

RESTORATION OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2004

REPORT TO THE *APEX HOUSTON* TRUSTEE COUNCIL

Gerard J. McChesney¹, Nathan M. Jones², Travis B. Poitras², Karen J. Vickers², Lisa E. Eigner²,
Harry R. Carter³, Richard T. Golightly², Stephen W. Kress⁴, Michael W. Parker⁵,
Kristina Studnicki², Phillip J. Capitolo², and James N. Hall²



U.S. Fish and Wildlife Service
San Francisco Bay National Wildlife Refuge Complex
P.O. Box 524
Newark, CA 94560



FINAL REPORT
1 August 2005

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Special thanks go to the *Apex Houston* Trustee Council for their unwavering support throughout the project: Dan Welsh (USFWS-Ecological Services), Maria Brown (NOAA-Gulf of the Farallones National Marine Sanctuary [GFNMS]), Paul Kelly (CDFG-Office of Spill Prevention and Response [OSPR]), Jennifer Boyce (NOAA alternate representative), Joelle Buffa (USFWS alternate representative). Thanks are also due to Carolyn Lown (Department of the Interior-Office of the Solicitor) for legal advice and assistance with landowner agreements.

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EXECUTIVE SUMMARY

The 1986 *Apex Houston* oil spill off the central California coast killed approximately 9,900 seabirds, including 6,300 Common Murres (*Uria aalge*). A litigation settlement in August 1994 provided funding for restoration of natural resources injured by the oil spill. To oversee the implementation of restoration actions, the *Apex Houston* Trustee Council (AHTC) was established and comprised of representatives from the U.S. Fish and Wildlife Service, California Department of Fish and Game, and National Oceanic and Atmospheric Administration. Three restoration projects have been approved to date: 1) the Common Murre Restoration Project; 2) the Marbled Murrelet (*Brachyramphus marmoratus*) Nesting Habitat Acquisition Project; and 3) seabird habitat restoration at the South Farallon Islands (Farallon National Wildlife Refuge).

The U.S. Fish and Wildlife Service (San Francisco Bay National Wildlife Refuge Complex; hereafter "Refuge") was selected by the AHTC to lead the Common Murre Restoration Project. Soon after the preparation of a publicly reviewed restoration plan the Refuge created the scientific and environmental education programs which constitute the Common Murre Restoration Project. Field data collection and analysis for the scientific aspect of the project is being conducted by biologists from the Refuge in collaboration with the U.S. Fish and Wildlife Service (Ecological Services), Humboldt State University, and National Audubon Society. Additional assistance has been by: Carter Biological Consulting, U.S. Geological Survey, Point Reyes Bird Observatory, National Park Service (Point Reyes National Seashore), Gulf of the Farallones and Monterey Bay National Marine Sanctuaries, California Department of Fish and Game, and the California Department of Transportation. The Refuge is also playing the lead role in the implementation of the environmental education program. This report summarizes the results for year nine (Federal Fiscal Year 2004) of the scientific and environmental education programs which make up the Common Murre Restoration Project.

Efforts to restore the Common Murre colonies at Devil's Slide and San Pedro rocks using social attraction equipment began in 1996 and 1998, respectively, and have continued since then. At Devil's Slide Rock on 5 March 2004, 112 adult murre decoys were re-deployed and the sound system turned back on. Social attraction equipment was re-deployed on San Pedro Rock on 10 February 2004, including: 188 murre adult, 19 chick, and 15 egg decoys; 18 standing and 24 incubating (on decoy nests) cormorant decoys; and the sound system turned back on. Two remote video cameras were reinstalled on San Pedro Rock to assist monitoring efforts. At Devil's Slide Rock, the decoys were removed following the breeding season to be cleaned and re-painted and sound systems were turned off. All equipment was permanently removed from San Pedro Rock.

Besides the social attraction work, information associated with Common Murre breeding and population ecology, as well as information concerning human and natural disturbances, was collected at Devil's Slide Rock, San Pedro Rock and at the Castle/Hurricane Colony Complex as in previous years. Point Reyes Headlands, which was monitored from 1996 to 2002, was not monitored in 2004. Parameters monitored included: seasonal attendance patterns, colony and subcolony population sizes, breeding phenology, reproductive success, and adult time budgets. Also, data on Brandt's Cormorant (*Phalacrocorax penicillatus*) attendance and productivity were collected. In addition, aerial photographic surveys of Common Murre, Brandt's Cormorant, and Double-crested Cormorant (*P. auritus*) colonies were conducted in northern and central California. These surveys showed higher numbers of all three species at most central California colonies counted in 2004 compared to 2003. All information collected is used to help evaluate and refine restoration efforts at Devil's Slide Rock, San Pedro Rock, Castle/Hurricane Colony Complex, and other colonies in central California where restoration may be needed. This information is helping us gain a better understanding of Common Murre breeding and population biology, as well as the impacts of human and natural disturbances on murres in central California.

Efforts of the Scientific Program resulted in 190 pairs of murres nesting and 133 chicks fledging from Devil's Slide Rock (DSR) in 2004, an increase of 80 nesting pairs and 63 fledged chicks from the 2003 breeding season. This was the fourth consecutive year of exceeding the 10-year project goal of 100 breeding pairs of murres on DSR, first obtained in year six (2001) of restoration efforts. For the seventh consecutive year since social attraction techniques began at San Pedro Rock, no breeding occurred and murre attendance was low, leading to the discontinuation of efforts there following the 2004 season. Murre plots monitored at Castle/Hurricane Colony Complex experienced almost complete breeding failure in 2004 due to raven and pelican disturbance and predation.

The Environmental Education Program continued for the ninth consecutive year in 2004. The program focused on teaching students about: 1) the natural history and adaptations of Common Murres; 2) the detrimental impacts humans have had on central California murres from the 1800s to the present; 3) efforts to restore Common Murres in central California; and 4) ways students can help restore and protect seabirds. The project also provided students with the opportunity to participate in the restoration project at Devil's Slide Rock by repainting the murre decoys before their re-deployment. Personnel from this year's education outreach program taught approximately 880 students from nine San Francisco Bay Area schools about the conservation issues impacting seabirds in the student's local area and around the world.

PROJECT STRUCTURE AND ADMINISTRATION - 2004

TRUSTEE COUNCIL

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INTRODUCTION

Common Murre (*Uria aalge*) colonies in central California occur on certain nearshore rocks and adjacent mainland points between Marin and Monterey counties as well as at the North and South Farallon islands, 20 to 40 kilometers offshore (Carter et al. 1992, 1996, 2001). Trends in this population of murre at all colonies have been well-documented since 1979 (Sowls et al. 1980; Briggs et al. 1983; Ainley and Boekelheide 1990; Takekawa et al. 1990; Carter et al. 1992, 1995, 2001; Sydeman et al. 1997; McChesney et al. 1998, 1999). A steep decline in the central California population between 1980 and 1986 is attributed primarily to mortality in gill nets and oil spills, including the 1986 *Apex Houston* oil spill (Page et al. 1990; Takekawa et al. 1990; Carter et al. 2001, 2003b). Between 1982 and 1986, a colony of close to 3,000 breeding murre on Devil's Slide Rock in northern San Mateo County was extirpated by these mortality events. Since 1996, the Common Murre Restoration Project has sought to restore this and other central California colonies using social attraction and other techniques. Social attraction has been utilized at Devil's Slide Rock and nearby San Pedro Rock, which was extirpated in the early 20th century primarily by commercial egg harvesters (Ray 1909, Carter et al. 2001). Efforts at other colonies, especially the Castle/Hurricane Colony Complex, have focused mainly on reducing anthropogenic disturbance and mortality factors.

Since 1989, murre breeding populations in central California have increased. The rate of increase for the total population was estimated at 5.9% per annum between 1985-1995 (Carter et al. 2001). This partial recovery of the central California Common Murre population has been attributed to a series of gill-net fishing closures that have occurred in central California since 1982, as well as reduced oiling from 1986-1995 (Carter et al. 2001). Despite population increases, Devil's Slide Rock was not recolonized by 1995 and most colonies remained in a reduced state. Until more extensive gill-net closures (<60 fathoms from Point Reyes to Point Arguello) were enacted by California Department of Fish and Game in September 2002, gill-net mortality of murre continued through at least 2000 (Forney et al. 2001; National Marine Fisheries Service, unpubl. data). In addition, oil pollution (e.g., *Command* Oil Spill, and the series of oil releases from the sunken vessel *S.S. Jacob Luckenbach*) has continued to kill thousands of murre in central California (Carter 2003, Carter and Golightly 2003, Hampton et al. 2003, Roletto et al. 2003) and anthropogenic disturbance has affected colonies as well (USFWS, unpubl. data).

The *Apex Houston* Oil Spill

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

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

The Common Murre Restoration Project

In 1995, the *Apex Houston* Trustee Council developed a restoration plan consisting of a Scientific Program and an Environmental Education Program for the Common Murre Restoration Project (USFWS 1995a). Field work for the Scientific Program has been conducted since 1996 by USFWS, San Francisco Bay National Wildlife Refuge Complex (hereafter

“Refuge”), in collaboration with the USFWS-Ecological Services (Sacramento Field Office), Humboldt State University (HSU), and the National Audubon Society. Additional assistance has been provided by: Carter Biological Consulting; CDFG; U.S. Geological Survey (Western Ecological Research Center; USGS); Point Reyes Bird Observatory (PRBO); National Park Service (Point Reyes National Seashore); National Oceanic and Atmospheric Administration (NOAA; Gulf of the Farallones and Monterey Bay National Marine Sanctuaries); and California Department of Parks and Recreation.

The primary goals of the Scientific Program are the restoration of extirpated Common Murre colonies at Devil’s Slide and San Pedro rocks (Figures 1, 2). Social attraction was selected as the best-available technique to be used to recolonize these rocks (Parker et al. 1997, Carter et al. 2003b) because of its effective use elsewhere in encouraging seabirds to recolonize extirpated colonies (Kress 1983; Podolsky 1985; Kress and Nettleship 1988; Podolsky and Kress 1989, 1991; Schubel 1993).

In January 1996, social attraction equipment (murre decoys, mirror boxes, and two sound systems) was deployed on DSR for the first time (Parker et al. 1997). Decoys have been deployed in a similar manner each year since. Successful breeding was recorded in 1996 and the number of breeding pairs increased each season up to 2002. Because of the continuous annual growth of the DSR colony since 1996, the amount of social attraction equipment has been reduced in recent years to provide additional breeding space within decoys areas. As the colony grows over time, social attractants eventually will be phased out completely.

Common Murres have not been recorded breeding on San Pedro Rock (SPR) since 1908 (Ray 1909, Carter et al. 2001). No murres were detected on SPR during ground and boat observations or aerial surveys conducted in 1979-1997 (Parker et al. 1997, 1998; Carter et al. 2001). Social attraction equipment (adult, egg, and chick decoys, mirrors, and two sound systems) was first deployed in April 1998 and small numbers of murres were observed among the decoys thereafter. Social attraction equipment has been used each year since 1998 but breeding has not occurred.

We also monitored murre colonies at Castle Rocks and Mainland (CRM), Hurricane Point Rocks (HPR), and Bench Mark-227X, all located on the Big Sur coastline in Monterey County (Figures 1, 3). The CRM and HPR colonies were impacted by the *Apex Houston* spill and declined afterwards (Carter et al. 2001, 2003b). By 1997, they had recovered to about 52% of their pre-decline numbers (McChesney et al. 1999). Information from the Castle/Hurricane Colony Complex has allowed us to assess the necessity of restoration actions, as well as examine aspects of breeding biology at these disjunct, southernmost colonies.

This report summarizes restoration and monitoring efforts conducted by the Common Murre Restoration Project at DSR, SPR, CRM, HPR, and BM227X in 2004. Monitoring at these colonies included collecting data similar to previous years on murre colony population sizes, attendance patterns, productivity and nesting phenologies. Aircraft, vessel, and avian disturbances are also summarized. We also report on Brandt’s Cormorant (*Phalacrocorax penicillatus*) nesting phenology and productivity at DSR and Mainland, and nesting phenology only at CRM. In addition, summaries of murre and cormorant counts from central California aerial photographic surveys are provided.

SCIENTIFIC PROGRAM

METHODS

Social Attraction

Devil's Slide Rock

On 5 March 2004, 112 adult murre decoys (98 standing, 14 incubating) were re-deployed and the single solar-powered sound system turned back on (Figure 4). Decoys had been removed from DSR on 16 September 2003 following the 2003 breeding season. Decoys were then cleaned and repaired during the fall of 2003, using the same techniques employed in previous years (also see Environmental Education, below).

The number of decoys deployed was 9.7% lower than in 2003 (N=124) and 71% lower than the original plot design utilized in 1996-1998 (N=384 decoys). The placement and number of standing-posture and incubating-posture decoys was determined based in part on the locations of usable decoy rods previously placed on DSR, and murre breeding and territorial sites from previous years. As in 2002-2003, the variable density plot treatment method was not utilized in favor of a more site-by-site approach in an attempt to increase densities of nesting murres and join some of the disjunct breeding groups on DSR. However, decoys were still placed mainly within the original plot boundaries. Our strategies involved thinning the decoys in high-density nesting areas and removing decoys from portions of the rock with no active breeding sites.

The largest reduction of decoys was in plot 7, where 5 fewer decoys were deployed than in 2003. The breakdown of the number of decoys placed in each plot is as follows: Plot 1, 18 decoys; Plot 2, 3 decoys; Plot 3, 7 decoys; Plot 4, 6 decoys; Plot 6, 13 decoys; Plot 7, 13 decoys; Plot 8, 17 decoys; Plot 9, 12 decoys; Plot 10, 10 decoys; and Plot 12, 13 decoys.

As in 2003, uniquely painted wooden dowels 1.5 feet (0.46 m) in height were placed on existing decoy rods in plots 1, 2, 3, 7, 9, 10 and 12 at or near former mirror locations to serve as landmarks. One mirror box remained in plot 8.

Monitoring and analysis of murre site locations on DSR was again enhanced this year through the use of Geographic Information System (GIS) data collected in 2000 and 2001 (Parker et al. 2001, 2002). During the 2004 breeding season, new nest sites and decoys were added to the GIS database by approximating their locations in the field based on previously mapped (by GPS) sites and equipment. Additional verification was done using using high quality aerial photographs taken during colony surveys on 25 May 2004 and additional GPS work following the breeding season (see below). Numbers of breeding and territorial sites found within decoy areas were compared to numbers outside decoy areas. Murres were considered to be in a decoy area if they were within approximately one murre-width (about 15 cm, or six inches) of a decoy.

Following the 2004 breeding season, decoys were removed from DSR on 4 October for cleaning and repainting. At this time, the sound system was still turned on but one speaker had been disconnected from the system and the other was emitting only static. It is unknown how long the system had been in this condition, but we suspect that the one speaker had the cable disconnected by a cormorant during the nest building stage in April-May. Also, several decoys and wooden dowels had been lost from the rock for unknown reasons.

