boat nest count is the total number of nests counted during the boat survey, although boat counts often included only nests that could not be seen from mainland vantage points. Combined counts include the highest count of the two survey methods for each subcolony/subarea, plus any nests known to be visible only with the alternate method. Comparisons to 2007 are made between total counts (when available) or land counts only (where no boat survey was conducted in 2007).

Pelagic Cormorant - Nest counts increased from 2007 at PRH (127 nests to 160 nests), PRS (7 nests to 9 nests), MPR (13 nests to 19 nests), and DSRM (45 nests to 52 nests). However, counts decreased at DPR (8 nests to 0 nests) with no change at CHCC (7 nests; Table 15). No Pelagic Cormorant nests were seen on SPR. Well-built nests and eggs were first observed at DSRM on 21 April and at PRH and DBCC on 19 May. At CRM and HPR, the first well-built nests were recorded on 25 April and the first egg sighting was on 8 May. On HPR-01 the peak count (n = 6) occurred on 11 May but all nests on this subcolony were abandoned by mid-June.

Western Gull - Nest counts increased from 2007 at PRH (164 nests to 181 nests), MPR (8 nests to 15 nests), and CHCC (48 nests to 58 nests), but declined at SPR (14 nests to 8 nests). Gull nest counts were unchanged at other colonies (Table 16).

Pigeon Guillemot - At PRH, the high standardized count from the lighthouse of 117 birds on 21 April was similar to 2007 (n = 113 birds). For entire headlands counts, there was a large decrease from 2007 from both mainland (323 to 233 birds) and boat (454 to 103 birds) surveys (Table 16). The high guillemot counts at DBCC colonies were 24 birds at PRS, 22 birds at MPR, and 34 birds at DPR, although these surveys were not done during standardized times. At the Devil's Slide Colony Complex (SPR and DSRM), the high count of 258 guillemots on 22 April was similar to the 2007 high count (256 birds). Counts were fairly high in April but declined in May presumably because many birds were incubating eggs in nest crevices. The boat count (159 birds) of DSCC was also similar to 2007 (164 birds). No birds were seen carrying fish. At CHCC, the high land count of 41 birds on 26 July was slightly higher than in 2007 (33 birds).

Productivity

Pelagic Cormorant - Nests were monitored at PRH, DSRM, and CHCC (Table 17). At DSRM, the same mainland subcolony (DSRM-04) was followed as in 2007 but sample size increased due to a greater number of nests in 2008. Pelagic Cormorant productivity decreased 43% at PRH and 14% at DSRM from 2007. One Pelagic Cormorant nest was monitored on CRM-07 but was not successful (nest with one egg was abandoned on 25 May).

Black Oystercatcher - Productivity was determined in 2008 at PRH (0.0 chicks/pair; n = 2) and at CRM (0.5 chicks/pair; n = 2).

Western Gulls – Gulls had low breeding success (range = 0.5-1.4 chicks/pair) at all colonies (Table 17). Productivity decreased from 2007 by 70% at PRH and 57% at DSRM, but increased 64% at CRM. At DSRM, low productivity was mainly affected by low fledging success.

Common Raven Surveys – Big Sur

In 2008, 52 Common Raven surveys were conducted along Highway 1 between Pt. Lobos and Point Sur. A total of 30 raven detections were recorded (Figure 22), corresponding to 0.58 ± 0.8 detections/survey (range = 0-3) or 0.022 detections/km. Unlike previous years, the majority of ravens (19; 63%) were detected in the southern portion of the survey area, from Bixby Landing to Point Sur (0.37 detections/survey). Clusters of observations occurred on the north slope of Hurricane Point and north of the Little Sur River mouth. The detection rate of 0.048/km in this region was intermediate between that seen in 2006 and 2007 (0.062/km and 0.020/km, respectively).

In the northern portion of the survey route between Point Lobos and Bixby Landing, the detection rate of 0.016/km was much lower than in 2006 or 2007 (0.036/km and 0.032/km, respectively). A total of 11 ravens were detected in this area, a rate of 0.21 detections/survey. Ravens were most frequently observed near the Soberanes Creek trailhead.

Incidentally, ravens were occasionally observed on the mainland during colony monitoring, especially at Castle pullout, between Bixby Landing and Hurricane Point, and at Rocky Point. However, no nesting pairs were evident near CHCC and none were observed landing on or otherwise disrupting the colonies.

DISCUSSION

Anthropogenic Disturbance

At Point Reyes, overflight observation rates remained at low levels and declined somewhat from 2007. Boat observation rates declined substantially from 2007 and were the lowest since monitoring resumed there in 2005 but were still much higher than pre-2003. Higher boat activity, mainly from small recreational fishing vessels, may be associated with changes in fishing regulations or fishing success in the area. Also, several recreational boats fished within the Point Reyes Headlands State Marine Conservation Area, in violation of recreational take prohibitions. However, disturbance rates were relatively low. Interestingly, the one boat disturbance seen during standardized monitoring was from the only kayak event observed. This and past data have shown that kayaks passing close to colonies tend to elicit disturbance responses from seabirds.

Within the Drakes Bay area, Double Point Rocks continue to show fairly high activity rates of both planes and boats (small recreational, fishing) with low to moderate disturbance rates. The high boat activity rates are likely associated with Double Point's proximity to Bolinas Harbor.

Devil's Slide Rock and Mainland continued to have the highest activity rates for planes, helicopters and boats. High aircraft activity rates were associated with several factors. The main cause is the close proximity to Half Moon Bay Airport, which appears to be gaining in use over time, and probably from aircraft transiting between San Francisco Bay airports and points farther south. Also, the Half Moon Bay Dream Machines event in late April continued to be a source of high aircraft (mainly plane) activity. Disturbance rates also continue to be much higher than any other monitored sites. High boat activity is mainly associated with close proximity to Pillar Point Harbor. All but one major disturbance (displace or flush) was caused by helicopters and boats. Kayaks coming close to shore and transiting between DSR and the mainland caused some of the most severe disturbance events, similar to recent years. Such frequent disturbance, including agitation behaviors, may be having an impact on recruitment and breeding success.

At the Castle/Hurricane Colony Complex, both helicopter and boat activity increased dramatically and were the highest rates recorded in several years. Disturbance rates also increased dramatically and were the highest since at least 2001. Helicopters observed included military (three events) as well as others (private or charter), and all caused disturbance. Higher boat activity and disturbances resulted from small recreational fishing boats and commercial groundfish boats observed during periods of very calm seas. This increase is likely due to displacement from the new Point Sur State Marine Reserve, a formerly productive fishing area now closed to take of living resources.

Non-anthropogenic Disturbance

Similar to other recent years, avian disturbance impacted several murre colonies in 2008. Brown Pelicans caused major disturbances at PRH, PRS, DSRM, and HPR. In some cases, such as at DSRM and HPR, disturbances were caused by flocks of pelicans vying for roosting space. At DSRM, pelican disturbance caused high rates of nest abandonment on both DSR and the mainland. As in other recent years, pelican disturbance at DSRM occurs when few or no Brandt's Cormorants nest in proximity to murres, allowing roosting pelicans to gain easy access to the nesting area. For the second straight year at PRH, pelican disturbances were caused mainly by juveniles that walked through large portions of the Lighthouse Rock colony, resulting in the loss of an unknown number of chicks both inside and (mainly) outside of monitored plots. On a more positive note, no major pelican disturbances were observed at CRM for the first year since 2003, although a major disturbance at HPR-02 in May apparently caused several murres to lose eggs. Disturbances by single juvenile pelicans visiting for days to weeks at a time caused large-scale failure of the CRM colony in 2004-2007 and of HPR in 2007.

Disturbance and predation by Common Ravens continues to impact colonies at PRH and DBCC. Responsible ravens appear to be local resident pairs. Impacts appear to be most severe at DBCC colonies. Observations from this and past years suggest that abandonment of the two major murre subcolonies (North and South Rocks) at MPR in 2008 likely resulted from chronic raven disturbance and nest predation. At CHCC, ravens continued to be observed in the area but no local territorial pairs were evident and no raven disturbance to seabirds was observed. A local breeding pair caused large-scale disturbance, predation and partial abandonment of the CRM colony in 2003 and 2004. After abandoning nesting efforts in 2004 because of raven disturbance, murres finally began breeding again on CRM-03East in 2008.

Attendance Patterns and Reproductive Performance

There was considerable variation among species and colonies in 2008. For Common Murres, attendance patterns were fairly typical at most colonies, with peaks in attendance just prior to the start of egg-laying, relatively stable attendance during the incubation and early chick periods, then declines in attendance during chick fledging. Early breeding at CHCC resulted in early departure of most subcolonies. Some colonies were highly affected by disturbance. Disturbance by pelicans caused nest abandonment and reduced attendance (at least at certain times) at PRH, PRS, DSRM, and HPR. At HPR-02, pelican disturbance in May apparently resulted in egg loss on the 'Hump' subarea. Prolonged attendance there may have resulted from high rates of relaying. Raven disturbance and predation likely resulted in early abandonment of the two main MPR subcolonies (North and South Rocks). At PRH, murres almost always attend or breed at some unestablished, or "ephemeral", subcolonies, usually in association with nesting Brandt's Cormorants. However, in 2008 murres bred only at well-established subcolonies, a result of lower than average numbers of nesting cormorants. At BM227X in CHCC, premature abandonment may have been due to a lack of nesting Brandt's Cormorants, predation, or both.

At DSR, a new high count (961 birds) of murres was established since restoration began in 1996, although the high seasonal count occurred about two weeks later than normal. Despite the higher peak count, overall attendance patterns and numbers of breeding pairs were similar to 2007 although the total number of breeding sites in 2008 was not established. Also typical of the last few years, murre attendance patterns during the breeding season at DSR tend to be more variable than other well-established colonies.

Fascinating was the return of murres and breeding Brandt's Cormorants to Bird Island (Point Bonita) in 2008, where murres were first observed in 2007 (McChesney et al. 2008) along with the first cormorant nesting since 1990 (Carter et al. 2000). In 2008, murre breeding there was documented for the first time. Prior to the start of egg-laying in early June, attendance by murres was fairly low but Brandt's Cormorant numbers were stunningly high, with counts as high as 6,000 roosting birds in late May and early June. Following the start of egg-laying, murre numbers grew quickly and were surprisingly high for a new colony, with a high count of 652 birds. Unfortunately, murres did not return to Seal Rocks, where small numbers were observed in 2007, probably because no Brandt's Cormorants bred there in 2008.

Murre breeding phenology was earlier than average at both PRH and CRM but four days later than average at DSR. The first egg of the year at CRM (21 April) was the earliest recorded to date. Productivity was higher than average at PRH and CRM, although productivity was somewhat below average at CRM if years with no major pelican disturbances are excluded. Productivity was 15% below the long-term mean at DSR and extremely low at DSM. Later than average breeding at DSRM likely reflected disruption of breeding activities by Brown Pelicans and possibly anthropogenic disturbance, and low breeding success was mainly caused by these factors as well. However, despite fairly high fledging success (87.3%) and apparently productive ocean conditions, murre coattendance patterns at DSR were 13% lower than average, suggesting that parent birds had to spend more time foraging to provision chicks. This continued a trend observed since 2005.

Brandt's Cormorants had their poorest showing in several years, with delayed colony arrival, delayed breeding, low numbers of breeding pairs, high nest abandonment, and overall low productivity at all colonies. At DSRM, this was our first year since monitoring began that a sample of nests comparable to past years was not followed. The poor nesting effort in 2008 is surprising given the large colony sizes and high cormorant productivity in other recent years, especially 2006-2007, and upwelling-enriched ocean conditions in 2008 (McClatchie et al. 2008). Interestingly, feeding flocks of thousands of cormorants were observed just off the mouth of the Golden Gate for most of the season, and thousands roosted on nearby Bird Island in late May with some remaining to breed.

Contrary to Brandt's Cormorants, numbers of breeding Pelagic Cormorants and Western Gulls increased from 2007 at most colonies. However, breeding success was low and declined from 2007 at PRH and DSRM. Similar to Brandt's Cormorants, low productivity by these species is surprising given continued strong upwelling conditions along the central California coast (McClatchie et al. 2008).

Recommendations for future management, monitoring and research

Additional outreach, education, and enforcement are needed to reduce aircraft disturbance at the Devil's Slide Rock and Mainland colony. Aircraft activity and disturbance there has increased dramatically since the early 2000s and threatens the continued recovery of this restored colony. The establishment of Special Closures around major nesting colonies, as proposed for several Gulf of the Farallones colonies in the California Marine Life Protection Act Initiative, should substantially reduce disturbance to seabirds from boats. However, appropriate information will need to be provided to boaters to assure that closure boundaries are known and closures will need enforcement. Given increased boating activity and disturbance at CHCC in 2008, Special Closures should be considered for those colonies as well.

While annual aerial surveys of Gulf of the Farallones murre, Brandt's Cormorant and Double-crested colonies continued in 2008 (in cooperation with California Department of Fish and Game and U.C. Santa Cruz), no funds are currently available to count nests and birds from the photographs. These aerial surveys have provided the baseline for assessing population trends of these species since the 1980s and must be continued to track the success of murre recovery as well as murre and cormorant population changes caused by natural and anthropogenic sources. From 1996-2006, these counts were funded by the *Apex Houston* Trustee Council.

Research is needed to help explain the odd behavior more frequently observed in juvenile Brown Pelicans, where individuals land in, walk through, and cause total chaos in murre colonies. Captures of some of these individuals for health assessments would help determine whether or not such behavior is associated with poor health.

Additional research on factors affecting murre, Brandt's Cormorant, and other seabird breeding effort and success are needed. For example, in at least two of the last three years, Brandt's Cormorants have shown atypical patterns that are not understood. In 2006 when upwelling was poor, ocean conditions were warm and unproductive, and most seabirds performed poorly, Brandt's Cormorants bred in high numbers and had high breeding success. In 2008, the opposite occurred. In 2007 and 2008, both La Niña years (McClatchie et al. 2008), breeding effort and performance among species were mixed. While this may be lasting effects of the unusually low upwelling years of 2005-2006, they may also signify other changes, perhaps even brought about by long-term climate change. More research on foraging ecology, including prey use and foraging areas, would help assess these changes.

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Table 1. Monitoring effort of study colonies or colony complexes, November 2007 to September 2008.

Colony/Colony Complex	Start date	End date	No. of obs. days	Total hours	Person hours
Point Reyes	21 Apr 08	25 Aug 08	98	440.4	576.4
Millers Point Rocks	23 Apr 08	23 July 08	14	22.1	26.5
Point Resistance	23 Apr 08	23 July 08	14	17.37	20.5
Double Point Rocks	24 Apr 08	2 Aug 08	15	49.02	62.0
Bird Island (Point Bonita, MA)	24 Apr 08	29 July 08	15	23.93	24.27
Lobos Rock and Land's End[1]	24 Apr 08	26 July 08	9	2.60	3.02
Seal Rocks[1]	24 Apr 08	26 July 08	9	6.48	8.52
Devil's Slide Rock & Mainland[2]					
Pre-breeding season	7 Nov 07	11 Apr 08	12	27.30	32.02
Breeding season	17 Apr 08	27 Aug 08	104	570.83	778.85
San Pedro Rock[2]					
Pre-breeding season	8 Nov 07	11 Apr 08	10	5.95	7.72
Breeding season	21 Apr 08	31 July 08	37	41.98	45.07
Castle/Hurricane Colony Complex[3]					
Pre-breeding season	14 Mar 08	14 Mar 08	1	0.5	0.5
Breeding season	18 Apr 08	11 Aug 08	78	320.5[2]	383.7

[1] No monitoring conducted between 8 June and 18 July 2008 due to a lack of murre attendance and cormorant breeding activity.
[2] Total effort at the "Pipe Pullout" vantage point, where both Devil's Slide Rock and San Pedro Rock can be observed, was recorded simultaneously for both colonies. In previous years, effort for each colony was recorded separately depending on which colony was actually observed.
[3] Does not include Common Raven survey hours (25.63 h).

Table 2. 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, 2008. Total number observed and number per observer hour are reported.

Source	Total Obser-vations	No. Obs/hr	No. Disturbance Events			No. Disturbance Events/hr	
			A	D	F	Total/hr[1]	Flush or Displace/ hr
Plane	14	0.032	0	0	0	0	0
Helicopter	2	0.005	0	0	1	0.002	0.002
Boat	20	0.045	0	0	1	0.002	0.002
Humans on foot	-	-	0	0	1	0.002	0.002
Total	36	0.082	0	0	3	0.007	0.007

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 3. Numbers of events and mean (range) numbers of Common Murres (COMU), Brandt's Cormorants (BRCO), Pelagic Cormorants (PECO), Brown Pelicans (BRPE), Western or Unknown Gulls (WEGU/UNGU), Black Oystercatchers (BLOY), and Pigeon Guillemots (PIGU) flushed or displaced at Point Reyes, 2008.

Source	Mean No. Seabirds Flushed/ Displaced	COMU Disturbance		BRCO Disturbance		PECO Disturbance		BRPE Disturbance		WEGU/UNGU Disturbance		BLOY Disturbance		PIGU Disturbance	
		No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds
Plane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopter	30	1	30	0	0	0	0	0	0	0	0	0	0	0	0
Boat	44	1	40	1	3	1	1	0	0	0	0	0	0	0	0
Other	26	0	0	0	0	0	0	0	0	1	6	0	0	1	20
Total	27.5 (10-44)	2	35 (30-40)	2	6.5 (3-10)	1	1	0	0	1	6	0	0	1	20

Table 4. 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 Resistance, 2008. Total number observed and number per observer hour are reported.

			No. Disturbance Events			No. Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/ hr[1]	Flush or Displace/ hr	Mean No. Seabirds Flushed/ Displaced	No Events	Mean No. birds	No Events	Mean No. birds	No. Events	Mean No. birds
Plane	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopter	1	0.058	0	0	0	0	0	0	0	0	0	0	0	0
Boat	0	0.00	0	0	0	0.00	0.00	0	0	0	0	0	0	0
Total	1	0.058	0	0	1	0.058	0.058	150	1	100	1	50	0	0

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 5. Numbers of observed boats and aircraft and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at Double Point Rocks, 2008. Includes total numbers observed and numbers per observer hour.

			No. Disturbance Events			No. Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/hr[1]	Flush or Displace/hr	Mean No. Seabirds Flushed/Displaced	No Events	Mean No. birds	No Events	Mean No. birds	No. Events	Mean No. birds
Plane	5	0.102	3	0	0	0.061	0.000	0	0	0	0	0	0	0
Helicopter	0	0	0	0	0	0.000	0.000	0	0	0	0	0	0	0
Boat	4	0.082	0	0	1	0.020	0.020	60	0	0	1	50	1	10
Total	9	0.184	3	0	1	0.082	0.020	60	0	0	1	50	1	10

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 6. Numbers of observed boats and aircraft and resulting disturbances to all seabirds, Common Murres (COMU), Brandt's Cormorants (BRCO), and Brown Pelicans (BRPE) at Bird Island (Point Bonita), 2008. Total number observed and number per observer hour are reported.

			No. Disturbance Events			No. Disturbance Events/hr			COMU Disturbance		BRCO Disturbance		BRPE Disturbance	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/ hr[1]	Flush or Displace/ hr	Mean No. Seabirds Flushed/ Displaced	No Events	Mean No. birds	No Events	Mean No. birds	No. Events	Mean No. birds
Plane	0	0.0	0	0	0	0.0	0.0	0	0	0	0	0	0	0
Helicopter	1	0.042	0	0	0	0.0	0.0	0	0	0	0	0	0	0
Boat	4	0.167	0	0	1	0.042	0.042	800	0	0	1	800	0	0
Total	5	0.209	0	0	1	0.042	0.042	800	0	0	1	800	0	0

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 7. Numbers and hourly rates of observed boats, aircraft overflights, and resulting disturbances to all seabirds at Seal Rocks, 2008.

			No. Disturbance Events			No. Disturbance Events/hr	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/hr[1]	Flush or Displace/hr
Plane	1	0.154	0	0	1	0.154	0.154
Helicopter	1	0.154	0	0	0	0	0
Boat	1	0.154	0	0	0	0	0
Other	1	0.154	0	0	0	0	0
Total	4	0.616	0	0	0	0.154	0.154

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 8. Numbers of events and mean (range) numbers of Common Murres (COMU), Brandt's Cormorants (BRCO), Pelagic Cormorants (PECO), Brown Pelicans (BRPE), Western or Unknown Gulls (WEGU/UNGU), Black Oystercatchers (BLOY), and Pigeon Guillemots (PIGU) flushed or displaced at Seal Rocks, 2008.

		COMU Disturbance		BRCO Disturbance		PECO Disturbance		BRPE Disturbance		WEGU/UNGU Disturbance		BLOY Disturbance		PIGU Disturbance	
Source	Mean No. Seabirds Flushed/ Displaced	No. Events	Mean No. birds.	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds
Plane	10	0	0	0	0	0	0	0	0	1	10	0	0	0	0
Helicopter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10	0	0	0	0	0	0	0	0	1	10	0	0	0	0

Table 9. Numbers and hourly rates of observed boats, aircraft overflights, and resulting disturbances to all seabirds at Devil's Slide Rock and Mainland, 2008.

			No. Disturbance Events			No. Disturbance Events/hr	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/hr[1]	Flush or Displace/hr
Plane	224	0.392	70	1	0	0.124	0.002
Helicopter	43	0.075	26	0	8	0.060	0.014
Boat	32	0.056	5	1	10	0.028	0.019
Other (motorcycle)	-	-	1	0	0	0.002	0.0
Total	299	0.524	102	2	18	0.214	0.035

[1] Events where birds exhibited agitation or alert behaviors (A), flushing (F), or displacement (D).

Table 10. Numbers of events and mean (range) numbers of Common Murres (COMU), Brandt's Cormorants (BRCO), Pelagic Cormorants (PECO), Brown Pelicans (BRPE), Western or Unknown Gulls (WEGU/UNGU), Black Oystercatchers (BLOY), and Pigeon Guillemots (PIGU) flushed or displaced at Devil's Slide Rock and Mainland, 2008.

		COMU Disturbance		BRCO Disturbance		PECO Disturbance		BRPE Disturbance		WEGU/UNGU Disturbance		BLOY Disturbance		PIGU Disturbance	
Source	Mean No. Seabirds Flushed/ Displaced	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds
Plane	15	0	0	1	15	0	0	0	0	0	0	0	0	0	0
Helicopter	25 (1-80)	7	24 (1-80)	5	32 (5-70)	0	0	0	0	0	0	1	2	0	0
Boat	52 (2-345)	3	5 (2-10)	11	83 (3-345)	0	0	1	5	4	20 (2-50)	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	41 (1-345)	10	18 (1-80)	17	64 (3-345)	0	0	1	5	4	20 (2-50)	1	2	0	0

Table 11. Numbers and hourly rates of observed boats, aircraft overflights, and resulting disturbances to all seabirds at the Castle/Hurricane Colony Complex, 2008.

			No. Disturbance Events			No. Disturbance Events/hr	
Source	Total Obser-vations	No. Obs/hr	A	D	F	Total/hr[1]	Flush or Displace/hr
Plane	18	0.056	9	0	0	0.028	0.0
Helicopter	8	0.025	4	0	4	0.025	0.012
Boat	14	0.044	3	0	3	0.019	0.009
Other	-	-	1	0	0	0.003	0.0
Total	40	0.125	17	0	7	0.075	0.022

[1] Events where birds exhibited agitation (A), flushing (F), or displacement (D).

Table 12. Numbers of events and mean (range) numbers of Common Murres (COMU), Brandt's Cormorants (BRCO), Pelagic Cormorants (PECO), Brown Pelicans (BRPE), Western or Unknown Gulls (WEGU/UNGU), Black Oystercatchers (BLOY), and Pigeon Guillemots (PIGU) flushed or displaced at the Castle/Hurricane Colony Complex, 2008.

		COMU Disturbance		BRCO Disturbance		PECO Disturbance		BRPE Disturbance		WEGU/UNGU Disturbance		BLOY Disturbance		PIGU Disturbance	
Source	Mean No. Seabirds Flushed/ Displaced	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds	No. Events	Mean No. birds
Plane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopter	35 (10-60)	4	30 (10-60)	1	20	0	0	0	0	0	0	0	0	0	0
Boat	6 (3-10)	2	7.5 (5-10)	1	3	0	0	0	0	0	0	0	0	0	0
Total	19.8 (3-60)	6	22.5 (5-60)	2	11.5 (3-20)	0	0	0	0	0	0	0	0	0	0

Table 13. Common Murre breeding phenology and reproductive success at Point Reyes (2 plots and combined), Devil's Slide Rock and Mainland (DSR, 3 plots; DSM; and combined), and Castle Rocks and Mainland (2 plots), 2008. Means (range; n) are reported.

Colony/Plot	No. Sites Monitored	No. Egg Laying Sites	Mean Lay Date[1]	No. Eggs Laid	Mean Hatch Date	Hatching Success[2]	Mean Fledge Date	Fledging Success[3]	Chicks Fledged per Pair
Point Reyes (PRH)									
PRH-Ledge	80	64	20 May (5/3-6/9;63)	72	24 June (6/10-7/20; 46	72.2% (72)	17 July (7/4-7/27; 48)	92.3% (52)	0.75 (64)
PRH-Edge	60	49	25 May (5/13-6/12;38)	53	27 June (6/16-7/13; 26)	62.3% (53)	18 July (7/8-7/26; 27)	81.8% (33)	0.55 (49)
PRH- (combined)	140	113	22 May (5/3-6/12;101)	125	25 June (6/10-7/20;72)	68.0% (125)	17 July (7/4-7/27;75)	88.2% (85)	0.66 (113)
Devil's Slide Rock and Mainland (DSRM)									
DSR-A	85	74	29 May (5/6-6/24; 66)	91	5 July (6/19-7/24; 37)	51.6% (91)	29 July (7/13-8/8; 39)	83.0% (47)	0.53 (74)
DSR-B	81	55	27 May (5/5-6/27; 44)	69	6 July (6/21-8/5; 28)	44.9% (69)	28 July (7/15-8/12; 30)	96.8% (31)	0.55 (55)
DSR-C	35	9	20 May (5/12-5/28; 9)	12	18 July (7/18; 1)	8.3% (12)	N/A	0.0% (1)	0.0 (9)
DSR (combined)	201	138	28 May (5/5-6/27; 119)	172	6 July (6/19-8/5; 66)	45.9% (172)	28 July (7/13-8/12; 69)	87.3% (79)	0.50 (138)
DSM	115	67	30 May (5/11-6/20; 44)	71	29 June (6/24-7/13; 10)	18.3% (71)	24 July (7/13-8/5; 11)	84.6% (13)	0.16 (67)
DSR, DSM (combined)	316	205	28 May (5/5-6/27; 163)	243	5 July (6/19-8/5; 76)	37.9% (243)	28 July (7/13-8/12; 80)	87.0% (92)	0.39 (205)
Castle Rocks and Mainland (CRM)									
CRM-04	116	83	4 May (4/21-6/20; 55)	86	4 June (5/22-6/29; 60)	76.2% (86)	26 June (6/13-7/9; 47)	75.8% (62)	0.57 (83)
CRM-03B	50	36	6 May (4/27-5/31;13)	36	8 June (5/30-6/28; 16)	61.1% (36)	28 June (6/20-7/8; 17)	81.8% (22)	0.50 (36)

Table 13 (con't).

[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).

Table 14. Brandt's Cormorant breeding phenology and reproductive success at Point Reyes and Castle Rocks and Mainland, 2008. Reported are means (range; n).