GPS data collection

During decoy removal on 4 October 2004, additional GPS work was conducted to update the existing GIS database. GPS data collection was conducted by M. Hink (Bestor Engineers) and W.M. Perry (U.S. Geological Survey). The GPS locations of existing decoys (standing, incubating, standing but fallen) and wooden dowels were obtained, as well as locations of all

breeding and territorial sites used during the 2004 breeding season. The estimation of site locations was collaborated by the three wildlife technicians that monitored DSR in 2004 (Jones, Vickers, and Eigner), with Vickers on the rock and Jones and Eigner viewing from the principal mainland viewing points at the “Traditional DSR Pullout” (Jones) and “The Bunker” (Eigner). Locations of existing decoys, dowels, mirror, and other natural features were used to determine murre site locations.

Following GPS data collection, locations of equipment and murre sites that had been approximated during the field season were updated on the 2004 GIS map. Locations of decoys and dowels lost prior to GPSing were re-evaluated and changed if necessary. Although GPS provided a more accurate description of the rock, we found little difference in locations of decoys or murre sites before and after GPSing.

San Pedro Rock

On 10 February 2004, 188 adult, 19 chick, and 15 murre egg decoys were re-deployed on SPR, and one of the two sound systems playing murre calls was turned on. Decoys were attached to existing rods already in place throughout the various decoy plots or placed on newly placed rods where necessary. The mirrors in the mirror boxes were turned around to reveal their reflective sides, which had been turned the other way since early 2002 (Knechtel et al. 2003) because of Common Raven (*Corvus corax*) attraction to the mirrors. However, mirrors were again turned around on 18 June 2004 to show their non-reflective sides because of renewed raven activity at the mirrors.

As in 2003 we deployed Brandt’s Cormorant decoys in addition to the murre decoys. It has been documented that murres tend to establish new breeding sites in areas where these cormorants nest (Ainley and Boekelheide 1990; McChesney et al. 1998; Carter et al. 2001). We set out 18 standing and 24 incubating cormorant decoys. The incubating decoys were placed on top of synthetic nests made of rope and burlap, and held together with a natural fiber doormat (Figure 5).

The remote video monitoring system, developed and installed on SPR by SeeMore Wildlife Systems (Homer, Alaska) in 2003, was again utilized to enhance monitoring work. Two high resolution video cameras were anchored to the rock near the top of the decoy area and connected to a transmitter that sent live-streaming images to a portable, manually operated receiving system on the adjacent mainland. The receiving system included a desktop computer equipped with software for remote control of the cameras, with zoom and panning capabilities, squirt and wipe for lens cleaning, and the ability to take still pictures and video. Between the two cameras, the entire decoy area on SPR could be scanned at close range, with more limited viewing capabilities of other portions of the southwest side of the rock. The video system enhanced our otherwise poor viewing from mainland vantage points, which, prior to 2003, had been done solely with spotting scopes from a distance of about one mile (1.6 km). Without the cameras, portions of the decoy areas were not visible, and often poor visibility or heat waves precluded observations.

During the late winter and early spring, in the months prior to the seabird breeding season, the video system experienced a series of technical failures. In all, we visited SPR a total of three times (6 March, 29 March, and 12 April) after the initial decoy deployment in efforts to repair the video system and one malfunctioning sound system. The one sound system was never repaired. On the video system, the remote motherboard and camera cables were replaced, and Camera Two was returned to SeeMore Wildlife Systems for repairs, then reinstalled on 29 March. On the final trip on 12 April it was determined that the system was finally functioning satisfactorily, although video recording was still not fully operable (but still functioning using the “backcapture” feature). However, there were few subsequent difficulties throughout the 2004 field season. The video monitoring system was used successfully in addition to the standard spotting scope monitoring of SPR. As with the scope, video scans were conducted every 10 minutes during each SPR watch (see Seasonal Attendance Patterns, below).

Monitoring Effort

Prior to the start of regular breeding season monitoring (16 April), DSR was monitored for 52.42 hours on 26 observation days between 12 November and 12 April 2004. After 15 April, DSR and Devil's Slide Mainland (DSM) were monitored for a total of 618.48 hours on 117 observation days between 15 April and 7 September. Prior to the start of regular breeding season monitoring (before 17 April), SPR was monitored for a total of 44.32 hours, on 22 days between 12 November and 12 April 2004. SPR was monitored for a total of 184.83 hours on 84 observation days between 17 April and 31 July. CRM/HPR was monitored for a total of 462.40 hours on 77 observation days between 8 April and 29 July (522.05 total person hours).

Seasonal Attendance Patterns

Common Murre seasonal attendance patterns were examined at DSR, SPR, and at subcolonies located at CRM, HPR, and BM227X using 65-130x Questar spotting scopes from standardized mainland vantage points. Pre-breeding season (before 15 April) attendance was followed at DSR only, with counts conducted once or twice a week and generally between 08:00 and 11:00 h, although times ranged from 07:10 to 14:15 h. During the breeding season, counts were conducted at DSR every other day between 10:00 and 14:00 h. Breeding season attendance at CRM, HPR, and BM227X was determined from counts conducted twice per week (weather permitting), primarily between 08:00 and 12:00 h but times ranged 07:30 to 16:00 h. Each colony, subcolony, or study plot was counted three times consecutively and the means reported. SPR was counted differently, as described below. Seasonal attendance data were collected at all active subcolonies from mid-April (late pre-laying) until all chicks fledged and adult attendance ceased for the season in monitored productivity plots.

Devil's Slide Rock

Pre-breeding season attendance was monitored sporadically from 11 November 2003 to 2 April 2004. During the pre-breeding season when more than one count was made each day, the high count was used to describe attendance patterns. "Breeding season" counts were conducted from 16 April to 11 August 2004. During this period, when more than one count was made between 10:00 and 14:00 h, the count closest to 10:00 h was used for better comparability. Counts were conducted from a standardized observation site known as the Traditional DSR Pullout (see Parker et al. 1997). In addition, an aerial survey was conducted on 3 March 2004 to examine spatial distribution of murres on the rock prior to decoy deployment.

San Pedro Rock

From 9 December 2003 to 2 April 2004, SPR was monitored with spotting scopes only. From 17 April to 31 July 2004, the rock was monitored with a combination of video and scope work. During the latter period, attendance patterns were monitored during two-hour watches conducted about every one to two days. To examine potential diurnal differences in attendance patterns, watches were conducted on a rotating time schedule with more effort in the morning hours when higher attendance would be expected: 06:20-08:20; 07:20-0920; 08:20-10:20; 12:20-14:20; and 14:20-16:20 h. Observations were made from the "Pipe Pullout" along Highway 1 (see Parker et al. 1998), located about 1,700 m from the rock at an elevation of about 100 m. At the start of each watch, the numbers of birds and marine mammals of each species present on SPR and in the waters within about 300 m of the rock were recorded.

Watches were divided into ten-minute scans. When weather and viewing conditions allowed, scans were conducted using both a Questar spotting scope and the remote video system. Data were collected separately for both scope and video scans for comparison of each technique. When one observer conducted scans, the scope scan was conducted first followed by the video to reduce bias of the better viewing video system. When two observers were present, one viewed

with the scope while another viewed simultaneously with the video. It should be noted that while the video provided substantially better views of the decoy area, only scope scans provided views of the entire south side of the rock. For this report, scope and video scans have been combined to summarize murre and raven activity. Preliminary analyses indicate that video and scope scans did not differ significantly in the number of birds detected.

During each scan we recorded the number of murres and ravens seen on SPR, as well as their behavior and location on the rock. Locations were recorded within one of five areas of the rock (Figure 6). Murres attending SPR were reported in units as “murre-observations”, with each murre seen during a scan constituting one murre observation. Information on raven attendance was recorded in a similar manner, with each raven seen during a scan constituting one “raven observation.” Ravens were monitored because the presence of these nest predators may reduce murre attendance on the rock.

Castle/Hurricane Colony Complex

Seasonal attendance patterns of Common Murres were determined for 13 subcolonies at BM227X, CRM, and HPR (ten nearshore rocks and three mainland areas; Figure 3). All visible birds were counted at each subcolony from four standardized viewing locations. At three subcolonies, separate subarea counts also were obtained as follows: 1) CRM-04, separate counts were obtained for the productivity plot and “South Finger” (an ephemeral nesting area); 2) CRM-06 South, counts were distinguished between areas 1 (South side) and 2 (North side; see Knechtel et al. 2003); and 3) HPR-02, murre counts were distinguished between the traditional “Ledge” and “Hump” subgroups.

Productivity - Common Murre

As in prior years, we monitored productivity of Common Murre breeding pairs at DSR and CRM at least every two to three days (weather permitting) from mainland vantage points using 65-130x Questar spotting scopes. All plots were monitored in a manner consistent with “Type I” plots as described in Birkhead and Nettleship (1980). The locations of new, returning breeding, territorial, and sporadic sites were identified using maps updated from the 2003 breeding season. At DSR, locations of murre sites were refined through the interpretation of aerial photographs taken on 25 May 2004. We defined a “breeding site” as any site where an egg was laid and a “territorial site” as a site that had attendance greater than or equal to 15% of monitored days. Sporadic sites were attended on at least two days but on less than 15% of days; however, many possible “sporadic” sites were not identified as such because of the frequent movement by visiting birds. New breeding, territorial, and sporadic sites established in 2004 were numbered sequentially and added to existing maps created during previous years.

Although monitoring was conducted during all daylight hours, we conducted observations predominantly in the morning when murre activity was greatest and lighting conditions were best, which made site status easier to determine. Many observations also were conducted in evening hours after mid-day heat waves dissipated. Each monitoring day, we determined the status of each site, including the presence of adults, egg, or chick. Adult postures (i.e., incubating or brooding postures) and other behaviors (e.g., apparent egg turning, chick feeding) also were used as indicators of site status, until presence or absence of an egg or chick could be verified. From these data, egg laying date, hatching date, and chick fledging date (as well as egg losses and egg replacements) were determined for each breeding site using a standardized protocol. Chicks were considered to have fledged if they survived to at least 15 days of age. At breeding sites where phenology was less certain, chicks were determined to have fledged based on body size and plumage characteristics. From the data collected, we calculated the total numbers of eggs laid, chicks hatched, and chicks fledged per pair, as well as hatching, fledging, and breeding success.

Devil's Slide Rock

We monitored murre productivity at all active and inactive (recorded since 1996) sites on DSR with the use of 65-130x Questar spotting scopes. Using aerial photographs, we verified that all sites could be seen from a combination of viewing locations along the mainland to the east and southeast of DSR. Distances from observation locations to the rock ranged from 300 to 400 m. On each observation day, all sites were monitored to determine the presence or absence of an egg or chick.

Castle/Hurricane Colony Complex

All active and inactive murre nesting sites were monitored within one productivity plot on CRM-04 (established in 1996). An additional study plot on CRM-03 East, established in 1999, did not host breeding murres in 2004. In 2004, the CRM-04 study plot consisted of 106 sites. Observations of the plot were conducted from or near the "Castle pullout" located off Highway 1, approximately 300 m from the CRM-04 plot. An additional viewing location from private property above Funt Cove was added in 2003 and utilized again with permission in 2004. Both Questar (65-130X) and Kowa (20-60X) spotting scopes were used for observations.

Adult Time Budgets - Common Murres

Time budget (or, co-attendance) observations were conducted at DSR in the latter part of the season when approximately 50% of the breeding sites had chicks. Time budgets were conducted only on breeding pairs with chicks, based on the assumption that co-attendance during chick rearing is likely a better indicator of parental and feeding conditions than co-attendance during incubation, since parents must feed themselves as well as their chick during this stage of the breeding cycle. Criteria for selecting sites included:

1. Prior knowledge of the site as a nesting site;
2. Ease of viewing both adults (when both were attending the site at the same time);
3. Proximity to other breeding sites; and
4. Ability to include additional nearby breeding sites;

The same breeding pairs were monitored during each observation period. Three continuous watches were conducted between 1-9 July from sunrise to sunset (weather permitting) on 12-13 pairs of breeding murres.

Questar spotting scopes (65X-130X) were used to monitor arrivals, departures, and food deliveries to chicks (including prey type and size). Observations were conducted by a primary observer who was relieved every 2-3 hours. Information was recorded on a hand-held tape recorder and later transcribed onto paper data forms and then transferred to a computer database. The information reported here includes the average time pairs of murres spent in co-attendance per day at their breeding sites, as well as the average number of prey deliveries to the chick. For the purposes of this report, co-attendance is defined as the period of time when two adults (assumed mates based on behavioral interactions; see Johnsgard 1987, Gaston and Jones 1998) were present together at a breeding site.

Disturbance

Disturbance events affecting murres at DSR and CRM/HPR were recorded incidentally while collecting productivity and attendance data. Disturbances recorded included any event which caused one or more of the following: adult murres to be flushed or otherwise displaced; any eggs or chicks to be exposed, displaced, or depredated. Events which prevented prey from being

delivered to chicks were also considered to be disturbances. Data were then categorized as non-anthropogenic or anthropogenic disturbances.

Due to the close proximity of breeding Brandt's Cormorants to murres at DSR and high frequency of small-scale cormorant disturbances, we recorded displacement and flushing events caused by cormorants only at murre breeding sites with an egg or chick present. In the case of anthropogenic disturbances, aircraft flying at or below about 1,000 feet (305 m) above sea level and boats within about 1,500 feet (460 m) of the nearest murre colony were recorded, even if they did not cause disturbance. Information recorded regarding aircraft and boats included: type of craft, any identifying number(s), direction of travel, and distance from the nearest subcolony of murres.

To analyze disturbance events, we separated the data by source and type of disturbance. We present the number of non-anthropogenic and anthropogenic disturbances seen per hour of observation at each colony.

Brandt's Cormorant Productivity and Nest Surveys

Productivity - Devil's Slide Rock and Mainland

Since 1996, monitoring of Brandt's Cormorant (hereafter, "cormorant") productivity has been monitored at DSR and the adjacent mainland. This monitoring is conducted to better understand the influence of decoys on the DSR cormorant colony, the communal relationship between breeding cormorants and Common Murres, and to examine differences in cormorant reproductive performance between years and subcolonies. To determine timing of breeding and productivity, breeding activities were monitored in detail at DSR and two subcolonies on DSM: one on the south cliffs of the Devil's Slide point (also known as "Mainland South"); and the traditional Turtlehead Rock. Nests at all locations were monitored every three to seven days from points along the mainland using a Questar (65-130x) or Kowa (20x) spotting scope. Chicks were considered to have fledged if they survived to at least 25 days of age. After 25 days, many chicks begin wandering from their nests, reducing the ability to determine which nests they originated from (Carter and Hobson 1988; McChesney 1997). For each nest, we followed a standardized protocol to determine the laying, hatching, and fledging dates, as well as clutch and brood sizes and numbers of chicks fledged. We rated data quality for each parameter, and only high-quality data were used for calculations. Means were then calculated for each parameter at each subcolony.