Colony/ Subcolony	No. Sites Monitored	Clutch Initiation Date[1]	Clutch Size[1]	No. Chicks Hatched/Pair[2]	Hatching Success[2]	Fledging Success[2]	Breeding Success[2]	No. Chicks Fledged/Pair[2]	Breeding Success/Nest[3]
Point Reyes									
Area C (PRH-06C)	70	13 June (5/9-6/28; 55)	2.3 (1-4; 67)	1.29 (0-3; 65)	57.5% (0-100; 146)	35.2% (0-100; 71)	17.6% (0-100; 148)	0.41 (0-2; 63)	0.30 (63)
PRH-14A	19	7 June (5/31-6/20; 17)	2.6 (1-4; 19)	2.00 (0-3; 19)	76% (0-100; 50)	84.4% (0-100; 32)	65.8% (0-100; 41)	1.69 (0-3; 16)	0.88 (16)
Area B (PRH-14B)	22	13 June (5/21-6/24; 14)	2.6 (1-4; 19)	1.44 (0-3;18)	56.5% (0-100; 46)	45.8% (0-100; 24)	23.9% (0-100; 46)	0.52 (0-2; 21)	0.33 (21)
Border Rock (PRH-14C)	2	13 May (5/13-5/13; 2)	1 (1-1; 2)	0.00 (0; 2)	0% (0; 2)	0% (0; 0)	0% (0; 2)	0.00 (0; 2)	0.00 (2)
PRH-14E	3	20 June (6/20-6/20; 1)	1.7 (1-2; 3)	0.0 (0; 3)	0% (0; 5)	0% (0; 0)	0% (0; 5)	0.00 (0; 3)	0.00 (3)
Total - Point Reyes	116	11 June (5/9-6/28; 87)	2.4 (1-4; 110)	1.38 (0-3; 107)	59.4% (0-100; 249)	49.6% (0-100; 127)	23% (0-100; 242)	0.61 (0-3; 105)	0.38 (105)
Castle Rocks and Mainland	52	14 May (5/4-6/12; 30)	2.5 (1-4; 32)	0.81 (0-3; 42)	36% (0-100; 81)	65% (0-100; 34)	23% (0-100; 81)	0.52 (0-3; 42)	0.33 (42)

[1] Includes first clutches only.
[2] Includes replacement clutches. See text for details.
[3] Breeding success per nest is defined as the proportion of egg-laying nests that fledged at least one chick.

Table 15. High counts of nests for Brandt's Cormorant (BRCO) and Pelagic Cormorant (PECO), obtained during land, boat, and combined land/boat counts (total) in 2008. ND = No Data.

Species	Colony	Land[1]	Boat	Total Count[2]
Brandt's Cormorant	Point Reyes	156	0[3]	156
	Point Resistance	2	0[3]	2
	Miller's Point Rocks	15	3[3]	18
	Double Point Rocks	38	0[3]	38
	Bird Island (Point Bonita)	160	ND	160
	Lobos Rock and Land's End	20	ND	20
	Seal Rocks	0	ND	0
	Devil's Slide Rock and Mainland	121	0[3]	121
	San Pedro Rock	0	0	0
	Bench Mark-227X	0	0	0
	Castle Rocks and Mainland	52	11[3]	63
	Hurricane Point Rocks	2	0[3]	2
Pelagic Cormorant	Point Reyes	18	142	160
	Point Resistance	5	7	9
	Miller's Point Rocks	12	7	19
	Bird Island (Point Bonita, MA)	0	ND	0
	Lobos Rock and Land's End	0	ND	0
	Seal Rocks	0	ND	0
	Double Point Rocks	0	0	0
	Devil's Slide Rock and Mainland	48	52[4]	52[4]
	San Pedro Rock	0	0	0
	Bench Mark-227X	0	0	0
	Castle Rocks and Mainland	1	1	2
	Hurricane Point Rocks	6	1	6

[1] Sum of high seasonal counts at each subcolony or subarea.
[2] Nests that may have been counted on both land and boat surveys were included only once towards the total nest count.
[3] For Brandt's Cormorants, only nests that could not be seen from mainland vantage points were counted.
[4] Includes one empty nest.

Table 16. High counts of nests for Black Oystercatcher (BLOY) and Western Gull (WEGU), and of birds for Pigeon Guillemot (PIGU), obtained during land, boat, and combined land/boat counts (total count), in 2008. ND = No Data.

Species	Colony	Land[1]	Boat[2]	Total Count[3]
Black Oystercatcher	Point Reyes	2	0	2
	Point Resistance	0	0	0
	Miller's Point Rocks	1	0	1
	Double Point Rocks	1	0	1
	Bird Island (Point Bonita)	0	ND	0
	Lobos Rock and Land's End	0	ND	0
	Seal Rocks	2	ND	2
	Devil's Slide Rock and Mainland	0	0	0
	Bench Mark-227X	0	0	0
	Castle Rocks and Mainland	2	0	2
	Hurricane Point Rocks	1	1	2
Western Gull	Point Reyes	145	43	181
	Point Resistance	1	0	1
	Miller's Point Rocks	11	4	15
	Double Point Rocks	7	11	15
	Bird Island (Point Bonita)	16	ND	16
	Lobos Rock and Land's End	3	ND	3
	Seal Rocks	26	ND	26
	Devil's Slide Rock and Mainland	13	12	16
	San Pedro Rock	7	7	7
	Bench Mark-227X	7	7	11
	Castle Rocks and Mainland	15	9	18
	Hurricane Point Rocks	9	25	29
Pigeon Guillemot	Point Reyes	233[4]	103	-
	Point Resistance	24	9	-
	Miller's Point Rocks	22	10	-
	Double Point Rocks	34	21	-
	Devil's Slide Colony Complex	258	160	-
	Castle/Hurricane Colony Complex	41	4	-

[1] Sum of high seasonal counts at each subcolony or subarea.
[2] In several cases, oystercatcher and gull nests were counted only if they could not be seen from mainland vantage points.
[3] Oystercatcher and gull nests that may have been counted on both land and boat surveys were included only once towards the total count.
[4] Single day survey of entire Point Reyes colony.

Table 17. Productivity of Pelagic Cormorants, Black Oystercatchers, and Western Gulls at Castle Rocks and Mainland, Devil's Slide Rock and Mainland, and Point Reyes in 2008. Reported are means (range; n).

	Castle Rocks and Mainland				Devil's Slide Rock and Mainland				Point Reyes			
Species	N	No. of Chicks Fledged	Chicks Fledged/ Pair	Breeding Success/ Nest[1]	N	No. of Chicks Fledged	Chicks Fledged/ Pair	Breeding Success/ Nest[1]	N	No. of Chicks Fledged	Chicks Fledged/ Pair	Breeding Success/ Nest[1]
Pelagic Cormorant	1	0	0.0 (0;1)	0.00 (1)	26	45	1.8 (0-3; 25)	0.73 (26)	14	21	1.5 (0-3;14)	0.79 (14)
Black Oystercatcher	2	1	0.5 (0-1; 2)	0.50 (2)	0	-	-	-	2	0	0.0 (0;2)	0.00 (2)
Western Gull	9	13	1.4 (0-2; 9)	0.78 (9)	10	6	0.6 (0-2; 10)	0.30 (10)	12	9	0.5 (0-2;12)	0.42 (12)

[1] Breeding success per nest is defined as the proportion of egg-laying nests that fledged at least one chick.

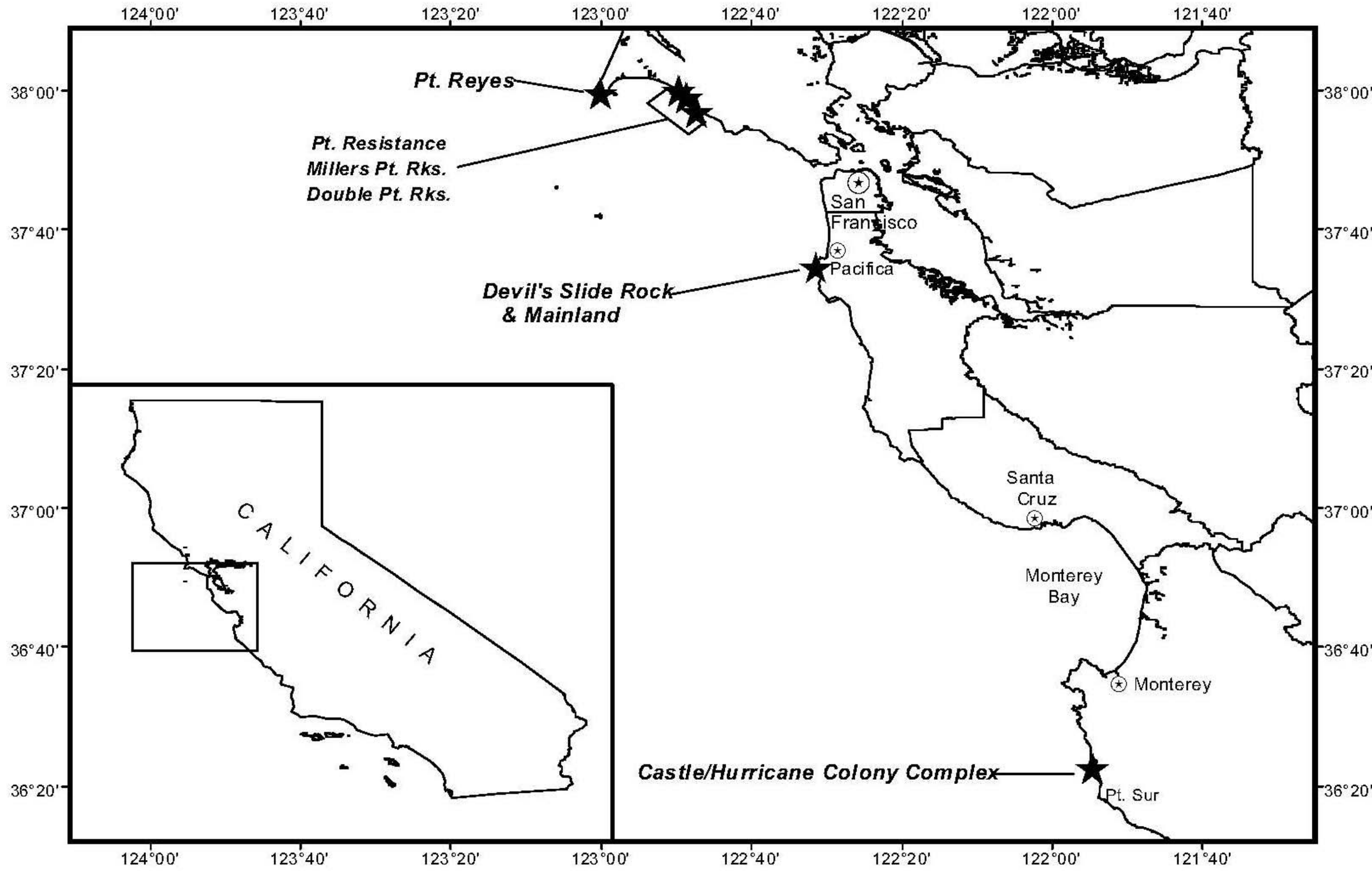


Figure 1. Map of the study area showing locations of study colonies or colony complexes.

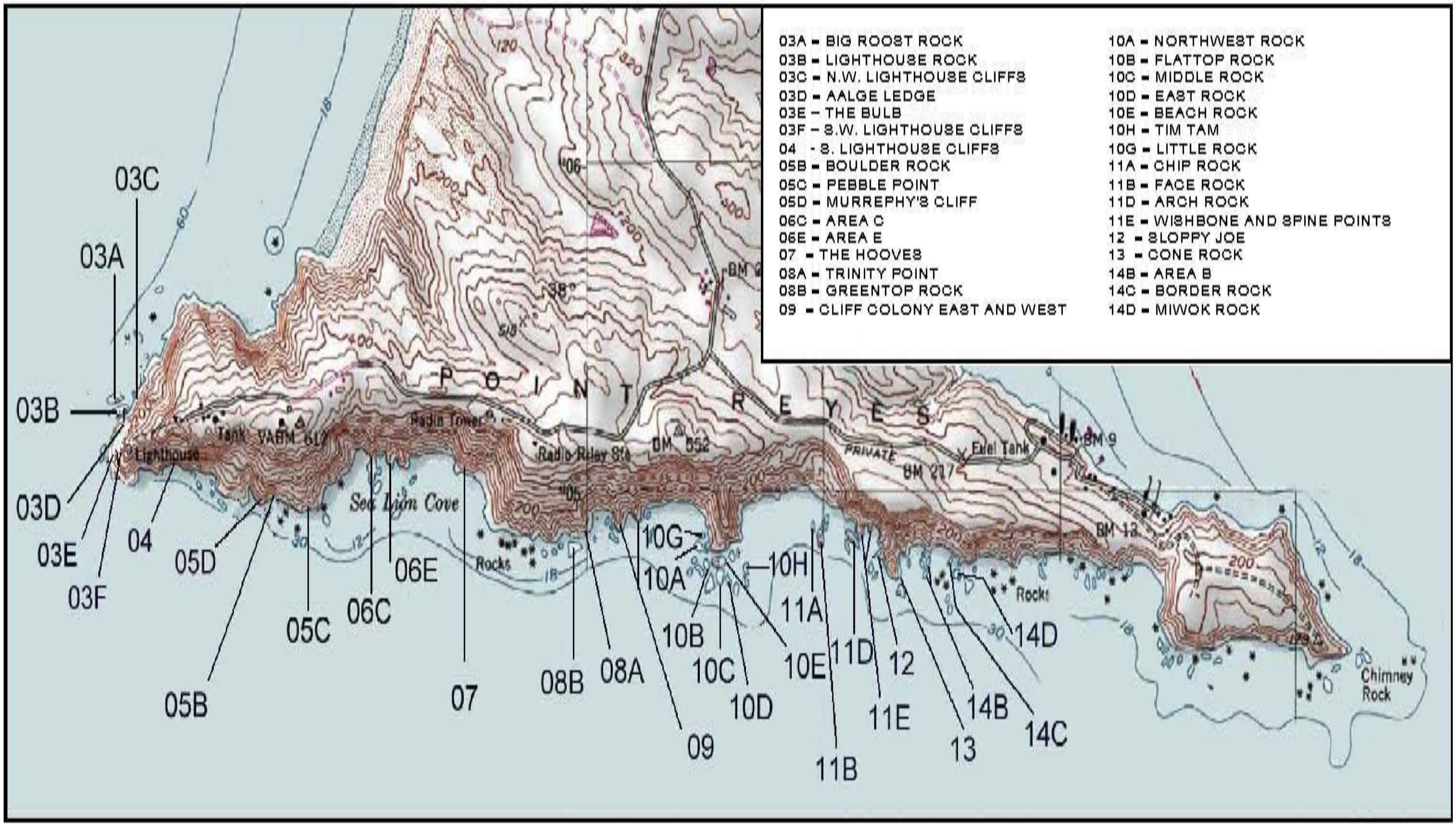


Figure 2. Map of the Point Reyes colony, including subcolonies mentioned in this report.

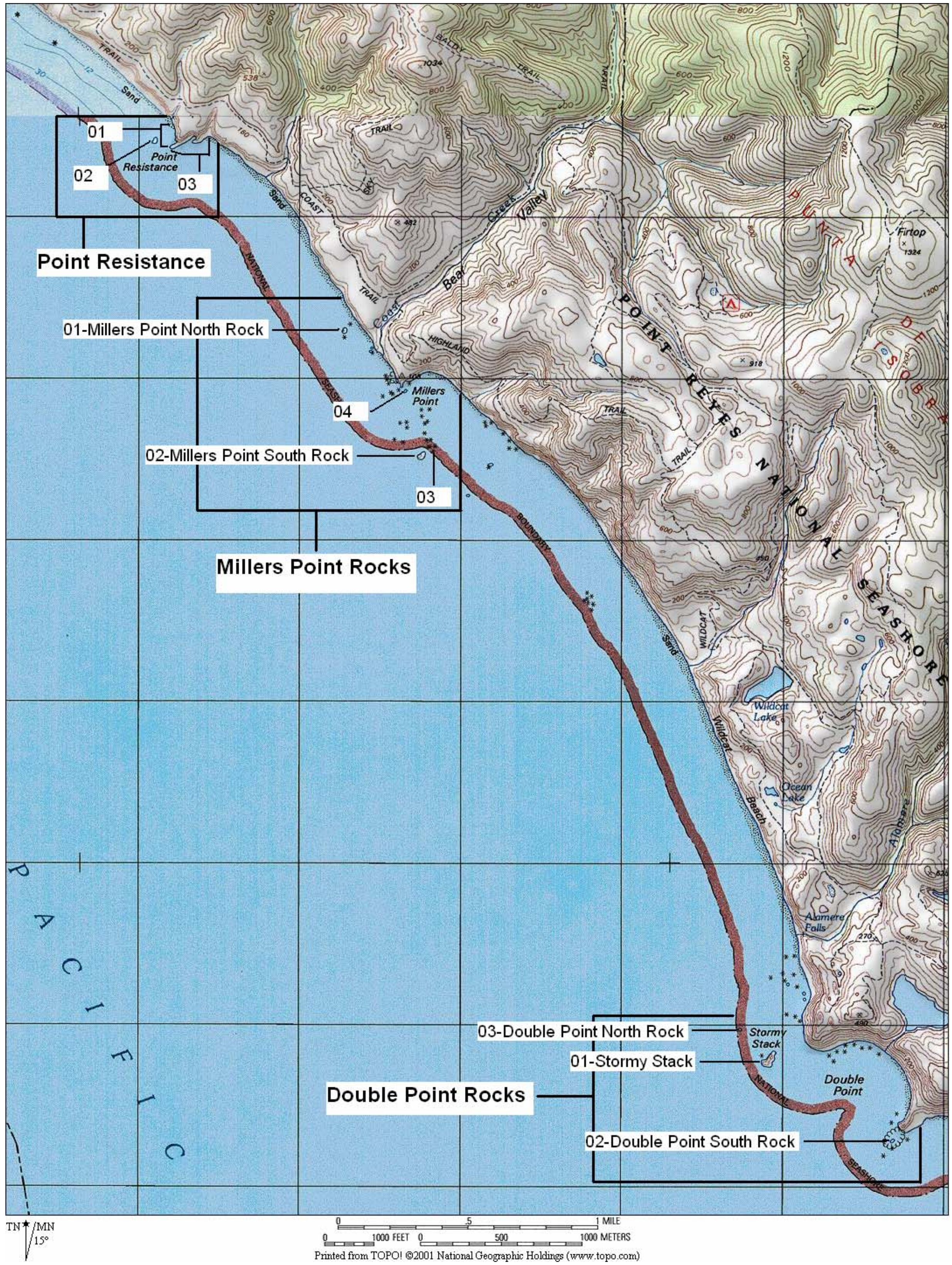


Figure 3. Map of the Drakes Bay Colony Complex, including Point Resistance, Millers Point Rocks and Double Point Rocks colonies and subcolonies.

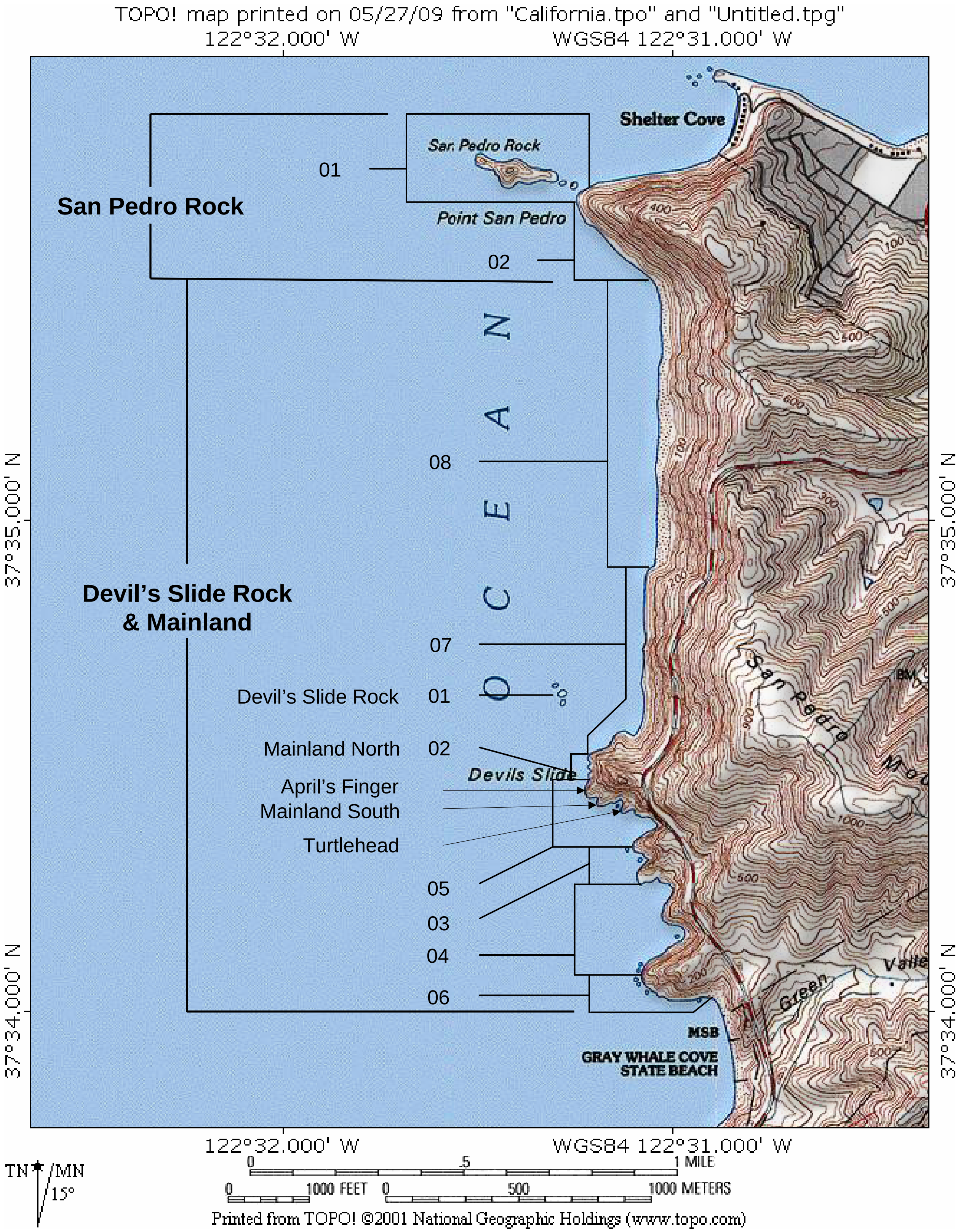


Figure 4. Map of the Devil's Slide Colony Complex, including San Pedro Rock and Devil's Slide Rock & Mainland colonies and subcolonies.

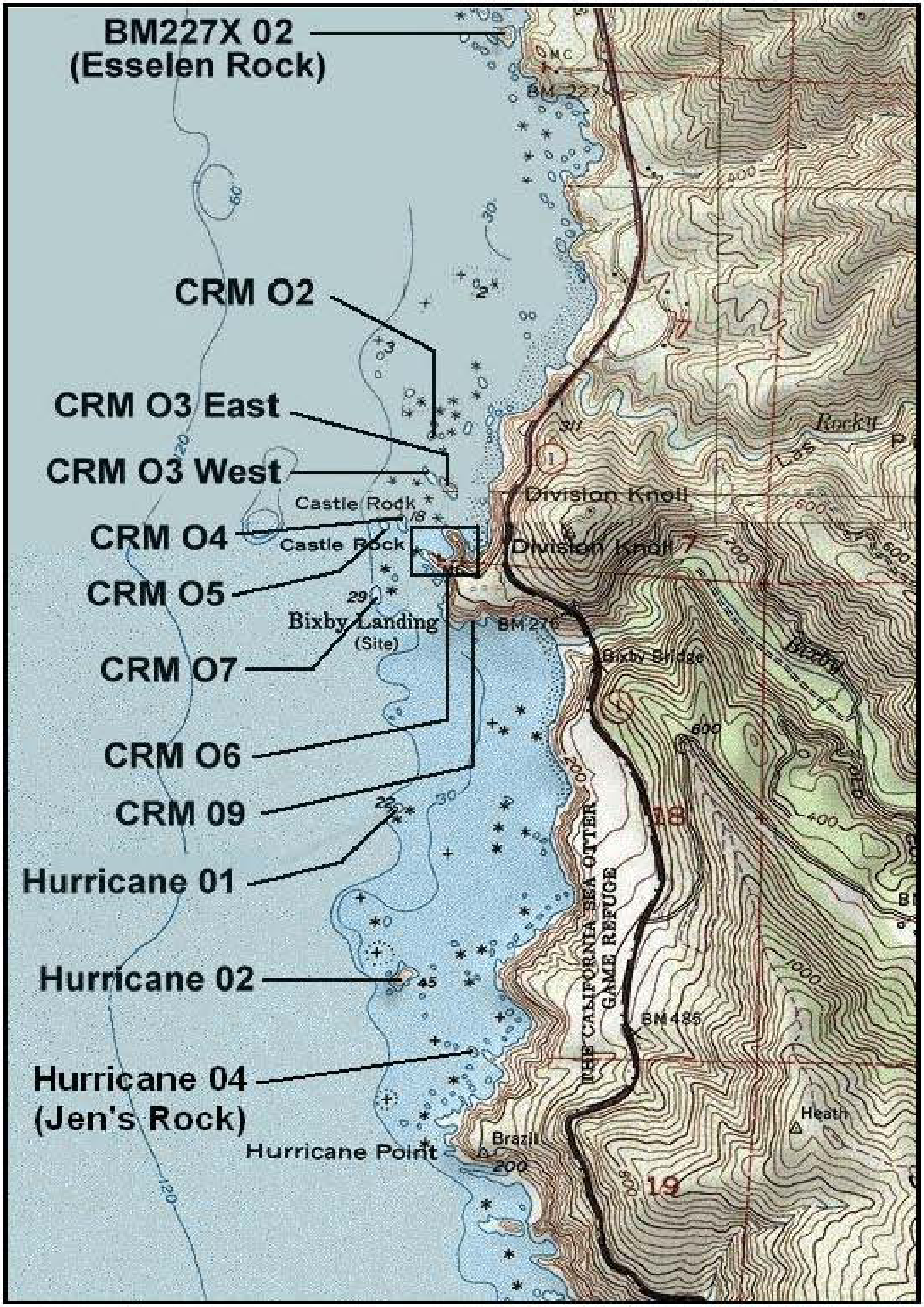


Figure 5. Map of the Castle/Hurricane Colony Complex, including Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (Hurricane) colonies and subcolonies.

Figure 6. Map of colonies monitored at the mouth of the Golden Gate, including Bird Island, Lobos Rock and Land's End, and Seal Rocks.