Nest Surveys

In 2004, cormorant nest surveys were conducted at Devil's Slide Rock and Mainland and Castle/Hurricane subcolonies once per week during the breeding season. At Devil's Slide, counts were taken from the Traditional pullout along Highway 1 (see Parker et al. 1998) and from the mainland bluffs above mainland subcolonies. Counts were taken between 08:00 and 11:00 h with a Questar spotting scope and 10x40 binoculars. At CRM/HPR, counts were taken generally between 10:00 and 14:00 h from the Rocky Creek Bridge, Castle, and Hurricane pullouts using a Questar spotting scope. For each count, cormorant territorial and nest sites were classified into four groups to roughly describe breeding phenology: 1) little nesting material; 2) poorly built nest; 3) fairly built nest; and 4) well-built nest. Numbers of large chicks also were counted. At CRM/HPR, we report on the high count of well-built nests per subcolony and associated dates. When possible we differentiated between juvenile, immature, and adult cormorants, though age determinations were inconsistent because of distant viewing.

Aerial Photographic Surveys

In 2004, aerial photographic surveys were conducted at all murre colonies and most (greater than about 10 nests) Brandt's and Double-crested (*P. auritus*) Cormorant colonies in northern and central California from the Oregon border south to Point Conception. These surveys are a continuation of a long-term data set focused on monitoring seabird breeding populations in California (e.g., Takekawa et al. 1990, Carter et al. 2001, Capitolo et al. 2004). Surveys were conducted between 24 May and 2 June and were flown in a California Department of Fish and Game twin-engine, high-wing Partenavia fixed-wing aircraft. Two personnel photographed colonies through a hatch opening in the belly of the aircraft using 35 mm cameras. Overview photographs of each colony were taken with a 50 mm or 70-200 mm zoom lens, while close-up photographs used for counting were taken mostly with 300 mm lenses or occasionally with a 70-200 mm zoom lens. Surveys of some areas were delayed by foggy conditions but were completed later in the survey period. Most colonies were photographed on one day only. In addition, a winter season survey was conducted on 3 March 2004 of nearshore murre colonies between DSR and Point Reyes. This survey was conducted primarily to obtain photographic documentation of murre spatial distribution on DSR prior to decoy deployment and to compare winter attendance at the different murre colonies in the area.

Counts at sample colonies were conducted using the "dotting" method and followed a standardized protocol. Standardized count areas at the South Farallon Islands followed Capitolo et al. (2002). As in other years since 1996, we obtained counts for all central California murre colonies with additional counts of other Brandt's Cormorant colonies in the Gulf of the Farallones area.

For murre, only birds were counted since they do not build nests. For cormorants, birds, nests, and territorial sites were counted. Nests and territorial sites were categorized as follows: 1) well-built nest with incubating/brooding adult; 2) nest with standing adult and visible chicks in the nest bowl; 3) empty nest (i.e., no eggs or chicks) with standing adult present; 4) abandoned nest (evidence of fairly to well-built nest with no adult present); 5) poorly built nest; 6) adult on territorial site with little or no nesting material; and 7) undetermined site (either nest or territorial site). We considered categories 1-5 as "nests" and categories 6 and 7 as territorial "sites".

Colony Surveys - Other species

We conducted nest and bird surveys from boat and land at both the Devil's Slide/San Pedro area and Castle/Hurricane in 2004 to assess breeding populations of non-focal species, including: Pelagic Cormorant (*P. pelagicus*); Western Gull (*Larus occidentalis*); Pigeon Guillemot (*Cephus columba*); and Black Oystercatcher (*Haematopus bachmani*). These species are not covered in regular monitoring and many nesting areas cannot be seen from mainland vantage points. On 18 June 2004, we conducted a boat survey between SPR and Pillar Point and counted all potential nesting birds. The survey was conducted in the morning (07:00-10:50 h) when larger numbers of Pigeon Guillemots, a crevice-nesting species, congregate on the land surface and water at and adjacent to colonies. At Castle/Hurricane, nests and birds of all species were counted from mainland vantage points on 9 June. A boat survey was attempted on 24 June but only a partial survey was conducted due to rough sea conditions. For Pigeon Guillemots, we present the high seasonal count obtained from colony counts and sea surface scans.

RESULTS

Social Attraction

Devil's Slide Rock

Common Murre - In 2004, 241 active sites (190 breeding and 51 territorial) plus 11 sporadic sites were recorded on DSR (Figure 7). This was an increase of 43 (21.7%) active and 80 (72.7%) breeding sites over the year 2003. Of the 190 breeding sites in 2004, 92 (48.4%) were reused breeding sites from 2003, 40 (21.1%) were territorial sites in 2003, six (3.2%) were not used in 2003 but were used in previous years, and 46 (24.2%) were new sites in 2004. Ninety-two active sites (38.2%) occurred within decoy areas (Figure 8).

San Pedro Rock

Common Murre - Murres were seen sporadically on SPR between 30 May and 31 July, but did not establish territories or breed. Through a combination of Questar scope and remote video scanning, murres were sighted on 14 of 84 (16.7%) observation days. Most murre sightings were of single birds. Like past years, most activity occurred during the latter part of the breeding season, particularly in late July. Most visiting murres attended a ledge below the main decoy area that contained low densities of standing murre and cormorant decoys in a pattern resembling a roosting area. This area is often used as a roost by pelicans, cormorants and gulls.

The high count for SPR in 2004 was 11 murres on 28 July at 10:30 h. There were 104 total murre observations, of which 87.5% were within decoy areas. Outside of decoy areas, there were 10 murre observations on the "Nose Area" near the decoys, and three in the "Lower Area" of the rock on the west end (Figure 6). Although two or more murres were occasionally seen attending or flying on and off the rock together, no murres were seen billing, allopreening, parading, or otherwise demonstrating courtship or other breeding behavior.

Brandt's Cormorant - Cormorants demonstrated no apparent response to the cormorant decoys placed on SPR in 2004. Although cormorants often roosted in the lower "roost" portion of the decoy area as well as other portions of the rock throughout the season, cormorants visited the upper "breeding" decoy area primarily late in the breeding season (mid-July to early August), where they roosted in small groups. There were no breeding-related behaviors observed.

Common Raven - Ravens demonstrated an intense interest in the mirror boxes once again in 2004. These mirrors had been turned around during the 2003 season to hide the reflective surface, but were re-exposed in 2004 after removal of a nesting pair of ravens in 2003 (McChesney et al. 2004). However, ravens were seen interacting with their reflections quite frequently in 2004, exhibiting both aggressive and inquisitive behaviors. After the mirrors were turned around once again on 18 June, raven activity directed toward mirror boxes ceased, although raven activity in other areas of SPR continued. Overall, raven activity was centered in the Decoy Area and the adjacent Nose Area, with 82.4% of raven observations occurring in these two areas.

Seasonal Attendance Patterns

Devil's Slide Rock

Common Murre - On DSR, murres were observed on 74 of 75 (98.7%) colony count days between 11 November 2003 and 11 August 2004 (Figure 9). Overall attendance this year was high with 84% of counts exceeding 150 murres and 64% of counts exceeding the 2003 high count of 214 murres. The 2004 high count was 336 murres on 28 April. However, this was obtained at 07:30 h, outside the standardized seasonal attendance count period of 10:00-14:00 h, so was not included in Figure 9. The highest standardized seasonal attendance count was 304

murres on 22 June. Attendance during the pre-breeding and early egg-laying period was highly variable and then leveled out during the incubation period. Numbers increased during the chick period, ranging 254-304 birds, but numbers began a steady decline in mid-July as chicks fledged and adults departed the colony.

A separate count of 285 murres (and 22 Brandt's Cormorants) was obtained from aerial photographs taken 3 March 2004 (Figure 15). These photographs showed the dense concentrations that murres were attending on many days even prior to decoy deployment on 5 March. A comparison count of 242 murres made from the standardized mainland location indicated that these colony counts are not entirely complete.

No murres were recorded on the Devil's Slide Mainland in 2004. Small numbers were observed among nesting cormorants in 2003 (McChesney et al. 2004).

San Pedro Rock

Common Murre - No murres were observed on 153 scans over 12 observation days during the pre-season from 9 December 2003 to 2 April 2004. Of the 1,109 scans completed on SPR during the field season (17 April - 31 July), 46 (4.1%) had at least one murre present, resulting in a total of 104 "murre observations" (Figure 10). Thirty-one scans (67.4%) recorded one murre, three scans (6.5%) recorded two, three scans (6.5%) recorded three, two scans (4.3%) recorded four, three scans (6.5%) recorded five, one scan (2.2%) recorded six, two scans (4.3%) recorded nine, and one scan (2.2%) recorded eleven murres. Murres were not seen on SPR until 30 May and the last murre was observed on the final day of observations on 31 July. However, the murre on 30 May was oiled and likely was not associated with the social attraction system. Twelve of 14 days of murre sightings occurred during the last six weeks of the season, with five of the fourteen occurring during the last ten days.

The video system allowed for an additional 254 scans not possible with the scope because of poor visibility. These accounted for 22.4% of all scans conducted at SPR during the field season. Thirteen scans had murre sightings, totaling 14 murre-observations, or 13.5% of total murre-observations for the season.

Of 837 scans utilizing both video and scope, the scope detected murres on 10 scans when the video system missed them, and on 13 scans the video system detected murres while the scope missed them. Part of this discrepancy was likely because video and scope scans usually were not conducted simultaneously (although occasionally two observers scanned simultaneously), and birds may have arrived or departed in the brief moments between scan types. Overall, the video system detected murres with slightly higher frequency (0.08 murres per scan) than the scope method (0.07 murres per scan). This difference was not significant (paired t-test; $t=-1.0$, $P=0.33$).

Common Raven - Ravens were observed on SPR throughout the winter, sometimes in groups of 5 or more. They were noted at least once on 13 of 18 (72.2%) observation days, with a high count of 14 ravens on 2 April. During the breeding season, ravens were seen on SPR on 45 of 84 (53.6%) observation days, and were observed on 187 of the 1,109 (16.9%) scans completed, for a total of 278 "raven observations" (Figure 10). Of the 278 raven observations, 115 (41.4%) occurred in the Nose Area, 25 (9.0%) on the "West End", 114 (41.0%) in the "Decoy Area", 13 (4.7%) in the "Lower Area", and the remaining 11 (4.0%) on the "East End" of the rock. Of the 187 scans in which ravens were seen, 102 (54.5%) recorded one raven, 83 (44.4%) recorded two ravens, and two (1.1%) recorded five ravens.

Throughout our pre-season observations we noted one pair of ravens in obvious association with one another, and these two birds were frequently seen attending SPR with no other raven present. They frequented the decoy area, especially around the mirrors. An active nest was

discovered on 17 April, on the south side of SPR high on the western-most peak. In an attempt to discourage raven use of this area and learn more about the effects of ravens on the restoration effort, one adult raven (probably the male of the pair) was collected, and the other member of the pair shot but just injured, on 7 May. All collections were done under permit by a U.S. Department of Agriculture wildlife biologist. The latter bird had been sitting in the nest earlier in the day. Subsequent to this action, ravens were not observed for several days (Figure 10). However, about a week later, what was likely a new raven pair began frequenting the rock, especially around the mirrors in the decoy area. Raven activity declined beginning in mid-June, and on 18 June the mirrors were turned back around so their reflective sides were not visible. This may have helped further reduce raven attendance by decreasing attractiveness of the site.

Castle/Hurricane Colony Complex

Common Murre - Seasonal attendance patterns varied between subcolonies. Only four subcolonies with confirmed breeding in 2004 were attended each count day from the start of observations on 8 April until the start of egg-laying: CRM-04; CRM-07, BM227X-02 (Esselen Rock), and HPR-02 (Figures 11-13). At CRM-02, CRM-03 West, and CRM-05 attendance was especially sporadic until early May.

The subcolony on CRM-03 East did not attempt breeding in 2004. Murres attended sporadically from the start of observations on 8 April until 11 May, at which point they stopped attending the rock. Ravens were recorded flushing this subcolony six times on five observation days within this period, and likely led to its abandonment. In 2003, ravens also caused several flushing events at CRM-03 East and depredated at least three chicks (McChesney et al. 2004).

During May (early to mid-incubation period), attendance was somewhat variable at most subcolonies, followed by less variability in June during the late incubation and early chick periods. Notable exceptions were at CRM-07, CRM-05 and both subcolonies at Hurricane Point Rocks, which had more variable attendance throughout the breeding season.

Murre attendance again became sporadic after 24 June following a series of Brown Pelican (*Pelecanus occidentalis*) disturbance incidents (see Disturbance, below). During the nine days this single pelican was present, murres were flushed several times daily from the CRM subcolonies and many birds spent considerable time rafting on the water nearby. Thus, attendance counts after 24 June are not comparable to prior counts or past years. Counts presented in Figures 11-12 after 24 June are the highest counts of up to several daily counts to best represent the numbers of adults still attending the subcolonies, and are shown as dashed lines. Ultimately these disturbances led to near or total breeding failure of all CRM subcolonies and early colony departure by breeding adults in 2004.

Productivity - Common Murre

Devils Slide Rock

Of 313 sites monitored at DSR in 2004, 190 (60.7%) were egg-laying, 51 (16.3%) were territorial, 11 (3.5%) were sporadically attended, and 61 (19.5%) were sites (breeding, territorial, or sporadic) in previous years that were unattended this season. Since they are difficult to follow, the number of sporadic sites is likely underestimated.

The first murre egg observed on DSR in 2004 was an abandoned egg seen on 15 April. It is unclear from which site this egg was laid, and this early egg may have been an infertile “dumped” egg and is not included in summaries of phenology and breeding success. The next egg was first observed on 27 April at a monitored site. Based on “first” eggs (n=190), mean egg-laying date was 24 May (range = 27 April-3 July). “First” eggs include all sites where only one egg was laid plus first eggs at sites where replacement clutches were laid. The first chick was observed on 3 June. Mean hatching and fledging dates were 22 June (n=137) and 18 July

(n=128), respectively (Table 1). Chicks that fledged remained on the rock for an average of 24.9 days after hatching and the last chick was seen on DSR on 11 August.

A total of 201 eggs were laid, including 11 replacement eggs. A total of 142 eggs hatched (overall hatching success of 70.6%) and 133 chicks fledged (93.7% fledging success). The number of chicks fledged per breeding pair was 0.70 (Table 1). Of 190 first eggs laid, 137 hatched (72.1% hatching success) and 128 chicks fledged (93.4% fledging success). Of 11 replacement eggs, 5 hatched (45.5% hatching success) and 5 chicks fledged (100% fledging success).

Castle/Hurricane Colony Complex

Of 106 monitored sites in the CRM-04 plot in 2004, 85 (80.1%) were egg-laying and 21 (19.8%) were territorial. There were four replacement eggs laid.

At the CRM-04 productivity plot, the first egg was seen on 1 May and the first chick was observed on 2 June. Based on first eggs only, the mean egg-laying date was 17 May (range= 30 April-11 June) and the mean hatch date was 18 June (range = 2 June-25 June). The last replacement egg was laid on 15 June. Of the 89 eggs laid (including four replacement eggs), 54 (60.7%) hatched and one (1.9 %) chick fledged. The number of chicks fledged per breeding pair was 0.01 (Table 1). It should be noted that the single chick considered to have fledged was present on the rock for only 15 days, the minimum time required for fledging under our protocol. The 15-day mark was reached at the start of pelican disturbances, and it is unclear if the chick actually fledged or died as a result of these events. The last chick was seen on 29 June, five days after the start of pelican disturbance events.

Although productivity was not monitored at other CRM/HPR subcolonies, other subcolonies with confirmed breeding in 2004 were: BM227X-02 (Esselen Rock); CRM subcolonies 02, 05, and 07; and HPR-02 (both Ledge and Hump). Breeding was not confirmed, though suspected, on CRM-03 West and HPR-01. All but Esselen Rock are established subcolonies with annual breeding in recent years. At Esselen Rock, breeding has occurred sporadically since 1996. As in previous years, but not 2003, murres attended this rock in association with nesting Brandt's Cormorants. No cormorants, and no more than 2-3 pairs of murres, bred on Esselen Rock in 2003 (McChesney et al. 2004). Numbers of breeders also appeared to be small (possibly less than 10-20 pairs) in 2004. At HPR-02 Ledge, 46 unattended chicks were counted during a pelican disturbance event on 25 June when all but 15 adults were flushed from the area. This was believed to represent most, if not all, murre chicks present on the Ledge subarea.

Adult Time Budgets - Common Murres

Devil's Slide Rock

Coattendance of breeding sites by pairs of mated murres during chick-rearing was determined from observations conducted between 1-9 July. Twelve to thirteen breeding sites were monitored from dawn to dusk on three days, resulting in a total of 38 site-days monitored. Murre pairs spent an average of 151.9 minutes per day in coattendance at their site (range 9-537 min/day; n=38). On average, mates arrived at their sites 5.4 times per day (range 1-12/day; n=38). These mate arrivals resulted in prey deliveries 65.7% of the time. Chicks were fed on average 3.4 times a day per site (range 0-8/day; n=38). Of 204 mate arrivals observed, 134 were with prey, 53 were without prey, and 17 were unknown. Of 134 prey deliveries, 128 resulted in chick-feeding, 4 resulted in an unknown prey fate, and 2 were eaten by the arriving adult. In addition, one chick feeding was recorded when a prey item was stolen from a neighbor by a coattending murre.

Disturbance

Disturbances are reported as either non-anthropogenic or anthropogenic. Disturbances per hour were calculated based on total observation hours at each colony (see Monitoring Effort, above).

Non-anthropogenic Disturbance

During 2004, we incidentally observed 308 non-anthropogenic disturbances at the two monitoring sites. Six disturbances were recorded at DSR, and 302 at CRM/HPR.

Devil's Slide Rock - There were six non-anthropogenic disturbance events observed at DSR. This resulted in an average of 0.010 disturbances per observation hour. All six of these disturbances were caused by Brandt's Cormorants and typically consisted of the cormorant lunging and jabbing at the murre, causing the murre to become displaced from its incubating position. Five disturbances were by cormorants nesting or attending a territory close to murre sites, and four incidents resulted in egg loss.

Castle/Hurricane Colony Complex - Non-anthropogenic disturbances were difficult to record in 2004. This was due to the high frequency, high impact, and long duration of many events. In many events of extended duration, birds were flushed and displaced repeatedly. In such cases, the extended event was treated as one disturbance event, and an approximate total number of birds affected was recorded.

There were 302 non-anthropogenic disturbance events recorded, resulting in 0.653 disturbance events per observation hour (Table 2). Of these events, 293 (91.6%) caused murre to flush, two (0.7%) caused murre to be displaced, and seven (2.3%) involved the loss of eggs or chicks. However, displacements are heavily underrepresented, since most flushing events also caused birds to be displaced that were too difficult to follow. As a result of non-anthropogenic disturbances, 45 egg and 28 chick depredations were observed.

Common Ravens were responsible for most non-anthropogenic disturbance events, contributing to 184 (62.7%) flushing events, 37 (20.1%) egg depredations, and seven (3.8%) chick depredations. Brown Pelicans were directly responsible for 97 (33.1%) flushing events and two (2.0%) chick depredations. Indirectly, the pelican was responsible for at least six depredated eggs and 21 depredated chicks; these egg and chick losses were due to raven and to a lesser degree Western Gull predation (Table 3). However, many other eggs and chicks, likely numbering in the hundreds, were lost when adults were forced to abandon their sites because of repeated flushings by the pelican (see below for more details). Western Gulls caused four (1.3%) flushing events and two (50.0%) egg depredations, Peregrine Falcons (*Falco peregrinus*) caused two (0.6%) flushing events, a Turkey Vulture (*Cathartes aura*) contributed to one (0.3%) flushing event, and 14 (4.7%) flushing events were due to unknown causes. Ravens flushed an average of 89.5 murre per event and pelicans flushed an average of 111.3 murre per event. Western Gulls, Peregrine Falcons and Turkey Vultures flushed on average 35.5, 120 and 50 murre per event, respectively.

On 25 April 2004, a raven nest was discovered low on a cliff face below Highway 1, about 100 m southwest of the "Castle Pullout" observation site. The nest faced west and was about 10 m up the cliff from "Castle Cove" beach, approximately 300 m east of Subcolony CRM-04 (Figure 19).

The first disturbance observed by a raven in 2004 occurred on 4 May, when approximately 150-200 murre flushed from CRM-04. The first observed predation on a murre egg by a raven occurred on 5 May. Subsequent to that event, a total of 35 murre egg predation events by ravens were observed until the start of the pelican disturbance events on 24 June (see below). In

addition to the raven depredations, there were two observations of a Western Gull depredating murre eggs as a result of those eggs being exposed during raven-caused flushing events. On one additional occasion, an egg was dislodged during a raven flushing event and broken after tumbling down the rock. In total, there were 38 lost murre eggs recorded due to raven disturbance and predation prior to 24 June. Although both members of the raven pair were responsible for disturbing murre eggs, most predation was performed by the male. The pair members were distinguished by plumage; the female, who performed incubation duties, had distinctive white wing patches, while the male was all black.

On 24 May, a raven was observed for the first time aggressively approaching small nesting groups of murre eggs, causing the murre eggs to retreat and expose their eggs. Up until this date, the ravens were taking advantage of exposed eggs during flushing events caused by their over-flights. On 26 May, both adult ravens were observed together for the first time on CRM-04; up until this date only a single adult raven had been observed during disturbance events. It was also on 26 May that a raven was first observed pulling a murre off its egg. The raven accomplished these tasks by grabbing the murre's wing-tip, or tail-tip, and pulling it back until its egg was exposed. This predatory technique became more common as the season progressed. On 3 June, a brood of four raven chicks was confirmed in the nest, all of which fledged by 18 June.

From 24 June to 2 July, an immature pelican was present at the CRM colony. During this period the pelican flew frequently between CRM-02, CRM-03 West, CRM-04, and CRM-07, and occasionally CRM-05. It landed on each rock repeatedly and appeared to deliberately approach and flush groups of murre eggs. The flushed murre eggs would circle the rocks and either land on the water nearby or return to the rocks in small groups, often only to be flushed again by the pelican's movements. Many murre chicks left unattended gathered in groups (or, "creches"), with many hiding in small caves and crevices. The flushing events offered the opportunity for the ravens, and to a lesser degree gulls, to depredate exposed murre eggs and chicks (Table 3). We believe the same immature pelican was responsible for these events at CRM based on its continuous attendance at the colony, consistent behavior, and lack of other pelicans roosting within the colony over that period (although flocks of migrating pelicans frequently passed by).

An additional immature pelican was observed behaving similarly and flushing murre eggs from HPR-02 on 25 June. Murre eggs observed flushing from HPR-02 during a boat survey on 24 June likely resulted from this pelican as well. The two different pelicans were observed simultaneously on 25 June, one at CRM and one at HPR-02. The HPR-02 pelican caused murre eggs to flush from both the Ledge and Hump, and at one point flushed all adult murre eggs from the Ledge, exposing all chicks which gathered into a creche. The impact of these flushing events on HPR-02 subcolony are likely but unclear. HPR murre eggs dispersed at roughly the same time as the CRM murre eggs, suggesting either breeding failure or somewhat early (compared to previous years) and highly synchronous chick fledging.

A total of 86 flushing events were caused by the two immature pelicans during their stays. Other pelican flushing events were caused by migrating flocks passing low over breeding murre eggs. In addition to egg and chick depredations, one murre chick was kicked by an adult murre during a flushing event, and tumbled down the rock into the water. Between 24 June and 2 July we observed six murre eggs and 21 murre chicks that were lost either directly or indirectly to pelican disturbances.

Anthropogenic Disturbance

During 2004, we observed 11 aircraft disturbances and one boat disturbance at the two monitored colonies. The disturbance rate at DSR was higher than at CRM/HPR. There were no recorded disturbances at SPR.

Devil's Slide Rock - A total of 147 aircraft and boats were incidentally observed near DSR: 66

(44.9%) were planes; 58 (39.5%) were helicopters; 20 (13.6%) were motorboats; and three (2.0%) were kayaks. This resulted in an average of 0.238 motorcraft sightings per hour (Table 4). Eight of these motorcraft caused birds to be flushed from DSR, resulting in an average of 0.013 disturbances per hour. Seven of the eight disturbances were caused by helicopters (five of which belonged to the U.S. Coast Guard) and one by a boat that came within 50 m of the rock. The greatest number of birds were disturbed on 22 May by a County Sheriff's helicopter flying at approximately 200 feet elevation that flushed about 50 birds, most of which were cormorants. Many of the planes were recorded on 25 April during the "Dream Machines" auto and air show at Half Moon Bay Airport. During the course of that day, 27 low overflights were recorded and no birds were observed flushing. However, by 10:30 h there were fewer than 50 murres on DSR and none remained by 13:30 h. It is believed that unusually warm air temperature on 25 April caused the colony to disperse to sea early in the day. On 26 June, 67 motorcycles heading south on Hwy 1 caused a large percentage of the murre colony to head-bob.

Castle/Hurricane Colony Complex - Only four anthropogenic disturbances resulted in birds flushing at CRM/HPR, an average of 0.008 disturbances per hour. All of these occurred during the Big Sur Marathon on 25 April and were the result of a single California Highway Patrol helicopter circling over the area. The helicopter was flying at approximately 1500 ft. during each pass and apparently caused birds to flush from CRM-03 East (5 murres), CRM-03 West (40 murres) and twice from CRM-04 (40 and 5 murres, respectively). However, prior to the overflights, murres had been flushing from the rocks for unknown reasons, which may have partly explained their flushing due to an aircraft at fairly high altitude.

Brandt's Cormorant Productivity and Nest Surveys

Productivity - Devil's Slide Rock and Mainland

In 2004, Brandt's Cormorants bred on DSR, the west and southwest side of the DSM promontory ("Mainland South;" MS), and on Turtlehead Rock (TRTH; Figure 2). All clearly visible egg-laying sites on DSR and TRTH were monitored, as well as a large, contiguous sample of nests on MS. Total numbers of breeding sites followed in all locations were 91 (DSR), 61 (MS), and 24 (TRTH).

On DSR, mean clutch initiation date for first clutches was 12 May (n=82 nests), with a range from 15 April to 26 June. On average, 3.3 (n=63 nests) eggs were laid per first clutch (Table 5). The mean hatching date was 10 June (n=74), with a range from 23 May to 17 July. Chicks hatched at 89.0% of breeding sites (including one successful replacement clutch), and fledged at 83.5% of breeding sites. For first clutches only, an average of 2.3 (n=90) chicks hatched per breeding pair, and hatching success of all eggs on DSR was 63.2% (n=62). Excluding the replacement clutch, an average of 1.9 (n=90) chicks fledged per breeding pair, and fledging success of all chicks was 85.3% (n=90). Breeding success (number of chicks fledged per egg laid) was 53.4% (n=62). One replacement clutch of four eggs was observed on DSR. This effort hatched two chicks that were both raised to fledging age.

On MS, mean clutch initiation date was 4 May (n=57), and ranged from 10 April to 29 May (Table 5). On average, 3.4 eggs were laid per clutch (n=59). The mean hatching date was 5 June (n=56), and ranged from 14 May to 28 June. Chicks hatched at 96.7% of breeding sites, and fledged at 95.1% of breeding sites. Hatching success was 80.6% (n=57), fledging success was 90.1% (n=59), and breeding success was 72.4% (n=57). On average, 2.7 chicks hatched (n=59) and 2.4 chicks fledged (n=61) per breeding pair. No replacement clutches were observed.

On TRTH, mean clutch initiation date was 6 May (n=24) and ranged from 12 April to 21 May (Table 5). On average, 3.7 eggs were laid per clutch (n=23). The mean hatching date was 7 June (n=24), and ranged from 27 May to 21 June. Chicks hatched and fledged at all breeding sites. Hatching success was 78.6% (n=23), fledging success was 79.7% (n=24), and breeding

success was 61.9% (n=23). On average, 2.9 chicks hatched (n=24) and 2.3 chicks fledged (n=24) per breeding pair. There were no replacement clutches.

Nest Surveys - Devil's Slide Rock and Mainland

Poorly-built and well-built cormorant nests were counted weekly on Devil's Slide Rock and all mainland subcolonies beginning on 17 April 2004 (Table 6). Numbers of poorly-built nests were highest in mid-April and began to decline as nests were completed at the onset of egg-laying in early May. On 22 June and 30 June, approximately two weeks after the mean hatching date for all DSR subcolonies, peak counts of well-built nests were recorded. After this time, counts of well-built nests declined as chicks began to wander from nests and nests were destroyed.

Nest Surveys - Castle/Hurricane Colony Complex

Well-built cormorant nests were observed at the following subcolonies: BM227X-02 (Esselen Rock), CRM-06 South, CRM-07, CRM-09, and HPR-02 (Table 7). Egg laying likely began in late April, when the first well-built nests were observed, and probably continued into June. Numbers declined on CRM-07 after the start of the pelican disturbances on June 24, possibly indicating low breeding success on this rock, although pelican disturbances were not observed to have affected cormorants.

Aerial Photographic Surveys

Aerial photographic survey data on Common Murres, Brandt's Cormorants, and Double-crested Cormorants at sample central California colonies are reported by colony in Table 8 and by subcolony in Appendix 1.

Compared to 2003 (McChesney et al. 2004), murre counts increased at most colonies. Changes in bird numbers at individual colonies ranged from -20.6% at CRM to +57.6% at Double Point Rocks, with an average change of +25.1%. The aerial survey count of 291 murres on DSR was 51.6-102.1% higher than the two aerial counts in 2003, or 73.2% higher than the average of the two 2003 counts. This is consistent with the 72.7% increase in breeding pairs on DSR in 2004. Numbers also increased substantially at Miller's Point Rocks (+47.0%), contributing to a 40.2% increase for the Drake's Bay Colony Complex (including Point Resistance, Miller's Point Rocks, and Double Point Rocks). The only colony showing substantial decline was CRM, but increases at BM227X and HPR resulted in an overall increase of 4.5% for the Castle/Hurricane Colony Complex. Counts at the two largest central California murre colonies, North and South Farallon Islands, were essentially unchanged (-0.7% each) for the second straight year. Numbers of murres at all colonies combined were 4.2% higher than in 2003, driven by a 21.1% increase at the nearshore colonies.