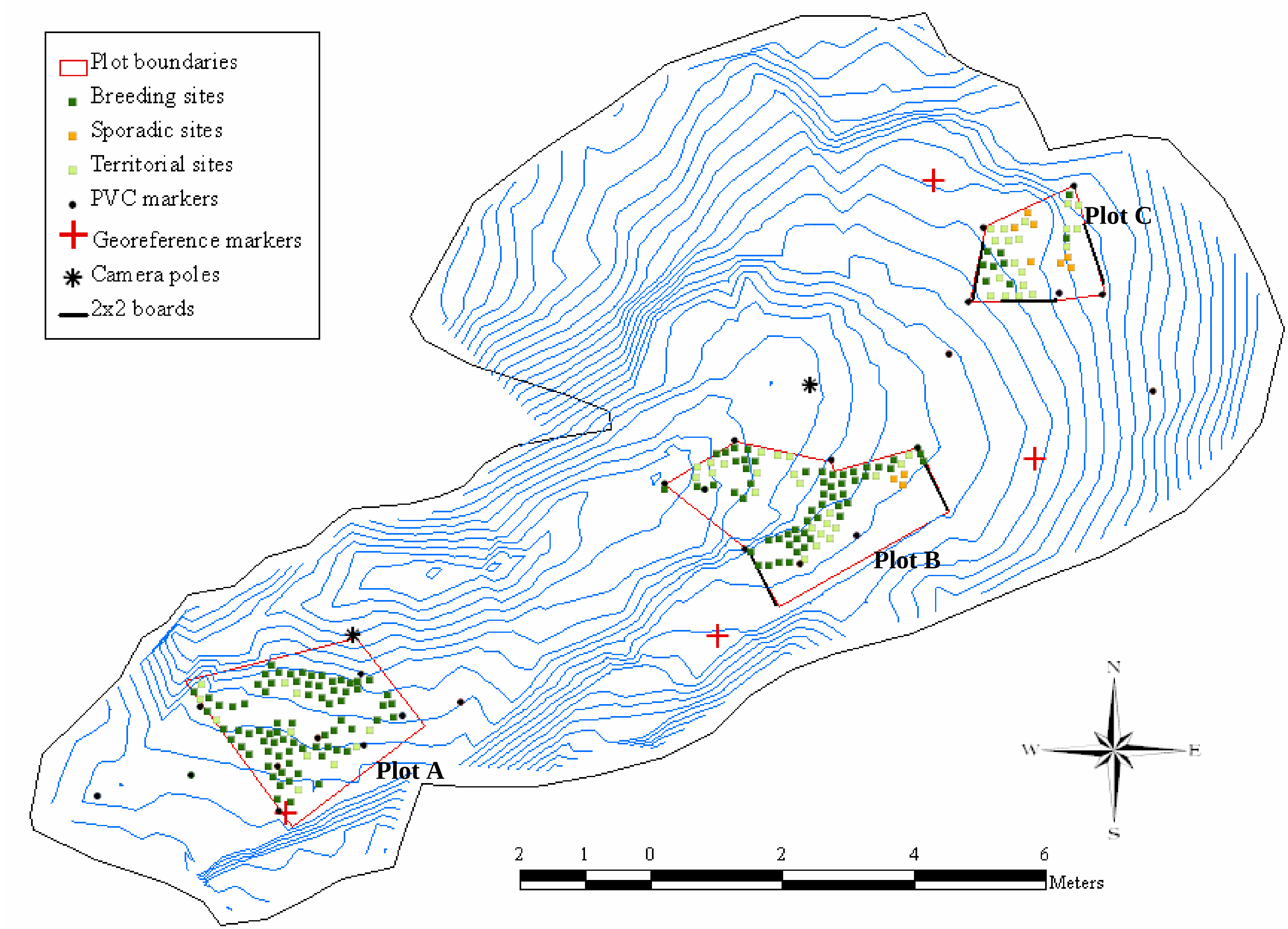


Figure 7. GIS map of Devil's Slide Rock, 2008. Shown are Common Murre breeding, territorial, and sporadic sites, plot boundaries, markers, and other features.

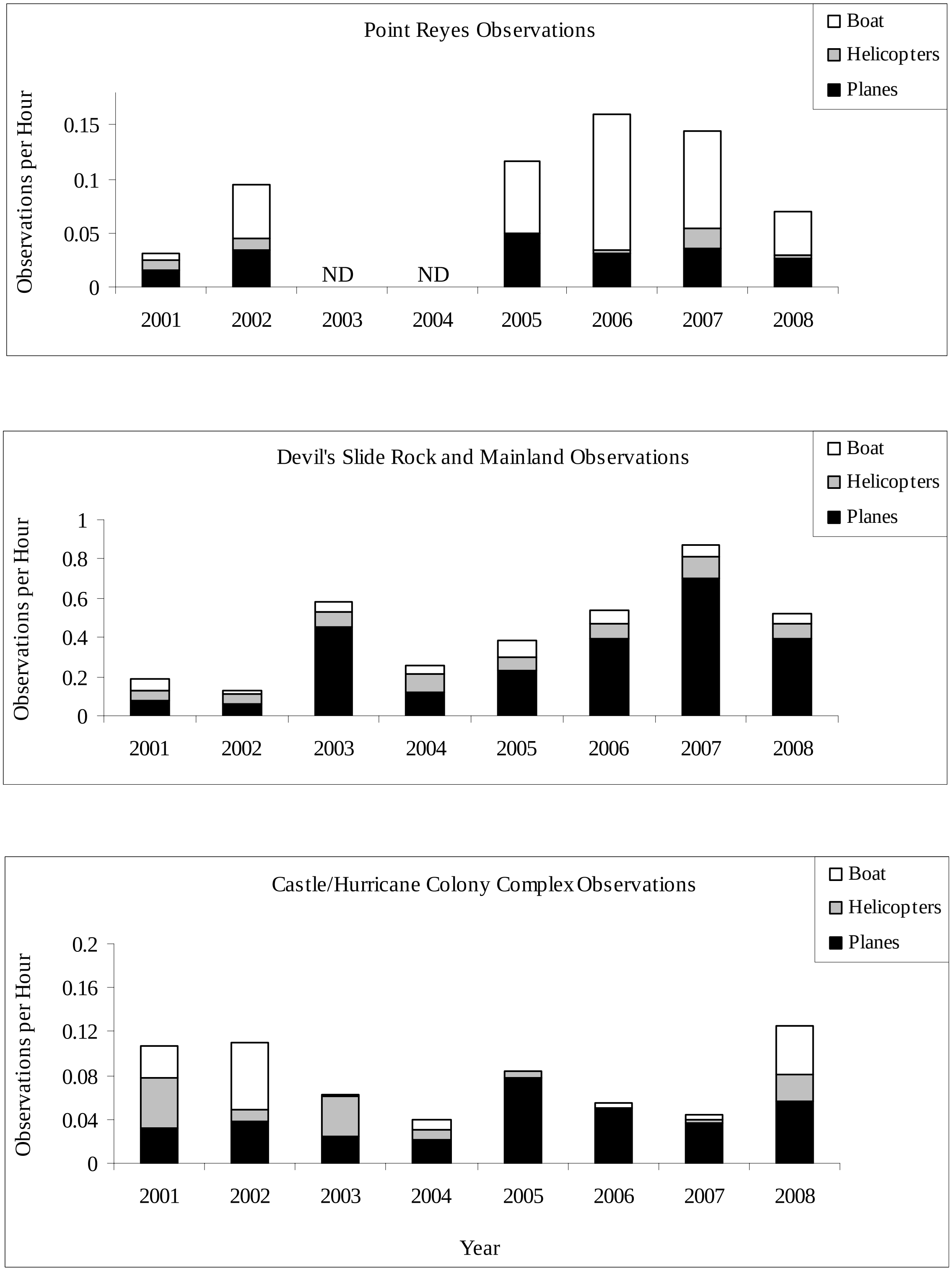
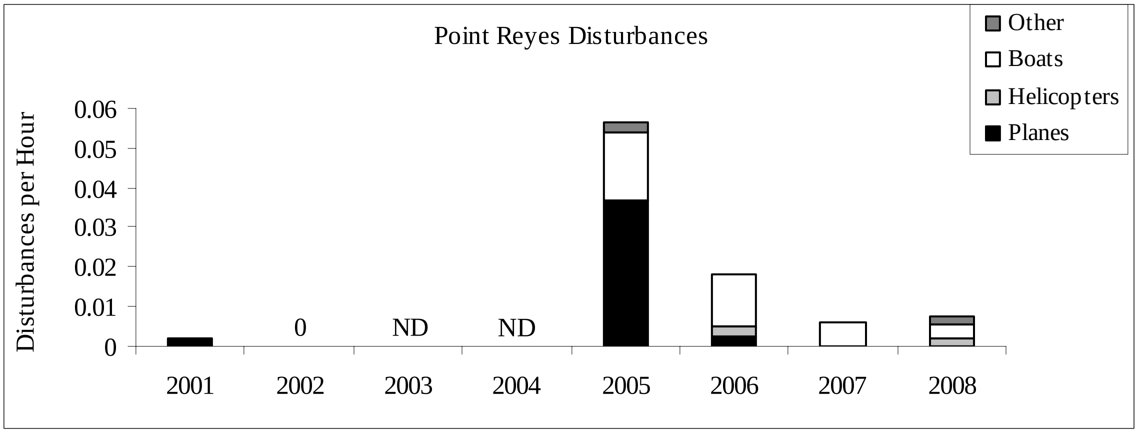
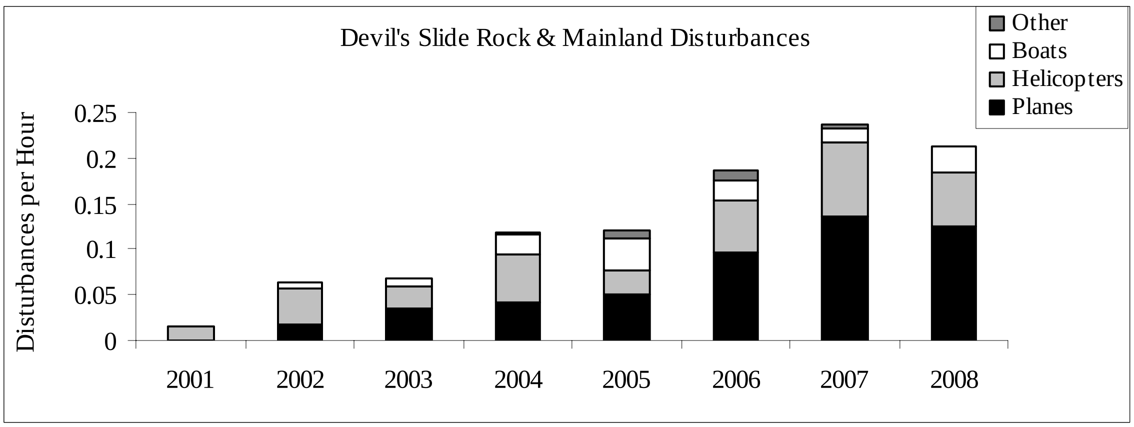


Figure 8. Observation rates (numbers/observation hour) of boats, helicopters, and planes at Point Reyes, Devil’s Slide Rock and Mainland, and Castle/Hurricane Colony Complex, 2001 to 2008.





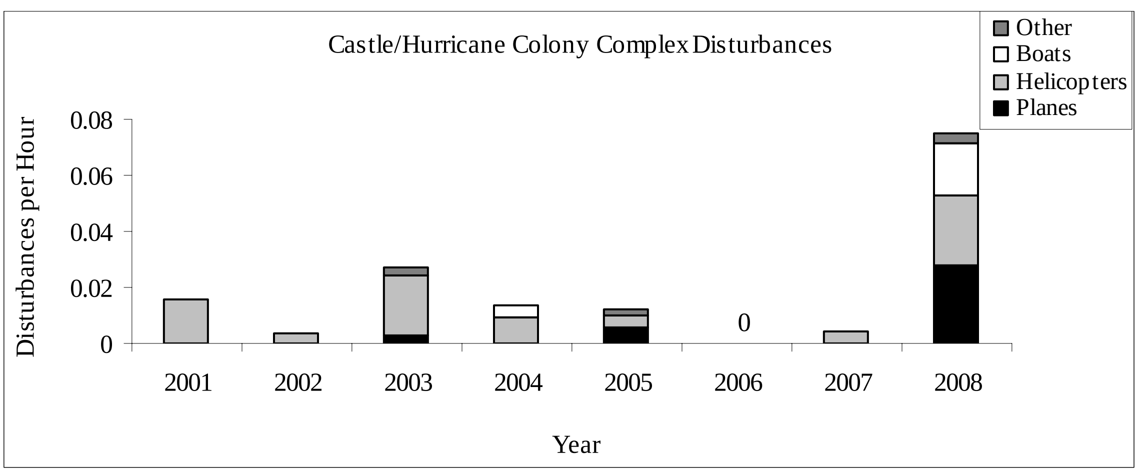


Figure 9. Disturbance rates (numbers per observation hour) of seabirds from boats, helicopters, planes, and other human sources at Point Reyes, Devil's Slide Rock and Mainland, and the Castle/Hurricane Colony Complex, 2001-2008.

Figure 10. Digiscoped photos of the east side of Devil's Slide Rock during Brown Pelican disturbances on 23 May 2008 (upper) and 4 July 2008 (lower). Note eggs exposed in the upper photo, and chick exposed and adults displaced in the lower photo.

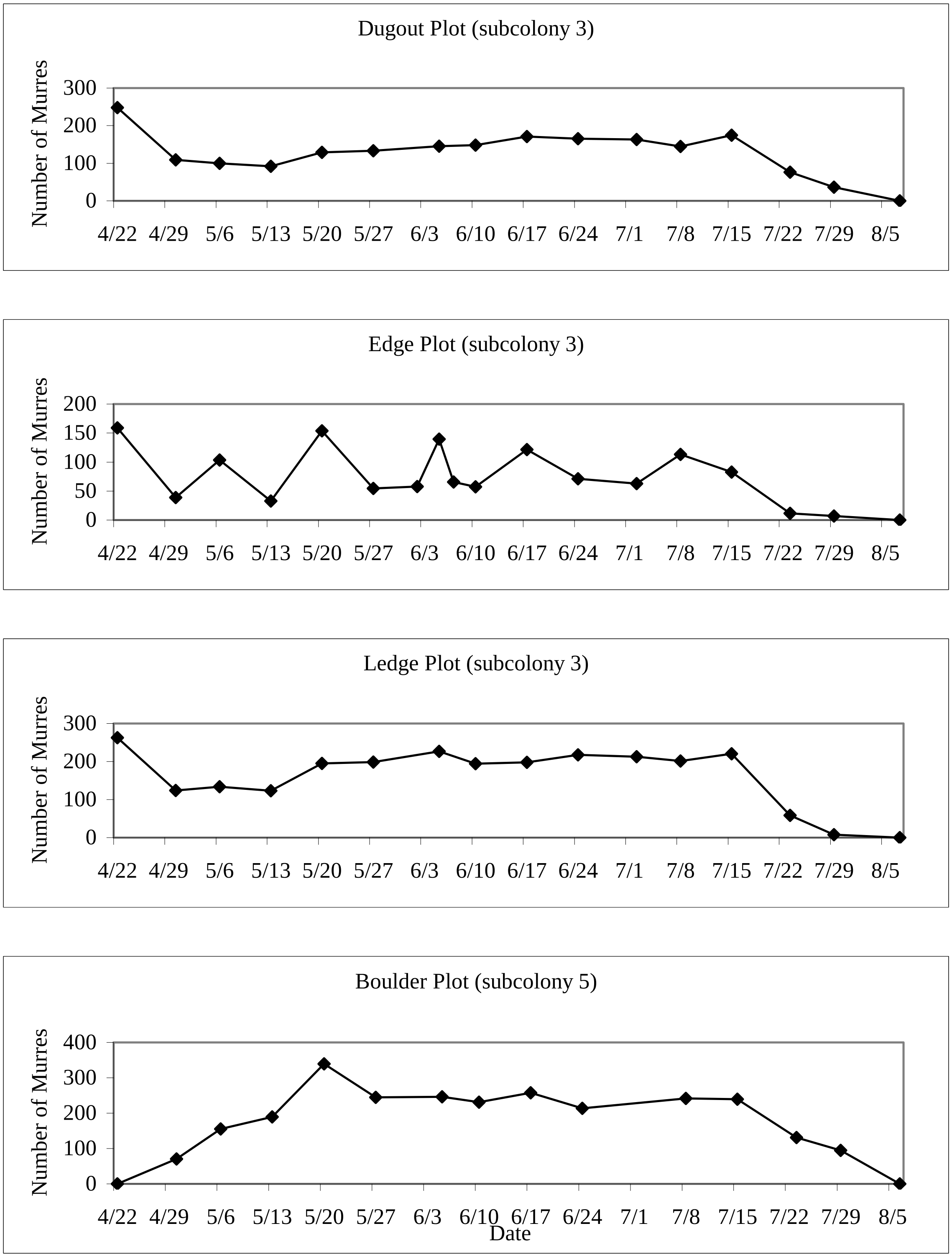


Figure 11. Seasonal attendance patterns of Common Murres at four index plots (3 on Lighthouse Rock: Dugout, Edge, and Ledge plots, and one on Boulder Rock), Point Reyes, 22 April to 5 August, 2008.