Numbers of Brandt's Cormorant nests increased at most colonies compared to 2003 (Capitolo et al. 2004, McChesney et al. 2004). Changes at individual colonies ranged from -48.7% (CRM) to +410% (Miller's Point Rocks). Numbers increased within all colony complexes except North Farallon Islands (-48.0%), ranging from +20.2% at Lobos/Seal Rocks to 81.1% at Drake's Bay. The largest Brandt's Cormorant colony, South Farallon Islands, increased 25.1%. Devil's Slide increased 31.6% and Castle/Hurricane increased 28.2%. At all sample colonies combined, nest numbers increased 30.7%. However, this total does not include all Brandt's Cormorant colonies in the region, as several large colonies occur between Año Nuevo and Castle Rocks. Inclusion of all colonies will be needed to further assess overall population changes for this species in 2004.

Count data indicated the timing of surveys coincided well with Brandt's Cormorant breeding phenology. For example, poorly-built nests (i.e, nests in early stages of construction) accounted for less than 5% of nests at most colonies, and numbers of territorial sites were also low.

Phenology was earlier at Alcatraz Island, where 16% of nests had visible chicks. No other colonies had visible chicks in nests in 2004.

We only counted one Double-crested Cormorant colony in the region, the South Farallon Islands. This is the only offshore colony in our focal area between Point Reyes and Hurricane Point, although several other colonies occur in the San Francisco Bay area. Our nest count at the South Farallones was 27.8% higher than in 2003.

Colony Surveys - Other Species

Results of colony surveys for Pelagic Cormorants, Western Gulls, Pigeon Guillemots, and Black Oystercatchers at Devil's Slide/San Pedro and Castle/Hurricane are summarized in Tables 9 and 10. Figure 14 shows the corresponding count areas between San Pedro Rock and Devil's Slide. At CRM, the high count for Pigeon Guillemots occurred at the fairly late date of 1 July, when 13 birds were counted on the water. Most sightings of guillemots at CRM occurred on or just offshore of CRM-04, CRM-05, and CRM-07. Counts at Castle/Hurricane are not considered complete since only a partial boat survey was conducted.

DISCUSSION

The 2004 breeding season marked the ninth consecutive year of seabird restoration and monitoring efforts in central California by the Common Murre Restoration Project. Efforts have focused on reestablishing breeding and increasing colony size at the recently extirpated murre colony at DSR, reestablishing breeding at the long-extirpated SPR colony, assessing the status of other nearshore murre colonies, and identifying other methods to restore the nearshore portion of the central California murre population.

A major project goal was to obtain 100 breeding pairs of murres on DSR within 10 years, using social attraction techniques. The 2004 breeding season marked the fourth consecutive year this goal was reached and surpassed. The 190 breeding pairs was an increase of 73% over 2003 and 54% higher than the previous high of 123 pairs in 2002. The increase in breeding pairs was complimented by an increase in overall attendance throughout both the pre-breeding and breeding seasons. Most counts ranged from about 200 to 260 murres, and the 2004 high count of 336 birds was 57% higher than our previous recent high of 214 birds in 2003. High attendance and an increase in new breeding sites indicated a high level of recruitment to DSR in 2004 which can be expected to continue in future years. While recruitment likely resulted in part from birds hatched at other colonies, it likely included birds hatched at DSR since 1996, with most of these hatched since the first larger cohorts began in 1999. Murres begin breeding at about age 3-9 years (summarized in Ainley et al. 2002).

Murre breeding success on DSR (0.70 chicks per pair) was 9.4% higher than in 2003, when breeding efforts were hampered by mild El Niño conditions, disturbance by roosting pelicans and cormorants, and possibly aircraft disturbance (McChesney et al. 2004). Average lay dates were also about eight days earlier in 2004 than in 2003. However, breeding success in 2004 was below average and was the second lowest since 1999. Most nest failure occurred during the egg stage. Co-attendance (time budget) watches showed much higher average levels of co-attendance than 2003 (151 min in 2004 compared to 63 min in 2003), but average number of mate arrivals was similar and average number of chick feeds/day was actually less (3.5 in 2004 compared to 4.5 in 2003). Lower breeding success and reduced chick feeding may reflect recruitment of relatively large numbers of first-time breeders which do not reproduce as well as more experienced adults.

Social attraction efforts at DSR in 2004 were little changed from 2003. Decoy numbers were

reduced somewhat (17.6%) but were placed in roughly the same configuration. The reduction in decoys appeared to have little to no effect on the murre colony. Most breeding sites were returning sites, indicating a high level of return by previous breeders. Given the size of the colony in 2004, in some areas decoys actually appeared to displace murres. Examination of murre attendance patterns before and after decoy deployment in early 2004 showed high attendance before deployment and suggested that on certain parts of the rock murres occurred in higher densities before decoy deployment. After decoy deployment, certain decoys took up space previously occupied by live murres.

Most new sites in 2004 were within or on the edge of previously existing breeding groups. “The Bridge” area between plots 9 and 10 experienced a substantial extension upslope into an area used as a non-breeding “club” in 2003. Another “bridge” was formed between breeding groups in plots 2 and 4 by the addition of several new breeding sites in the Plot 3 area. Murres also established new sites in formerly unused portions of DSR. For example, four breeding and three territorial sites were in a new area on the far southwest end of the rock, and three breeding and nine territorial sites were in two disjunct areas on the far northeastern portion of the rock. We view these as positive steps toward the permanent reestablishment of a self-sustaining murre colony on DSR which occupies most available breeding habitat and attains a population size in the thousands, as existed in the past.

This was the seventh consecutive year of social attraction efforts at SPR. Efforts to increase the attractiveness of SPR for murres were expanded in 2004, with the re-deployment of cormorant decoys (as in 2003), manipulation of mirrors, and removal of a breeding pair of ravens. However, results in 2004 were similar to most other years, with no pre-breeding season attendance, little breeding season attendance, most activity occurred in late July when chicks were fledging at other nearby colonies, most visits were to the lower portion of the rock frequented by other roosting birds, and no breeding by murres. Cormorants also did not show interest in the cormorant decoys, which were placed in hopes of attracting nesting cormorants that may have enhanced attraction of murres to the rock. While continued efforts over more years might eventually have led to recolonization of SPR by murres, after much thought and discussion we decided to discontinue these efforts following the 2004 season. Dwindling project funds and timeline plus a high level of difficulty installing and maintaining equipment on SPR guided this decision. However, valuable knowledge was gained from this effort that will benefit our assessment of restoration efforts at DSR and future efforts.

With almost if not total reproductive failure, breeding success at the Castle Rocks and Mainland murre colony in 2004 was by far the worst since we began monitoring in 1996. The presence of a breeding pair of ravens that fledged four chicks on the CRM mainland cliffs had a large impact on the colony. The murre subcolony at CRM-03 East, which contained one of two productivity plots, was abandoned prior to egg-laying following several disturbance events by ravens. Frequent disturbance during the pre- and early egg-laying period on other subcolonies, especially CRM-04, likely led to delayed breeding and nest abandonment at some sites. The high predation rate on murre eggs and chicks also contributed to low breeding success. However, even worse than raven impacts was the extended visit by a single juvenile Brown Pelican that actively chased and flushed murres from breeding sites near continuously for the better portion of nine days. Pelican impacts included losses of large numbers of eggs and chicks that were displaced and abandoned or exposed and scavenged by ravens and gulls. Similar disturbance on HPR-02 by another juvenile pelican on one to two days in late June likely led to losses there as well, but to what degree is unknown. Curiously, seasonal murre attendance at both HPR subcolonies ceased earlier than average and almost simultaneously along with the failed CRM subcolonies (except for a brief resurgence at HPR-02), suggesting failed breeding at HPR as well.

Efforts to reduce anthropogenic disturbance were continued in 2004 with additional outreach, including: 1) in April 2004, an informational letter on the effects of aircraft disturbance on seabirds, methods to avoid disturbance, and maps of sensitive colonies was mailed to 123

airports, aviation companies, and flying clubs throughout the San Francisco Bay area; 2) on 28 April, we coordinated with the Monterey Bay National Marine Sanctuary on a 45-minute presentation of similar information that was given to the pilots of the Coast Guard Group San Francisco during one of their safety briefings; 3) on 25 April at the 2004 Dream Machines Car and Air Show at Half Moon Bay Airport, we handed out flyers on effects of human disturbance to seabirds and coordinated with event organizers and air tour operators to reduce overflights near DSR during the show; and 4) on 25 April, we continued coordinating with organizers of the Big Sur Marathon and monitoring for disturbance during that event. These efforts appear to be having substantial benefits, as aircraft overflights and disturbance during the Dream Machines and Big Sur Marathon, as well as the remainder of the year, were highly reduced in 2004.

Efforts for reducing disturbance to seabirds were enhanced by the conviction in November 2004 of a helicopter pilot (J. Cheatham of Verticare, Inc.) for disturbing murres at CRM, a violation of the federal Airborne Hunting Act ("Act"; 50 CFR 27.51). This disturbance was recorded during the Big Sur Marathon ("Marathon") on 27 April 2003. During that event, the pilot's helicopter flew low ($\leq 1,000$ feet) over CRM several times, flushing birds on three passes according to project observers. Aircraft similar to the defendant's had been recorded flushing murres off CRM during past Marathons, which Verticare filmed each year, dating back at least to 1999 (USFWS, unpubl. data). Many contacts had been made with Cheatham and other pilots to advise them of the need to prevent disturbance of birds and the associated laws. Following recorded disturbance from this pilot's aircraft in the 2002 Marathon, USFWS law enforcement mailed the pilot a warning letter informing him of the law regulating harassment of wildlife by aircraft. In 2003, disturbances were documented by project personnel and the information passed on to USFWS law enforcement and the U.S. Attorney Office. Three citations were issued by USFWS law enforcement charging three separate violations of the Act. The defendant pled not guilty and a federal jury trial was conducted 16-19 November 2004 in San Jose, California. The defendant was found guilty of one count of "harassing" murres with his aircraft. This conviction, along with other outreach, may have substantial benefits to murres and other seabirds by demonstrating the will of federal agencies to enforce environmental laws that have been transgressed by aircraft and emphasizing the personal responsibility pilots have to avoid wildlife impacts.

ENVIRONMENTAL EDUCATION PROGRAM

OVERVIEW

The environmental education component of the Common Murre Restoration Project, conducted for 2.5 months in the fall, continued for the ninth year. This program serves two main functions: 1) to provide environmental education, especially on seabirds, to local children; and 2) to provide assistance to the project in maintaining murre decoys for the next year's deployment. These objectives are accomplished through classroom instruction and activities, including murre decoy painting.

In 2004, 33 classes ranging from kindergarten to 5th grade participated in the program. Approximately 6,250 students from the San Francisco Bay Area (Montara, Pacifica, Half Moon Bay, El Granada, Fremont, San Jose, and San Leandro) have participated since the program's inception. As in past years, the education project focused on: 1) natural history, ecology, biology and physiology related to seabirds, especially Common Murres; 2) the 1986 *Apex Houston* oil spill and its impact on the Common Murre colony on DSR; 3) current and historical pressures affecting seabird decline; and 4) the social attraction restoration efforts at DSR and SPR. The education program was divided into two separate presentations given about four weeks apart. The first presentation consisted of a participatory activity exploring seabird adaptations and a slide show summary of the project. The second presentation was conducted after decoys were cleaned and prepared for painting. This presentation included a review of seabird adaptations, an activity emphasizing the importance of coloring for camouflage, painting the decoys, and a group activity building a Common Murre food pyramid. All presentations were given between 14 September 14 and 3 November.

PARTICIPANTS

In 2004, nine schools from four school districts with 32 teachers and approximately 880 students participated in the education program. There were no new schools participating this year. However, Sunset Ridge rejoined the program after taking a year off. There were also nine new teachers participating.

Cabrillo Unified School District

El Granda Elementary

Jennifer Austin, 3rd grade, 22 students
Sue Hatfield, 3rd grade, 22 students
Pauline Shue, 3rd grade, 22 students
Lisa Steinburg, 3rd grade, 22 students

Farallone View Elementary

Linda Carroll, K/1st grade, 20 students
Laura Cooke, K/1st grade, 20 students
Rebecca Johnson, 2nd/3rd grade, 20 students
Diana Purucker, 2nd/3rd grade, 20 students

Hatch Elementary

Maria De La Cueva, 4th grade-immersion, 32 students
Lyn Kelly, 5th grade, 32 students
Bruce Linton, 5th grade-immersion, 32 students
Ann Mangold, 4th grade, 32 students
Vicki Reno, 4th/5th grade, 32 students

Pacifica Union School District

Cabrillo Elementary School

Tiffany Leung, 4th grade, 32 students

Dwan Padilla, 4th grade, 32 students

Ocean Shore Elementary

Sheila Gamble, 3rd grade, 32 students

Jonathon Harris, 4th/5th grade, 40 students

Sunset Ridge Elementary

Pat Costa, 3rd grade, 18 students

Chris Elvander, 3rd grade, 18 students

Valleamar Elementary

Doreen Barnes, 5th grade, 32 students

Cheryl Bingham, 3rd grade, 20 students

Anne Haas, 1st grade, 20 students

Jean McMartin, 5th grade, 32 students

Elizabeth Myers, 3rd grade, 20 students

Katie Pardee, 1st grade, 20 students

Tami Taylor, 3rd grade, 20 students

Alyce Wassall, 1st grade, 20 students

Union School District

Oster School

Barbara Finkle, 4th grade, 28 students

Beth Miller, 4th grade, 28 students

Dawn Ullmark, 4th grade, 28 students

Fremont Unified School District

Warwick Elementary

Melanie Moreno, 4th grade, 96 students (3 classes)

Ann Trammel, 4th grade, 32 students

TEACHER RESOURCE MATERIALS

Participating teachers were provided with the following educational materials:

Returning Home: Bringing the Common Murre Back to Devil's Slide Rock. (The Common Murre Restoration Project 1999) VIDEO. 24 min.

Trashing the Oceans. (NOAA 1988) VIDEO. 7 m in 21 sec.

Learn About Seabirds Curriculum Guide with supplements. (USFWS 1995b)

Poster: *Threats to CA Coastal and Marine Life.* California Coastal Commission.

Zoobooks: Seabirds. (Burst 1995)

A Guide to Alaska Seabirds. (Alaska Natural History Society 1995)

Learn About Seabirds. (USFWS 1995b). SLIDESHOW (30 slides)

Seabirds. (Rauzon 1996)

Project Puffin: How We Brought Puffins Back to Egg Rock. (Kress and Salmansohn 1997)

Giving Back to the Earth: A Teacher's Guide for Project Puffin and Other Seabird Studies. (Salmansohn and Kress 1997)

Educator Workshops/Field Trip Sites Resource Information

Each school's library has received one copy of:

Project Puffin: How We Brought Puffins Back to Egg Rock. (Kress and Salmansohn 1997)
Seabirds. (Rauzon 1996)

DECOY CLEANING AND REPAIR

The process of cleaning decoys included soaking each decoy in water for about 24 hours, scrubbing them with a wire brush to remove excess guano, and rinsing with clean water. The power washer was not used this year as rinsing with a regular hose attachment provided sufficient rinsing. Murre Project staff and volunteers spent about 200 person hours cleaning decoys in 2004.

During and following the decoy painting period, repairs were made to decoys in need. Approximately 100 wooden decoys needed head reattachment and/or bill repair. A wooden dowel was used in reattaching heads to provide extra support. Wood filler was used to fill in any cracks after reattachment. A wooden dowel was also used for decoys that had half or more of the bill missing. A dowel was inserted to determine the correct bill length and wood filler was formed around the dowel to create the shape of the bill. An electric sander was used to smooth out both head and bill repairs.

CLASSROOM PRESENTATIONS

Initial Visits

Adaptations Activity

After a short introduction to the Project, the majority of the presentation consisted of the “Build a Bird” activity modified from the *Learn About Seabirds* binder. This was a highly participatory activity in which all of the students were actively engaged. Whenever possible, questions were used in the presentation to encourage creative thinking and problem solving during the activity. A student was randomly selected to be turned first into a bird, and then a seabird, and then finally a Common Murre. This transition was accomplished by attaching representative objects to the student for each adaptation. Twelve students read aloud cards of bird/seabird adaptations or seabird threats as needed, while the rest connected the adaptation/threat to the object on their desk and pinned it to the ‘bird.’ For example, the “Down Feathers” card printed with the statement of function was read aloud and discussed; the down jacket was identified as a representative object for the adaptation; and finally the jacket was placed on the ‘bird.’ Other represented adaptations included contour feathers, hollow bones, air sacs, bill/beak, webbed feet, oil gland, and salt gland; wings, guano and murre eggs were also discussed without an accompanying card. The guano discussion included examining the ocean food web and the flow of nutrients. Once transformed into a Common Murre, four threats to seabirds were discussed in a similar format: disturbance; exotic and native predators; plastic trash; and oil pollution. The students brainstormed ways to prevent and mediate these threats.

Slide Show

A slide show comprised the final 15 minutes of the presentations. This slide show gave an overview of the Common Murre Restoration Project including: the natural history of the Common Murre; the effects of the 1986 *Apex Houston* oil spill on the colony at DSR; and the restoration efforts on DSR and SPR. The annual activities were explained in chronological order, starting with the deployment of the decoys and concluding with the students’ role in preparing decoys for deployment. Approximately 10 or more minutes were devoted to questions and answers after the presentation.

Assistants

Both a Murre Project staff member and the Environmental Education Specialist from the Refuge's Visitors Center attended an initial visit for observation and assistance. Assistance was provided for about half of the painting presentations by a Refuge employee, volunteer, or SCA intern.

Final Visits (Painting Decoys)

This presentation began with a review of the adaptations of the Common Murre. Students recalled both the adaptation and its function. Next the students participated in a feeding-relay-race activity to reinforce the adaptive function of the camouflage in predation. The students were separated into four teams. Each team had an assigned 'feeding ground' consisting of a white or black poster board covered with equal numbers of black and white fish-shaped pieces. The teams 'fed' simultaneously for a set amount of time and then the results were analyzed in relation to coloration. The students then painted the decoys. Many of the schools attended had two or four classes participating. The first class would paint the white part of the decoy while the second class would paint the black. This allowed time for the white paint to dry before the black was painted to prevent the two colors from mixing. After the decoys were painted, the class created a Common Murre food web together. Phytoplankton, zooplankton, squid, rockfish, sardines, and the Common Murre were attached to a poster with Velcro when students correctly guessed where they belonged on the pyramid. The importance of bringing the murre back to Devil's Slide Rock was discussed after the pyramid was fully constructed. The presentation concluded with a question and answer period.

CLASSROOM EXTENSION ACTIVITIES

Teachers and students have used the curriculum materials to conduct a number of activities and projects, varying from making paper mache eggs to writing stories. Participant classes received monthly newsletters during the spring with updates of the number of Common Murres, eggs, and chicks on DSR and SPR. As the breeding season progressed students tracked the number of Common Murres attending DSR and SPR by using a data chart in their classroom.

EDUCATION PROGRAM SUMMARY

The ninth year of the Common Murre Restoration Project's Environmental Education Program served many students by providing active participation in a local natural resource restoration project. Students continued to assist the project by repainting murre decoys while gaining knowledge of seabirds and marine conservation. Participants demonstrated a strong interest in Common Murres and their restoration, and retained much of the presented information from this year and past years. Many students, parents, teachers, and school staff living near the sites mentioned watching for the birds, decoys and biologists when they drive by the Devil's Slide area of Highway 1. The teachers who have participated for several years highly praised the project as an essential part of their curriculum. This year's education program was highly successful, reaching approximately 880 students and welcoming 9 new teachers. However, due to a reduction in the number of decoys deployed, the education program will no longer be able to offer decoy painting to the schools. Therefore, it will be necessary to design a new curriculum if the Education Program is to continue in future years. Participating teachers received a letter regarding this change and were asked for input for a potential new curriculum.

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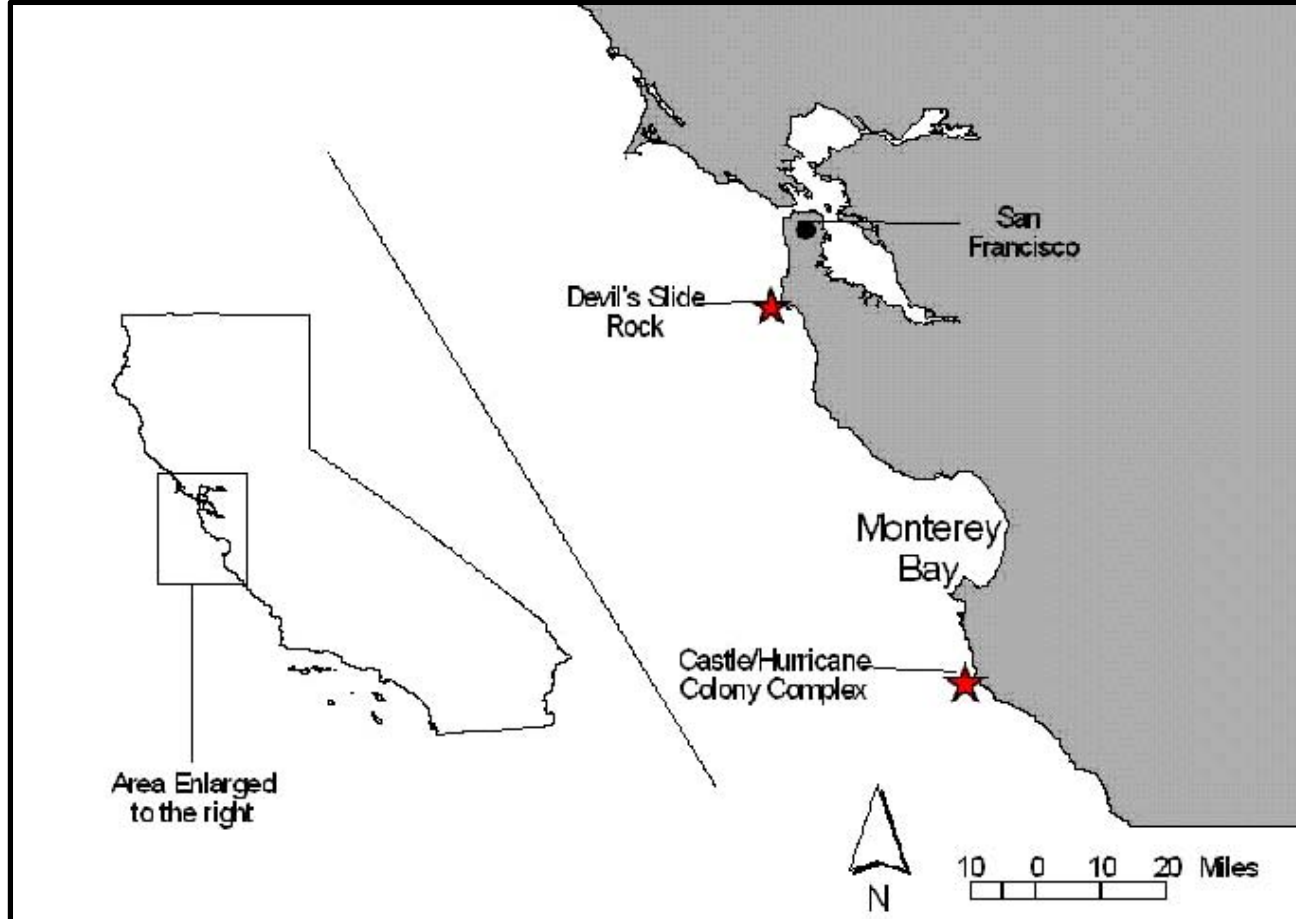


Figure 1. Map showing the location of the two study sites along the central California coast. Devil's Slide Rock and San Pedro Rock (not shown) are located within the Devil's Slide Colony Complex.

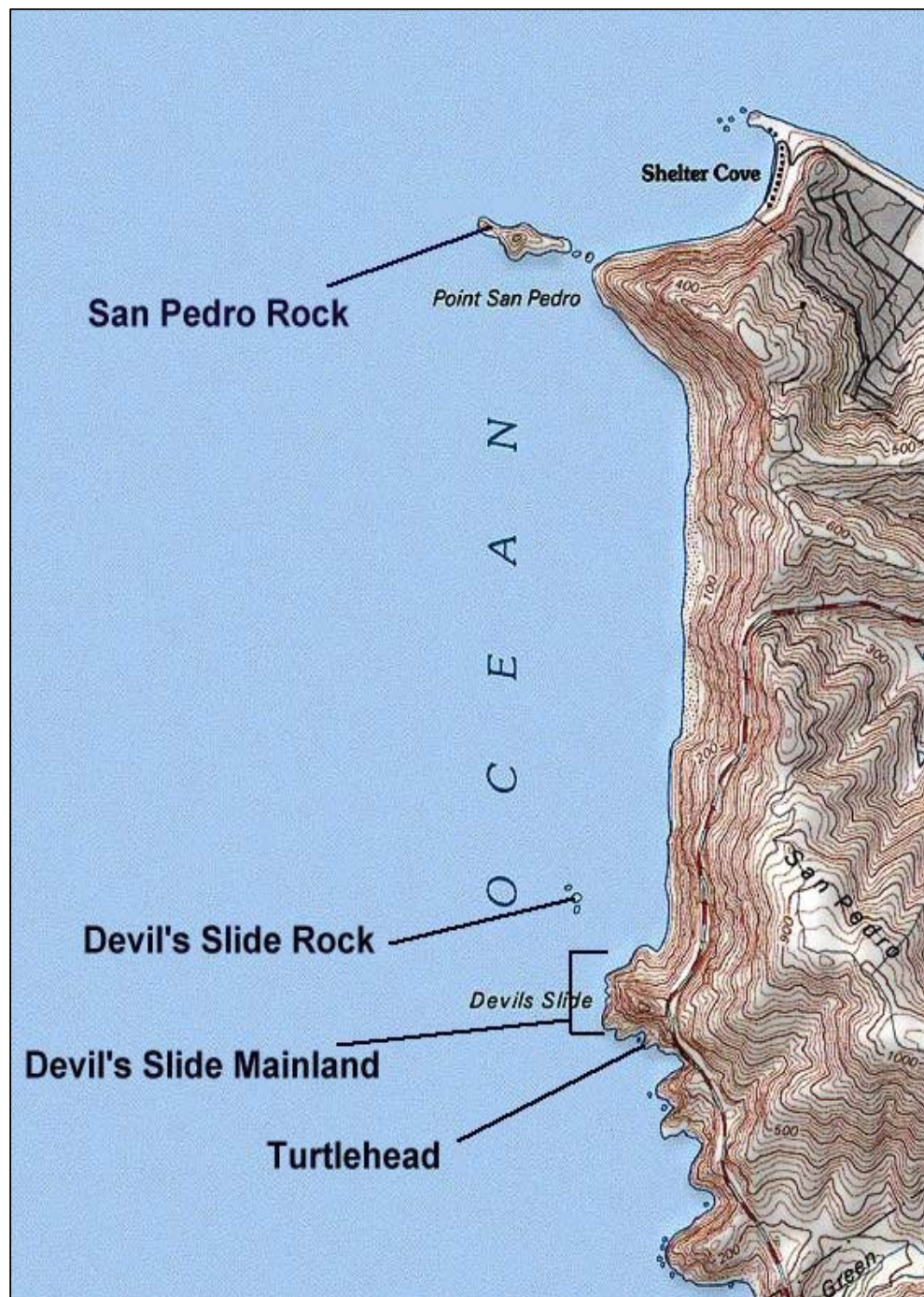


Figure 2. Devil's Slide Colony Complex including colonies and subcolonies monitored by the Common Murre Restoration Project.