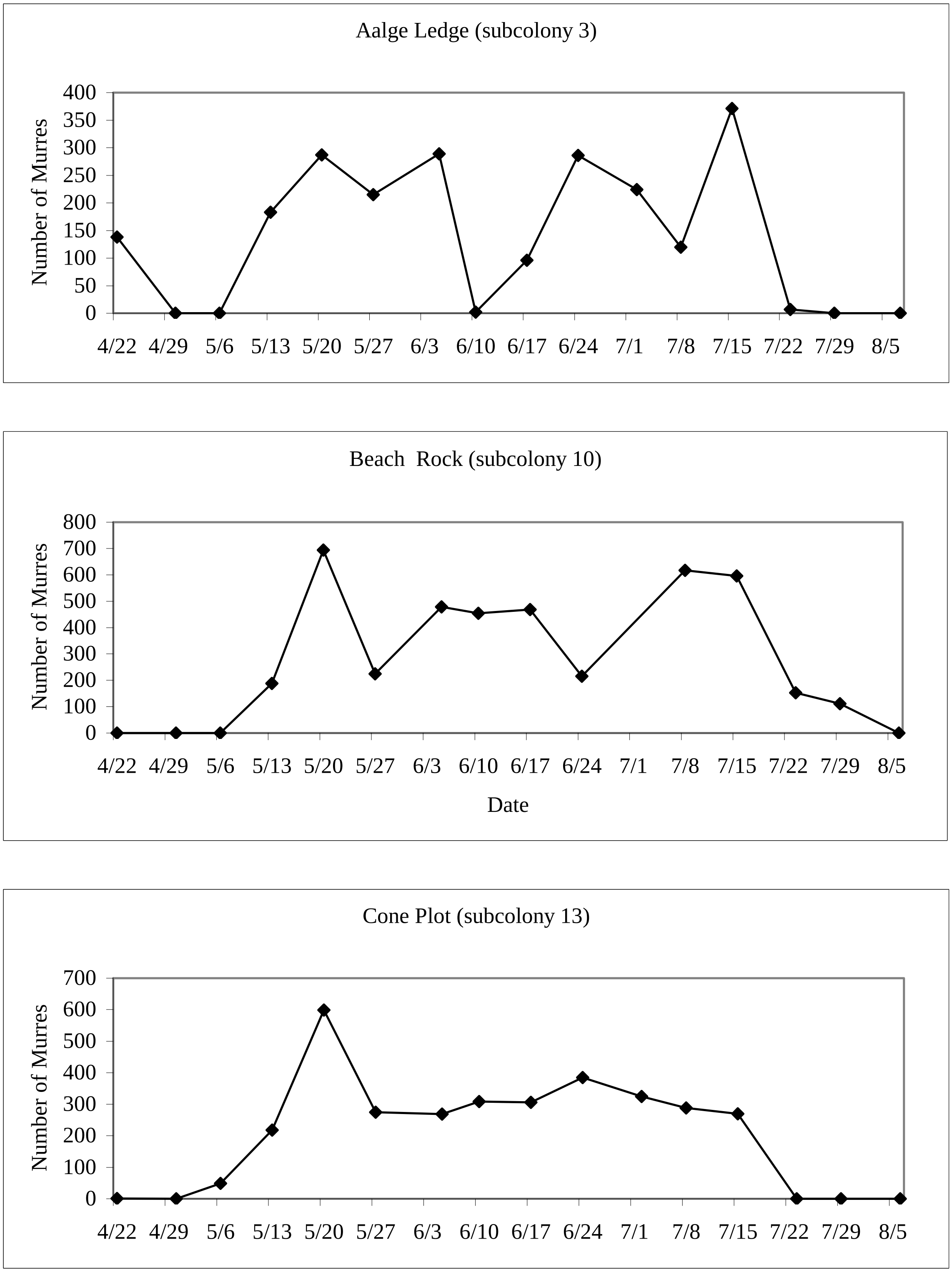


Figure 12. Seasonal attendance patterns of Common Murres at Aalge Ledge, Beach Rock, and Cone Rock (one index plot), 22 April to 5 August 2008.

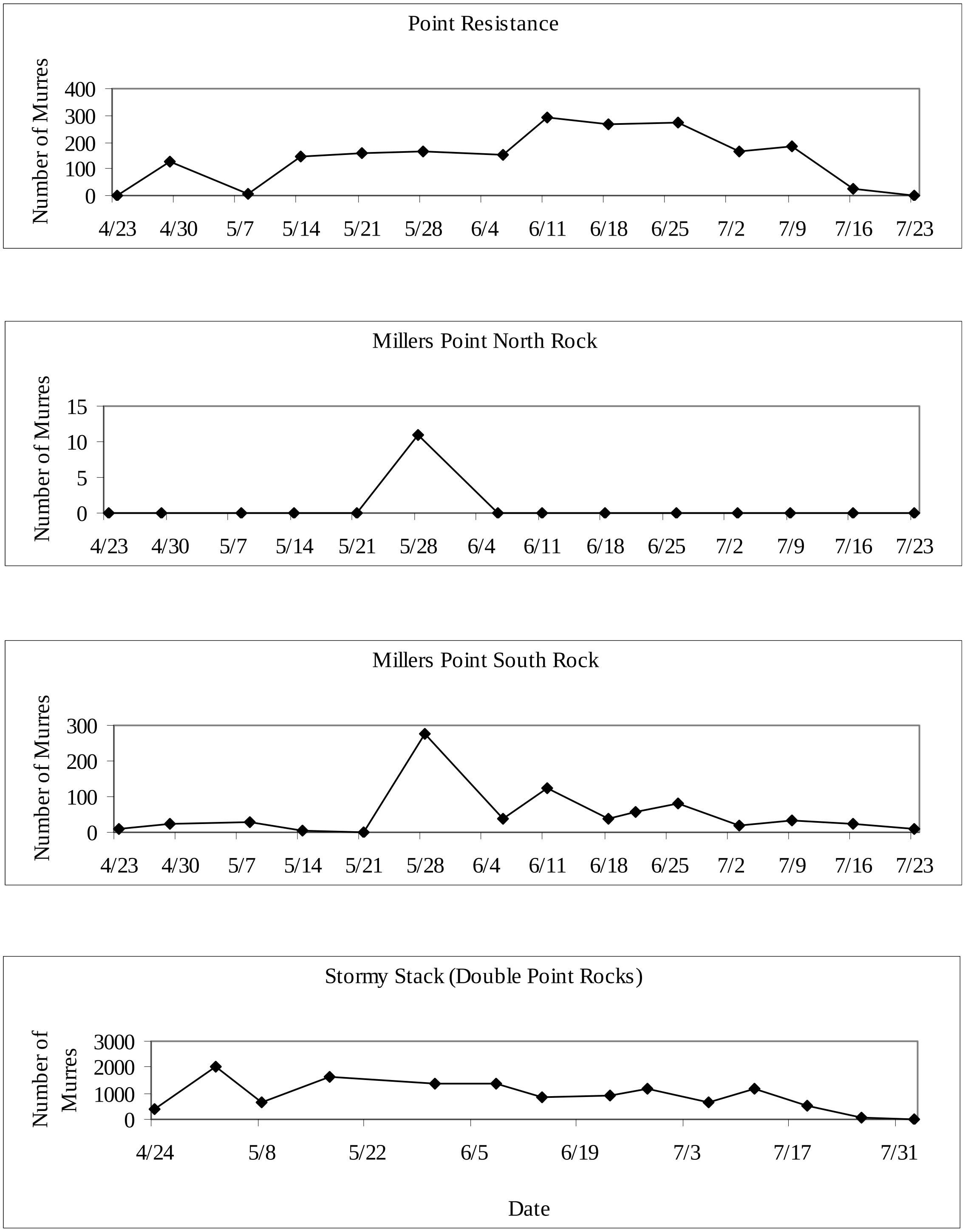


Figure 13. Seasonal attendance patterns of Common Murres at Point Resistance (four index plots combined), Miller's Point Rocks (North and South Rocks), and Double Point Rocks (Stormy Stack; five index plots combined), 23 April to 31 July, 2008.

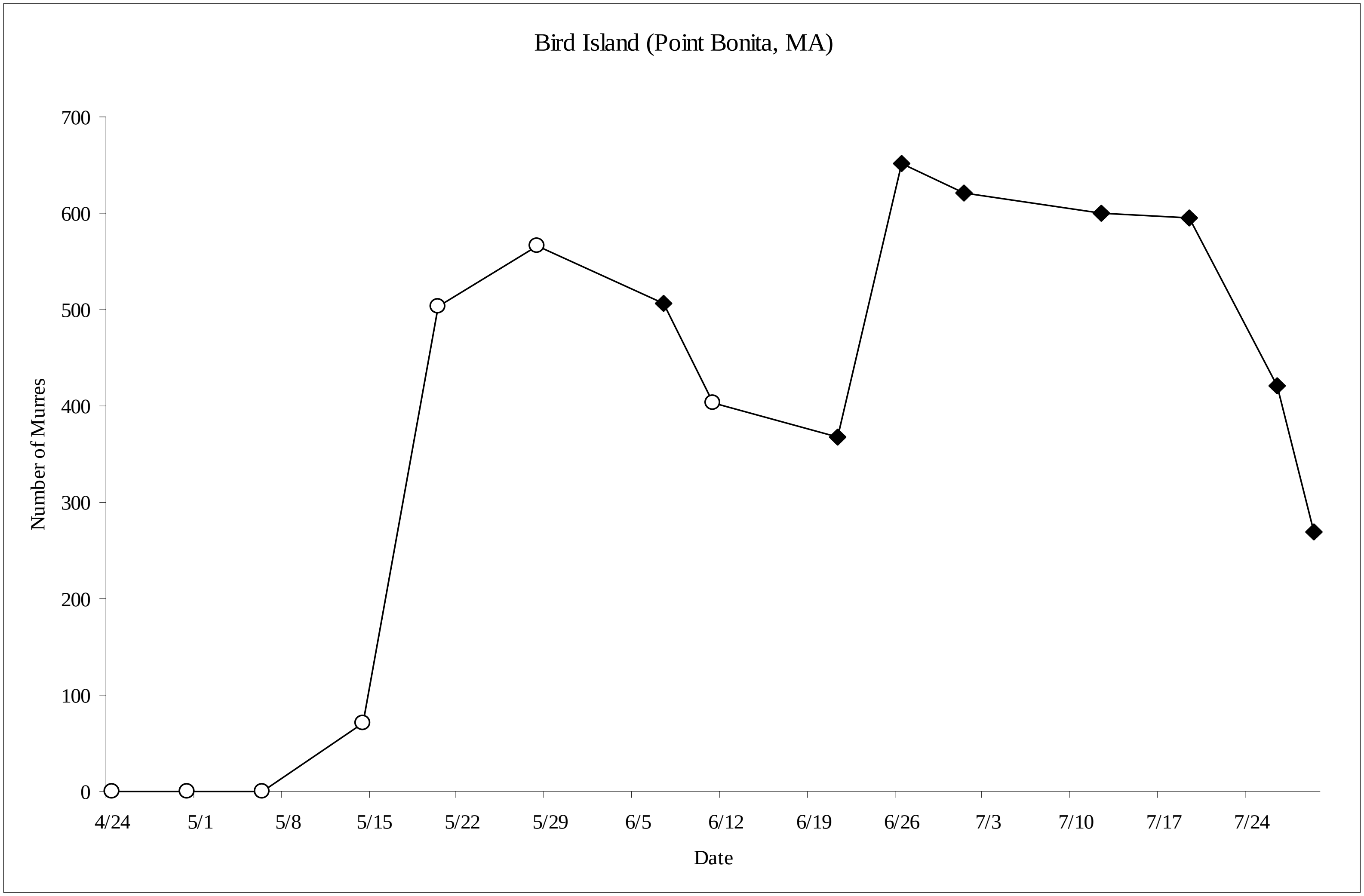


Figure 14. Seasonal attendance patterns of Common Murres at Bird Island (Point Bonita), 24 April to 29 July 2008. Open circles include counts conducted from Rodeo Beach, and solid diamonds include counts conducted from Rodeo Bluff (north end of Rodeo Beach). Counts prior to 6 June 2008 were conducted between 0700-1100 h; subsequent counts (following breeding confirmation) were conducted between 1000-1400 h.

Figure 15. Aerial photograph of the west end of Bird Island (Point Bonita), showing Common Murres among nesting and roosting Brandt's Cormorants, 7 June 2008.