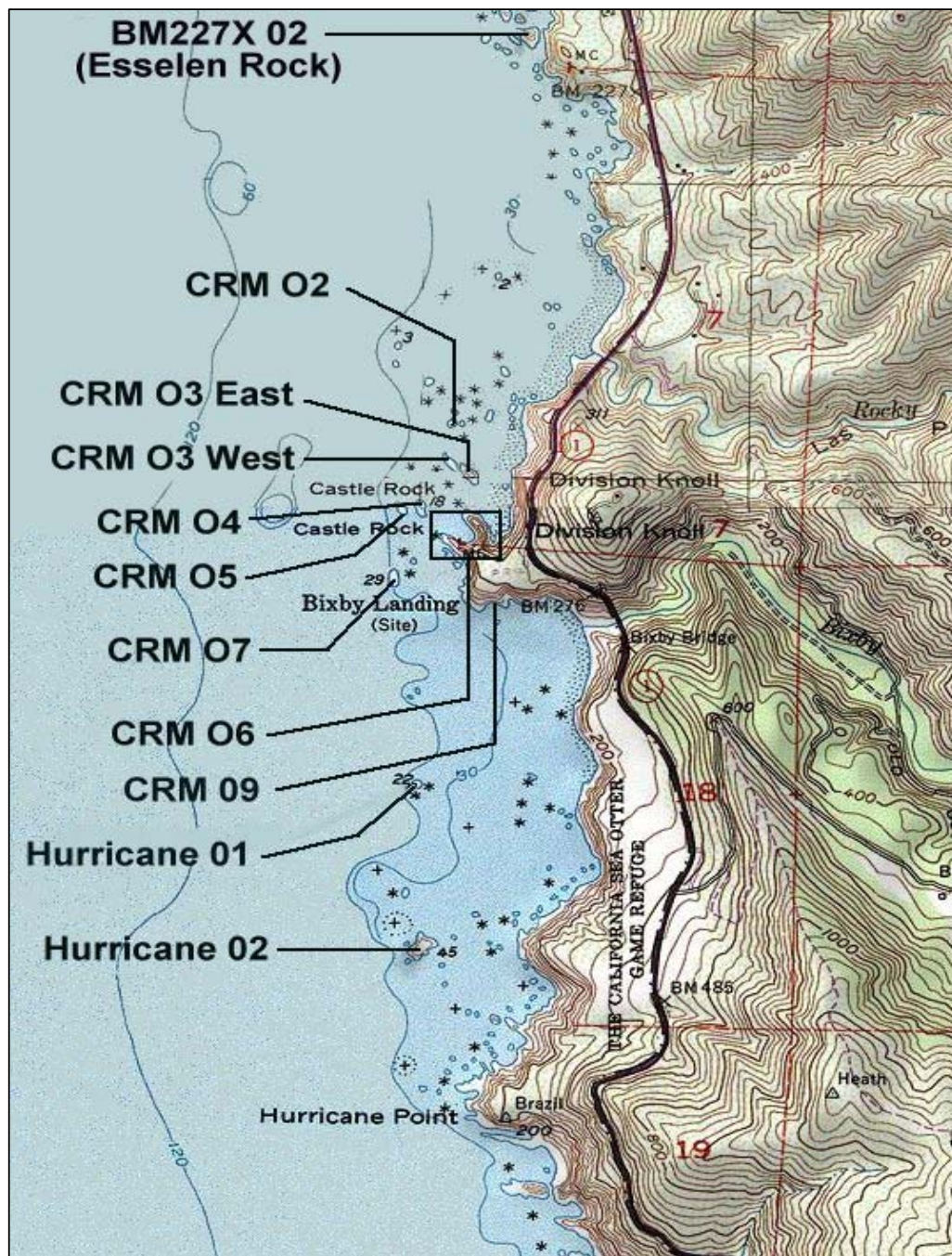


Figure 3. Castle/Hurricane Colony Complex, including Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (Hurricane). Labels indicate subcolonies mentioned in the text.

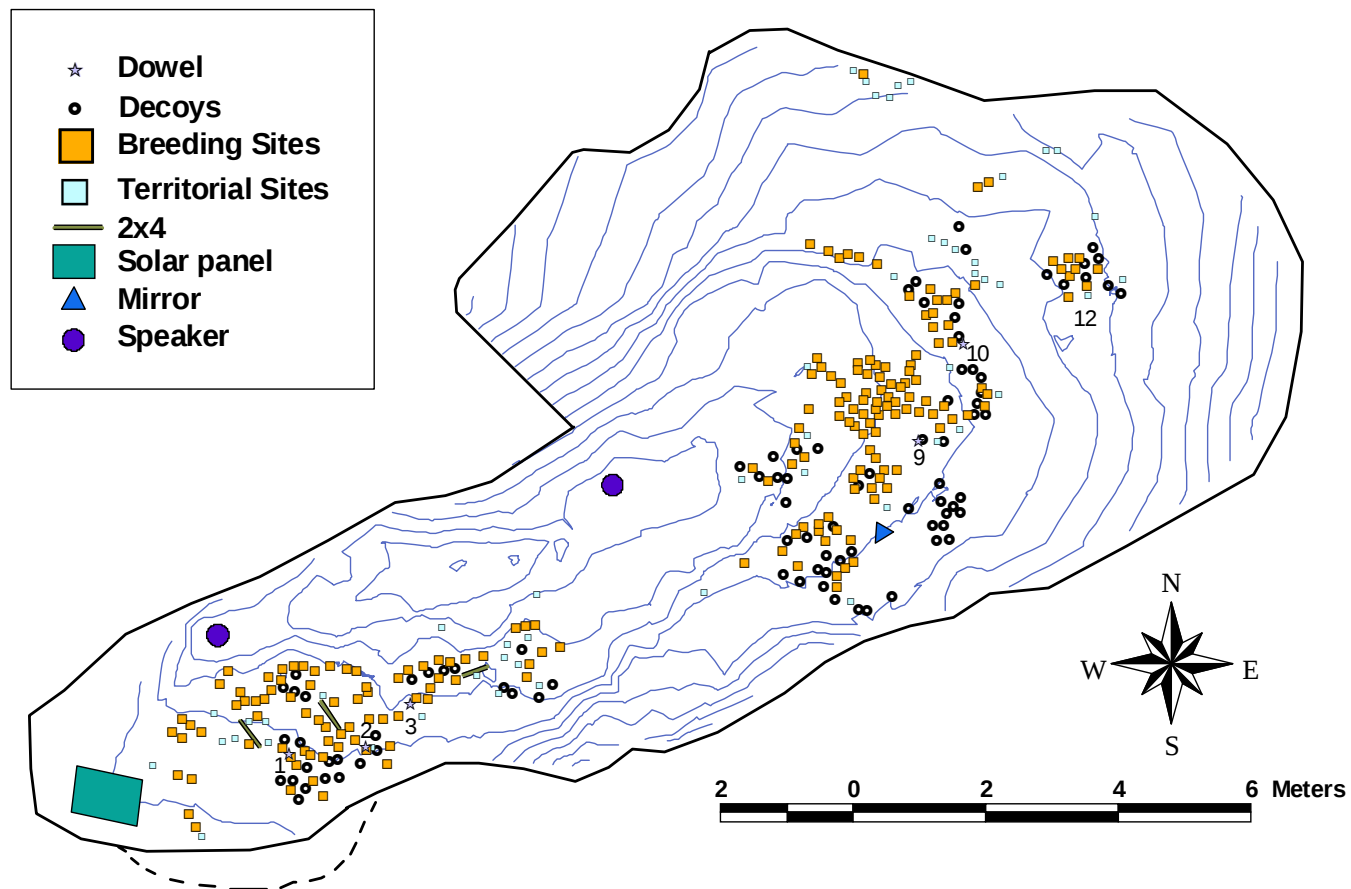


Figure 4. GIS map of Devil's Slide Rock, 2004. Common Murre breeding and territorial sites are shown in relation to social attraction equipment.



Figure 5. Photograph of Common Murre and Brandt's Cormorant decoys on San Pedro Rock.

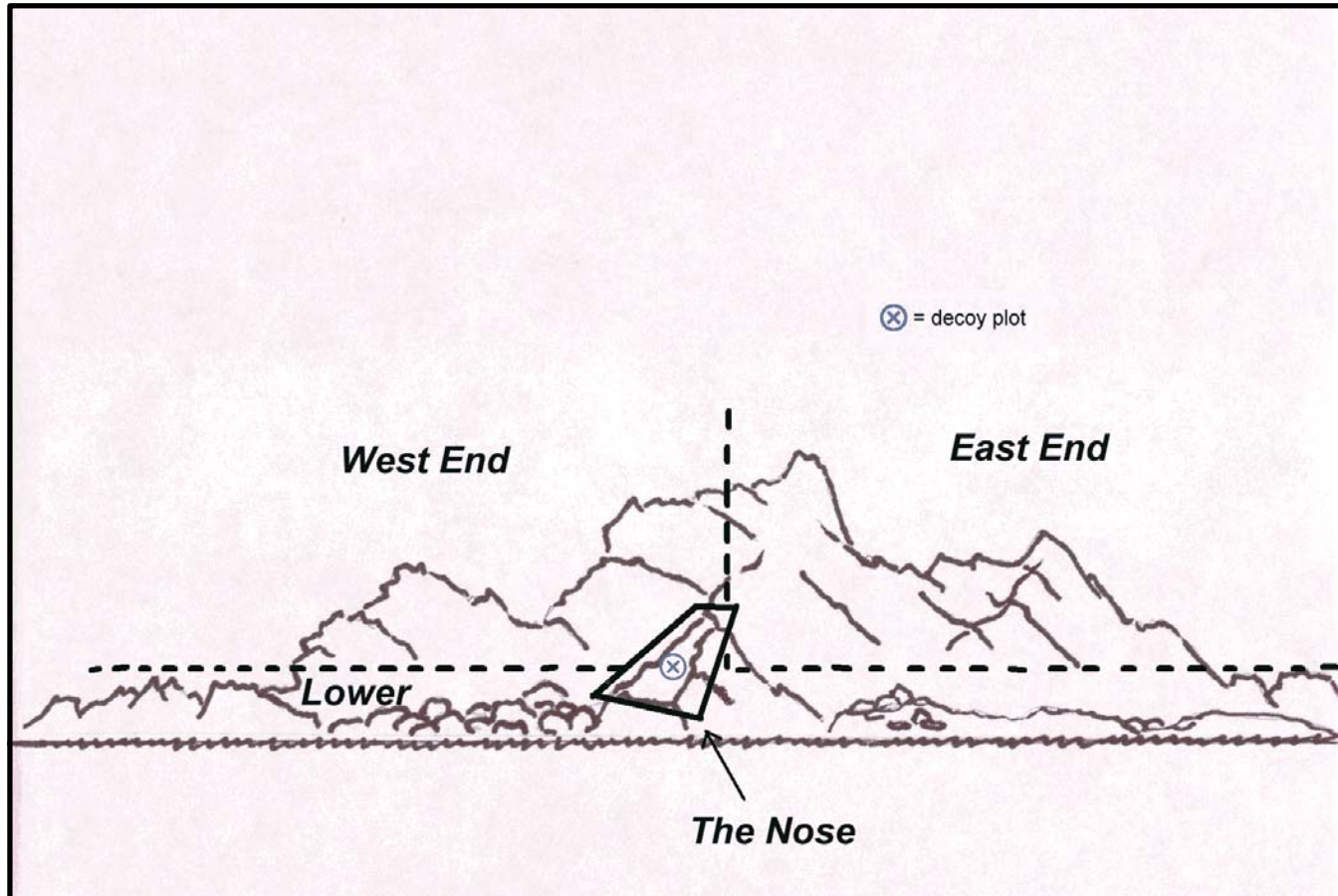


Figure 6. San Pedro Rock (south side) as it appears from the viewing location along Highway 1. The rock is divided into five sections for recording bird and marine mammal locations (West End, East End, Lower, The Nose, Decoy Area).

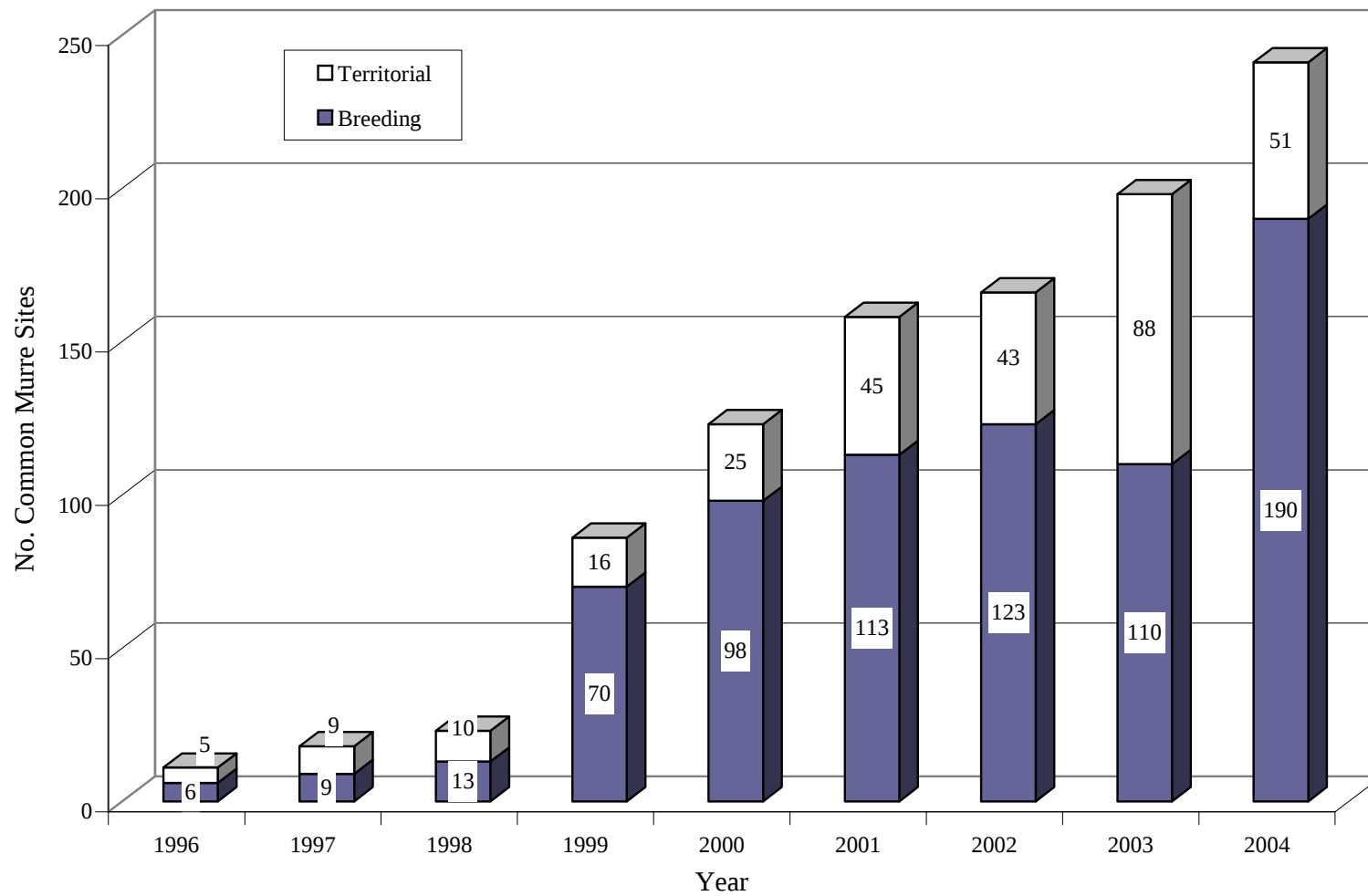


Figure 7. Numbers of Common Murre breeding and territorial sites on Devil's Slide Rock, 1996-2004.