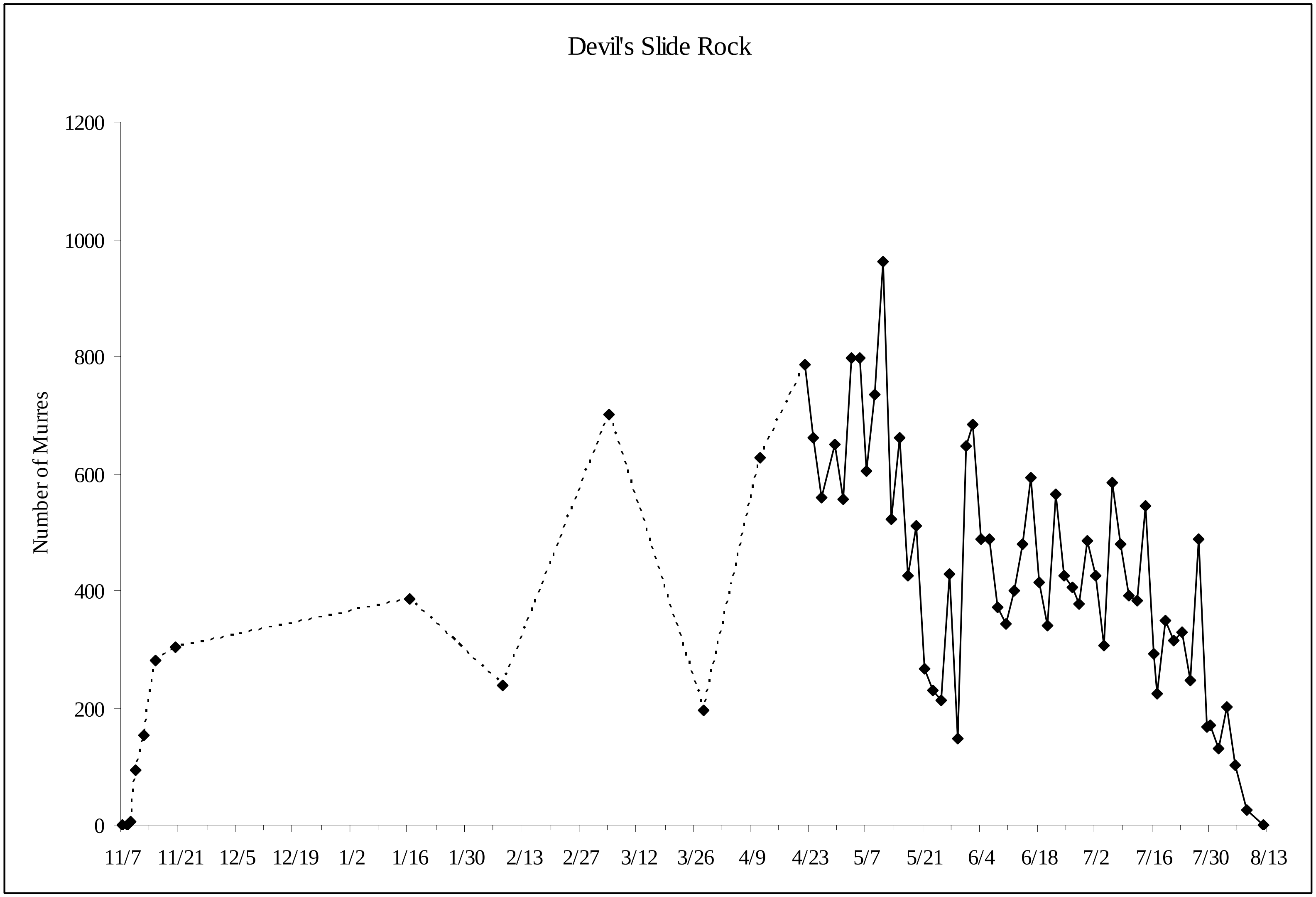
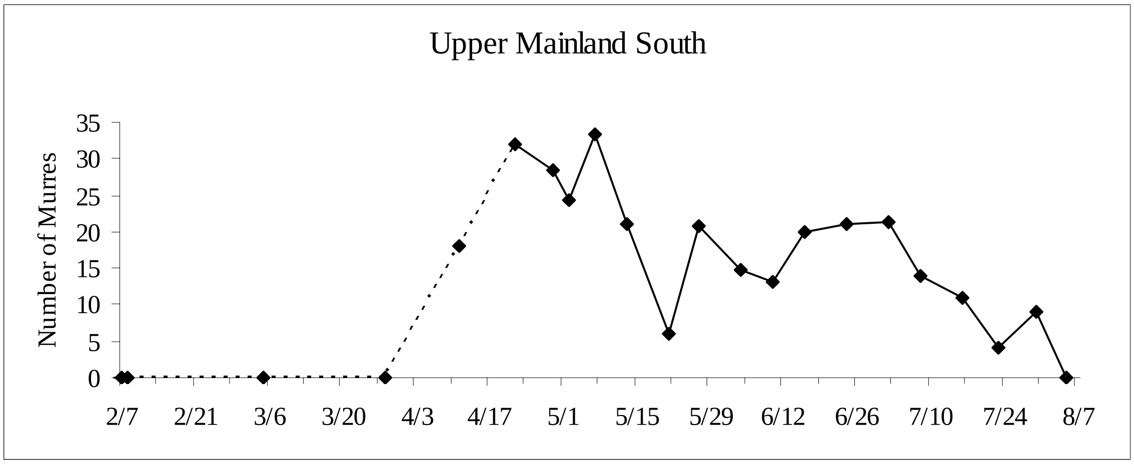
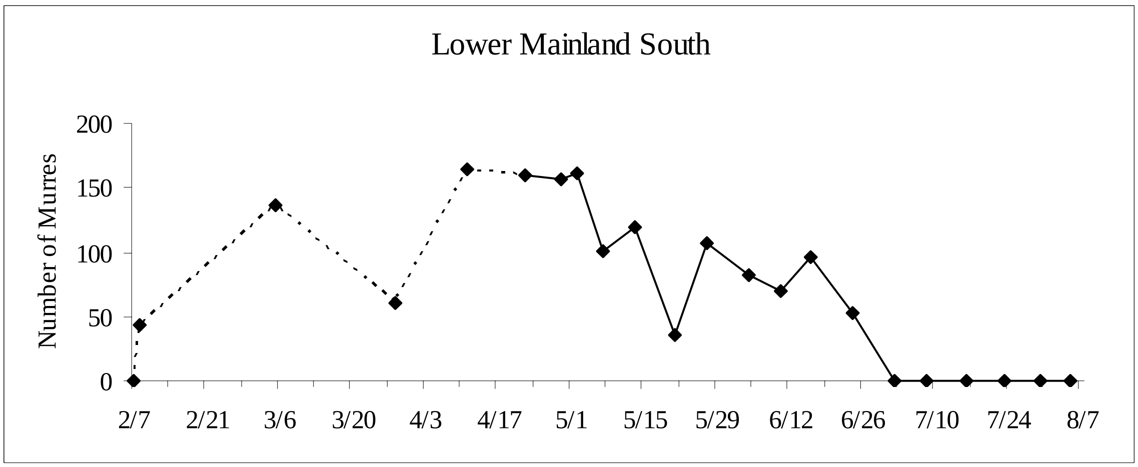


Figure 16. Seasonal attendance patterns of Common Murres at Devil's Slide Rock, 7 November 2007 to 12 August 2008. Dashed line indicates pre-breeding season counts and solid line indicates breeding season counts.

Figure 17. Aerial photograph of Devil's Slide Rock, 6 June 2008, showing the distribution of the Common Murre breeding colony and roosting Brandt's Cormorants. Note the lack of nesting cormorants.





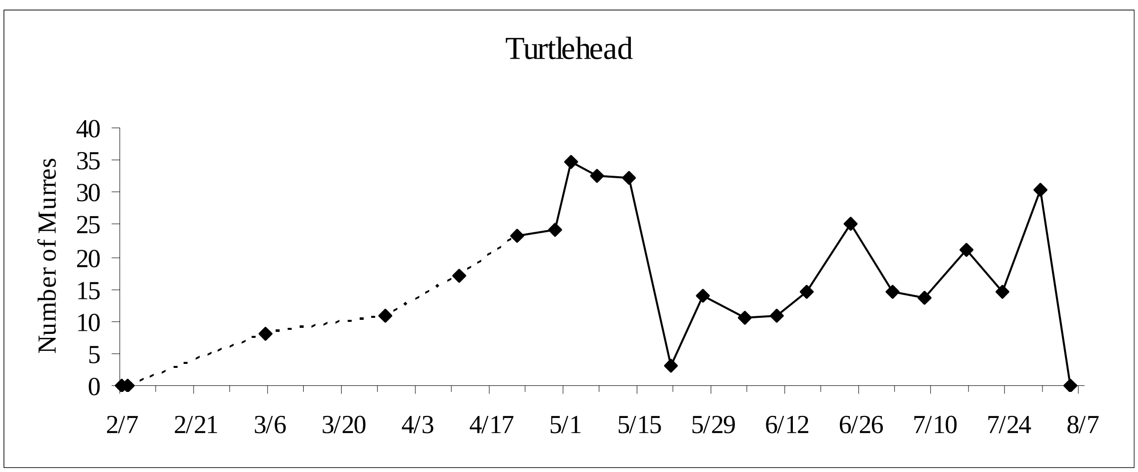


Figure 18. Seasonal attendance patterns of Common Murres at mainland subareas of Devil's Slide Rock and Mainland, 7 February to 5 August 2008. Dashed lines indicate pre-breeding season counts and solid lines indicate breeding season counts.

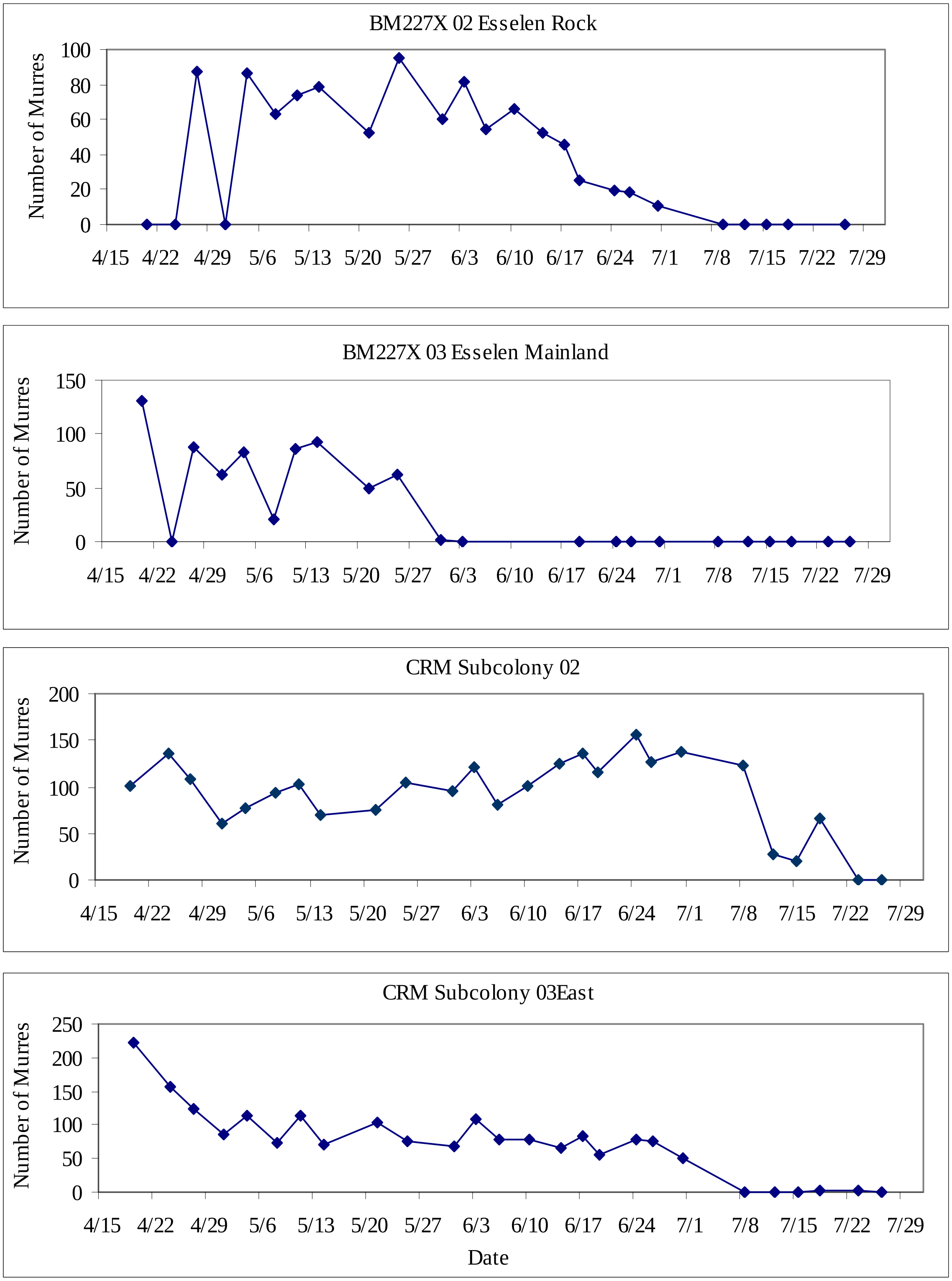


Figure 19. Seasonal attendance patterns of Common Murres at Bench Mark-227X subcolonies 02 and 03 and Castle Rocks and Mainland subcolonies 02 and 03East, 20 April to 26 July 2008.

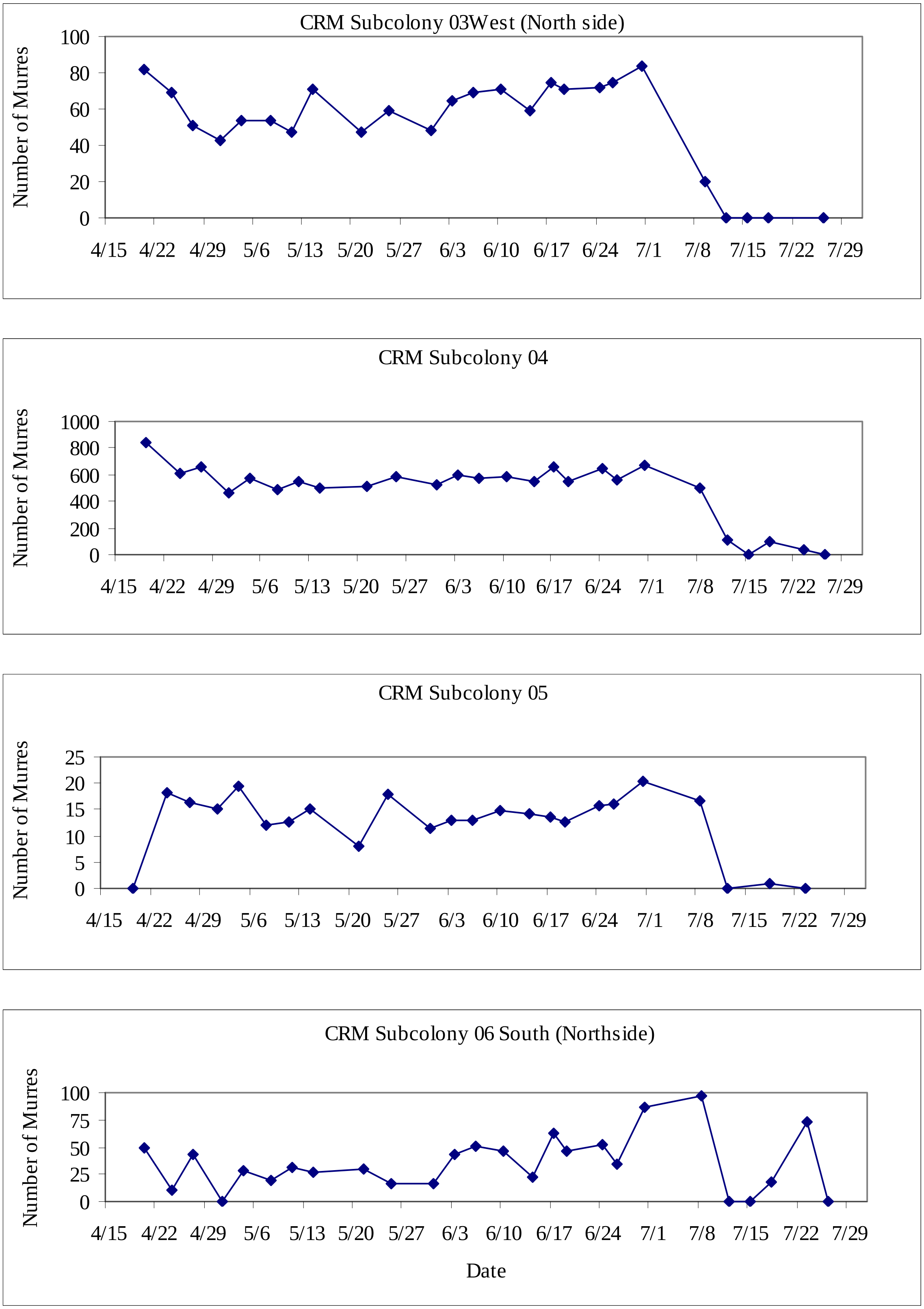
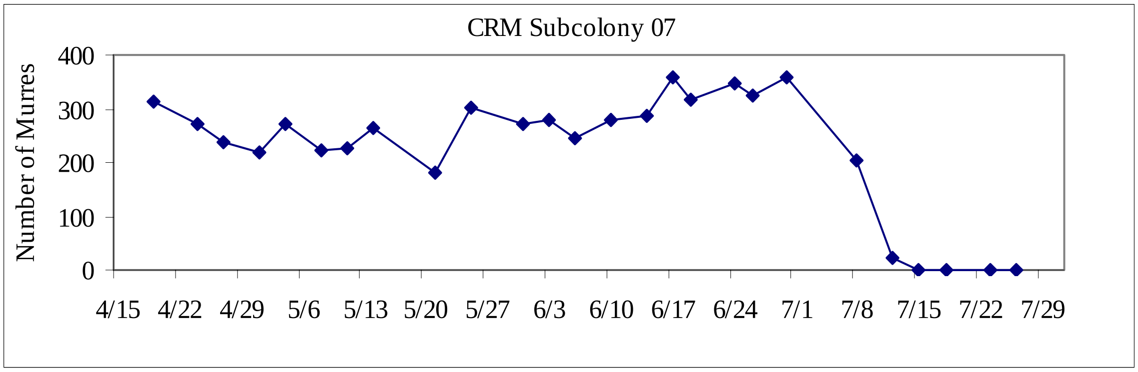
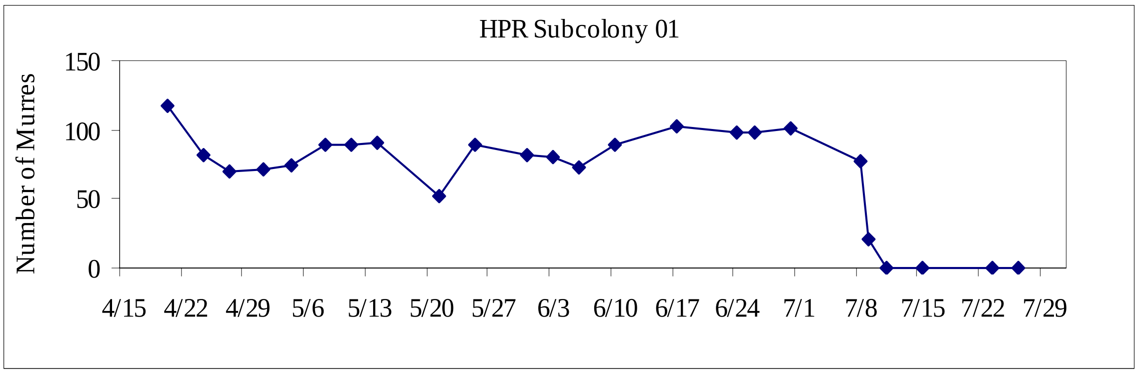
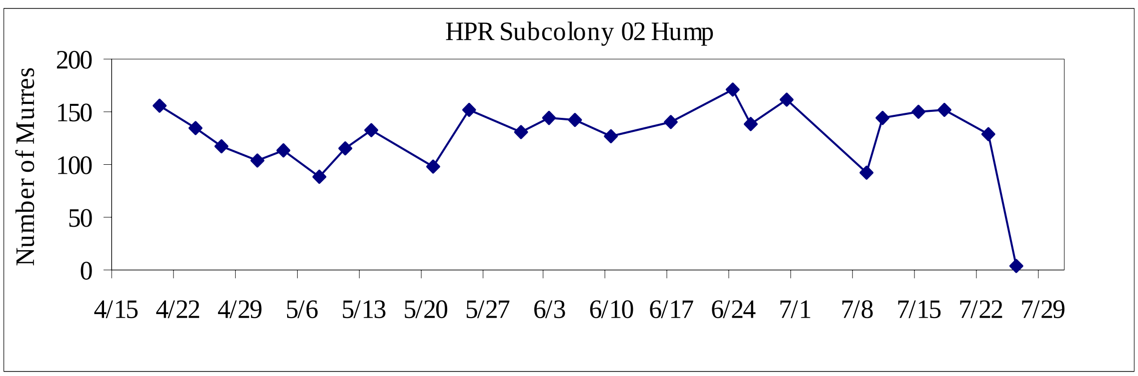


Figure 20. Seasonal attendance patterns of Common Murres at Castle Rocks and Mainland subcolonies 03West, 04, 05 and 06South, 20 April to 26 July 2008.







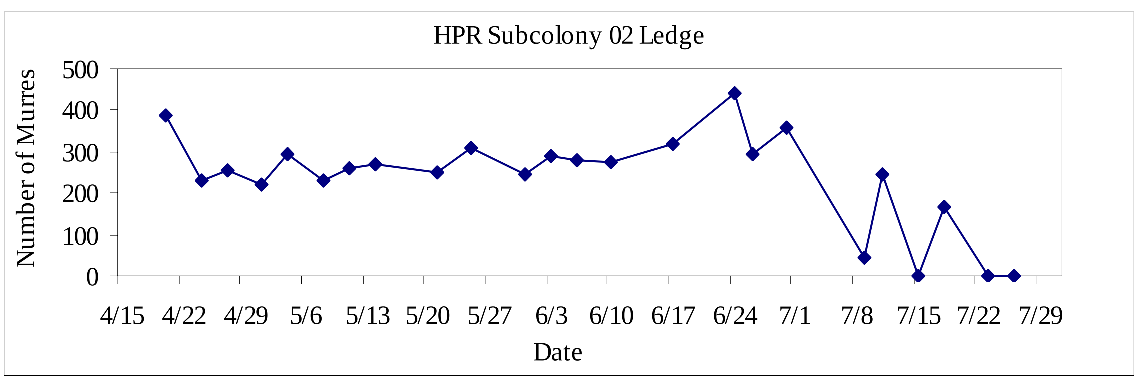


Figure 21. Seasonal attendance patterns of Common Murres at Castle Rocks and Mainland subcolony 07 and Hurricane Point Rocks subcolonies 01 and 02 (Hump and Ledge subareas), 20 April to 26 July 2008.

Figure 22. Locations of Common Raven detections along Highway 1 between Point Lobos and Point Sur, California, 2008. Red flags mark survey start and end points and the red X marks Bixby Landing.

Appendix 1. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Point Reyes, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	11	0	0	0	0	0	0	0	0	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0	0
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	3	2	0	0	0	0	0	1	0	1
Unknown	0	0	0	0	0	0	0	0	0	0

Appendix 2. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at Point Reyes, 2008.

Watercraft Type	Total Observations	# Agitation Events	# Displacement Events	# Flushing Events	Total Disturbance
Commercial Fishing	0	0	0	0	0
Recreational (≤25') Small Private	19	0	0	0	0
Recreational (>25') Large Private	0	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	0	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	1	0	0	1	1
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0

Appendix 3. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Point Resistance, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	0	0	0	0	0	0	0	0	0	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0	0
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	0	1	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0

Appendix 4. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Double Point Rocks, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	0	0	0	0	0	0	0	0	0	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0	0
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	5	0	3	0	0	0	0	0	3	0
Unknown	0	0	0	0	0	0	0	0	0	0

Appendix 5. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at Double Point Rocks, 2008.

Watercraft Type	Total Observations	No. Agitation Events	No. Displacement Events	No. Flushing Events	Total Disturbance Events
Commercial Fishing	0	0	0	0	0
Recreational (≤25') Small Private	4	0	0	1	1
Recreational (>25') Large Private	0	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	0	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	0	0	0	0	0
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0

Appendix 6. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Bird Island (Point Bonita), 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	0	0	0	0	0	0	0	0	0	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0	0
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	0	1	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0

Appendix 7. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at Bird Island (Point Bonita, MA), 2008.

Watercraft Type	Total Observations	No. Agitation Events	No. Displacement Events	No. Flushing Events	Total Disturbance Events
Commercial Fishing	0	0	0	0	0
Recreational (≤25') Small Private	4	0	0	1	1
Recreational (>25') Large Private	0	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	0	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	0	0	0	0	0
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0

Appendix 8. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Seal Rocks, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	0	0	0	0	0	0	0	0	0	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	0	0	0	0	0	0	0	0	0
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	1	1	0	0	0	0	1	0	1	0
Unknown	0	0	0	0	0	0	0	0	0	0

Appendix 9. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at Seal Rocks, 2008.

Watercraft Type	Total Observations	No. Agitation Events	No. Displacement Events	No. Flushing Events	Total Disturbance Events
Commercial Fishing	0	0	0	0	0
Recreational (≤25') Small Private	0	0	0	0	0
Recreational (>25') Large Private	1	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	0	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	0	0	0	0	0
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0

Appendix 10. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at Devil's Slide Rock and Mainland, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	6	0	2	0	0	0	0	0	2	0
USCG	1	13	0	7	0	0	0	0	0	7
Military	1	4	0	1	0	0	0	2	0	3
Law Enforcement	1	1	1	0	0	0	0	0	1	0
Other	215[1]	25	67[1]	18	1	0	0	6	68[1]	24
Unknown	0	0	0	0	0	0	0	0	0	0

[1] Includes one event in which one prop plane and three ultra-light planes passed at the same time

Appendix 11. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at Devil's Slide Rock and Mainland, 2008.

Watercraft Type	Total Observations	No. Agitation Events	No. Displacement Events	No. Flushing Events	Total Disturbance Events
Commercial Fishing	0	0	0	0	0
Recreational (≤25') Small Private	27	5	1	7	13
Recreational (>25') Large Private	0	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	2	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	3	0	0	3	3
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0

Appendix 12. Numbers of observed aircraft overflights categorized by type and resulting disturbance events recorded at the Castle/Hurricane Colony Complex, 2008.

Aircraft Type	Total Observations		No. Agitation Events		No. Displacement Events		No. Flushing Events		Total Disturbance Events	
	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo	Plane	Helo
Commercial	0	0	0	0	0	0	0	0	0	0
Media	0	0	0	0	0	0	0	0	0	0
Research	10	0	5	0	0	0	0	0	5	0
USCG	0	0	0	0	0	0	0	0	0	0
Military	0	3	0	2	0	0	0	1	0	3
Law Enforcement	0	0	0	0	0	0	0	0	0	0
Other	4	4	2	1	0	0	0	3	2	4
Unknown	4	1	2	1	0	0	0	0	2	1

Appendix 13. Numbers of observed watercraft categorized by type and resulting disturbance events recorded at the Castle/ Hurricane Colony Complex, 2008.

Watercraft Type	Total Observations	No. Agitation Events	No. Displacement Events	No. Flushing Events	Total Disturbance Events
Commercial Fishing	5	1	0	0	1
Recreational (≤25') Small Private	9	2	0	3	5
Recreational (>25') Large Private	0	0	0	0	0
Charter	0	0	0	0	0
Research	0	0	0	0	0
Sailboat	0	0	0	0	0
Yacht/Cruiser	0	0	0	0	0
Speed Boat	0	0	0	0	0
Jet-ski	0	0	0	0	0
Kayak/Canoe	0	0	0	0	0
Law Enforcement	0	0	0	0	0
USCG	0	0	0	0	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0