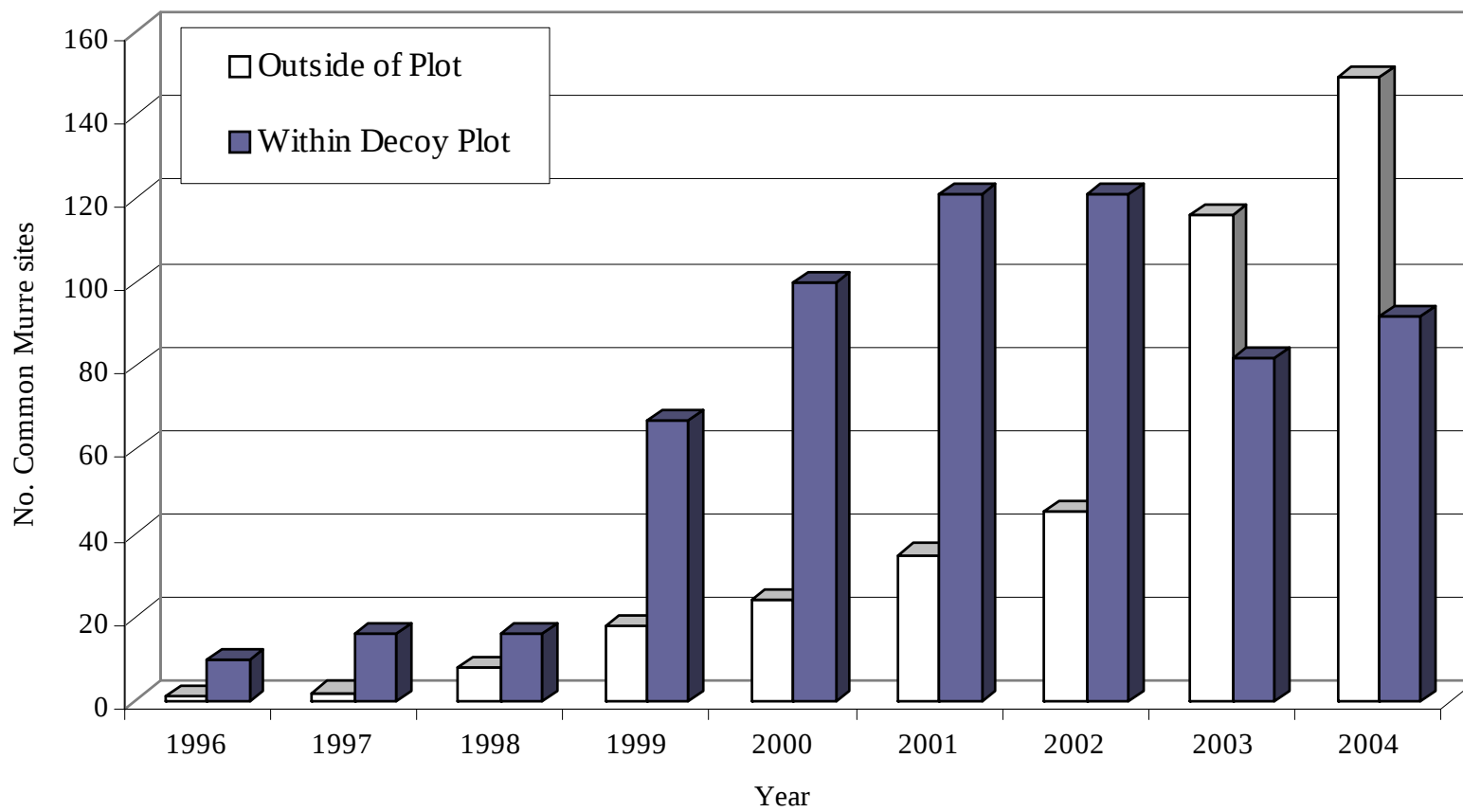


Figure 8. Number of Common Murre breeding and territorial sites within and outside of decoy plots on Devil's Slide Rock, 1996-2004.

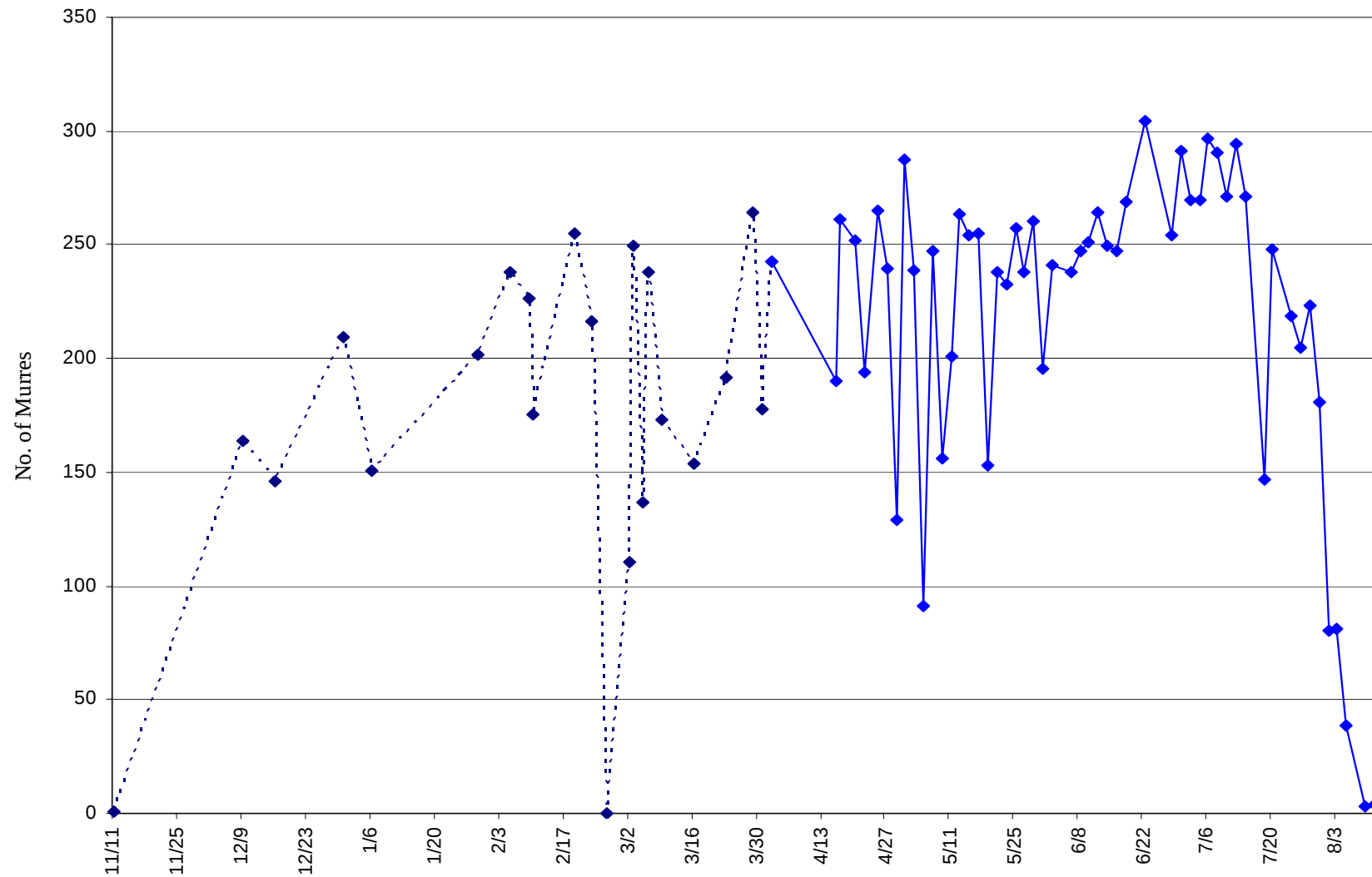


Figure 9. Seasonal attendance of Common Murres at Devil's Slide Rock, 11 November 2003 to 11 August 2004. Attendance is reported as an average of three consecutive counts. Dashed line indicates pre-season (prior to 16 April).

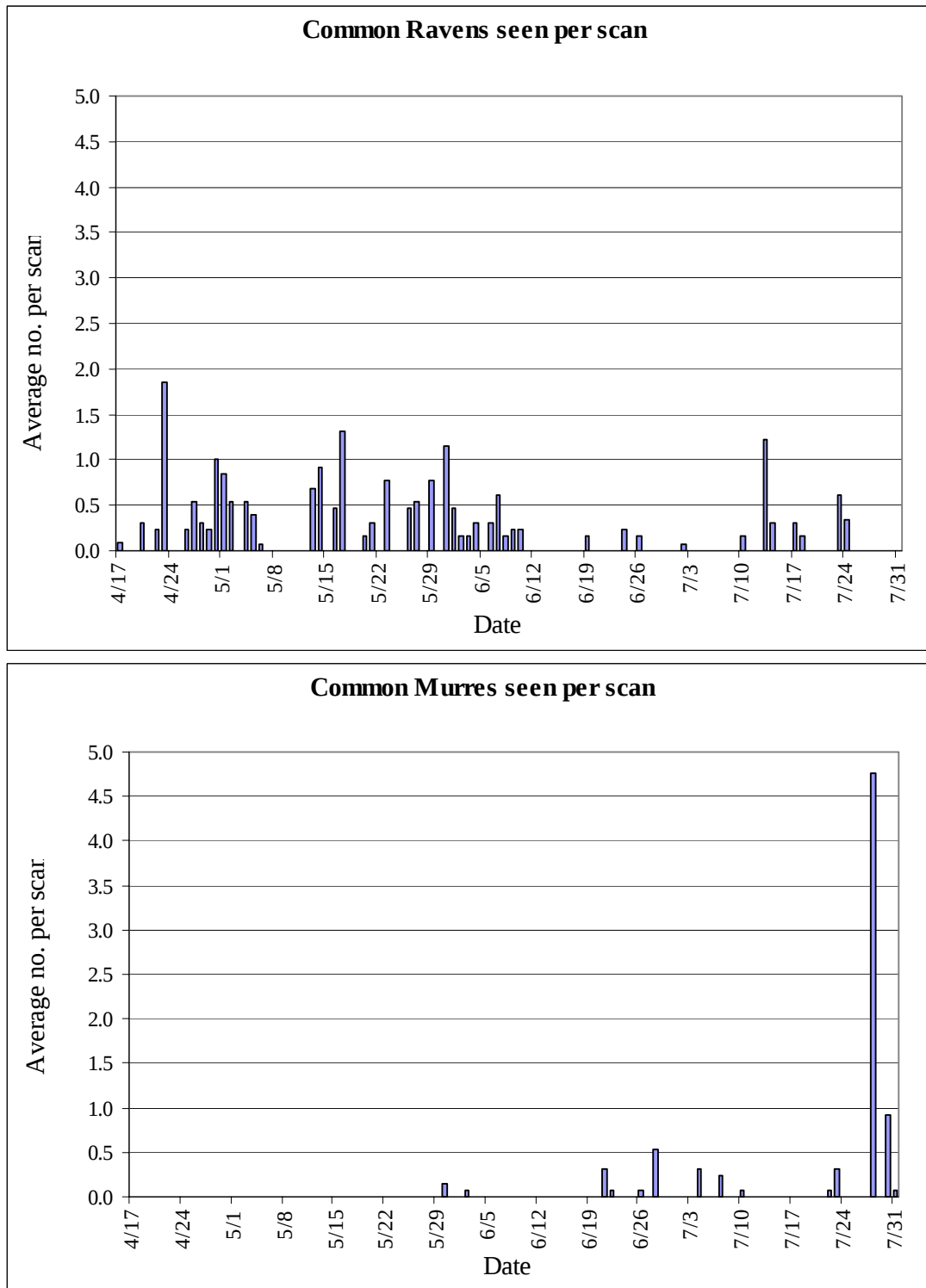


Figure 10. Seasonal attendance of Common Ravens and Common Murres at San Pedro Rock, 17 April to 31 July 2004. Data are presented as the average number of birds seen per 10 minute scan during two hour watches.

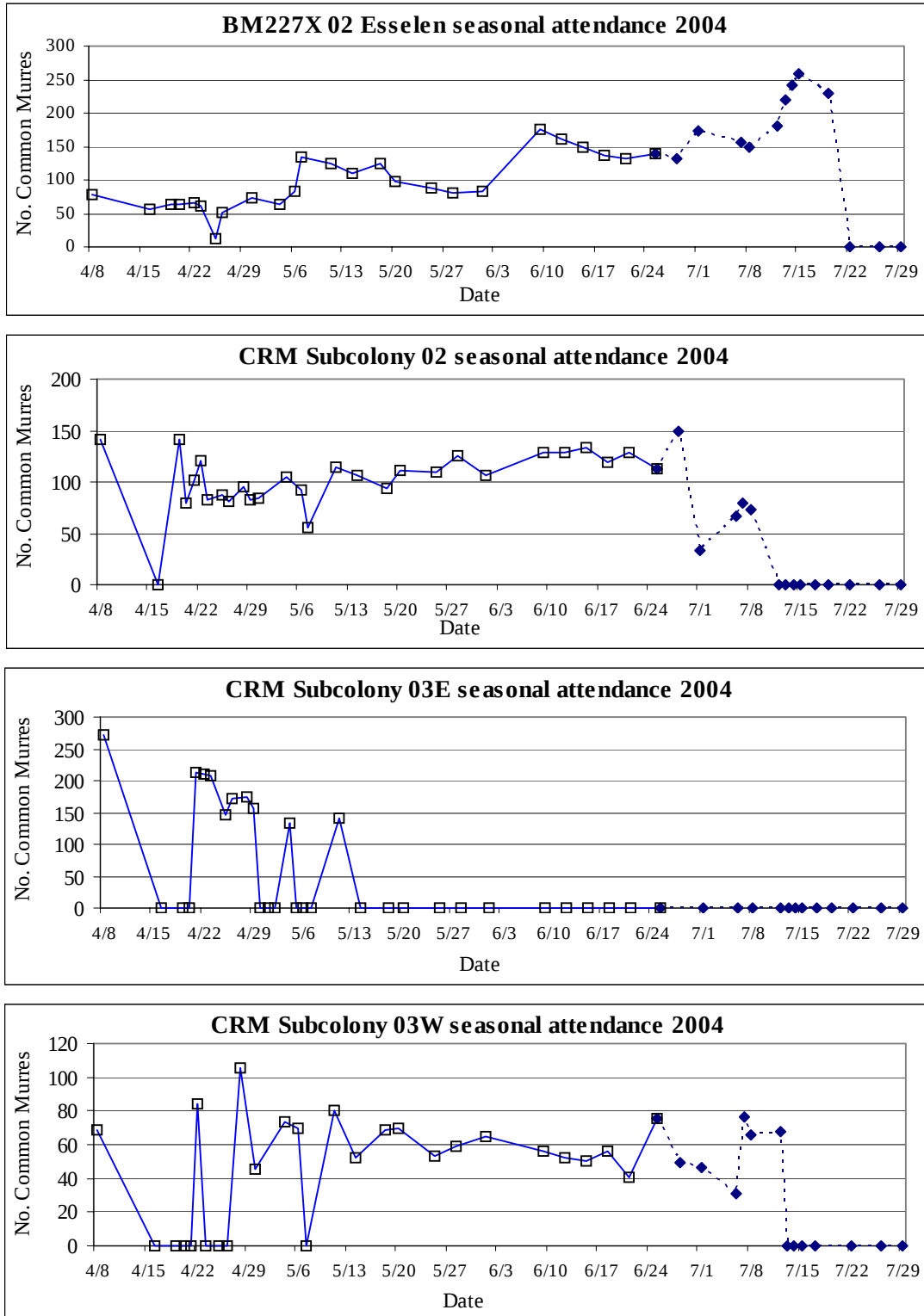


Figure 11. Seasonal attendance patterns of Common Murres at BM227X subcolony 02 (Esselen) and Castle Rocks and Mainland subcolonies 02, 03 East, and 03 West, 8 April to 29 July 2004. Dashed line indicates attendance after arrival of a juvenile Brown Pelican on 24 June (see Disturbance).

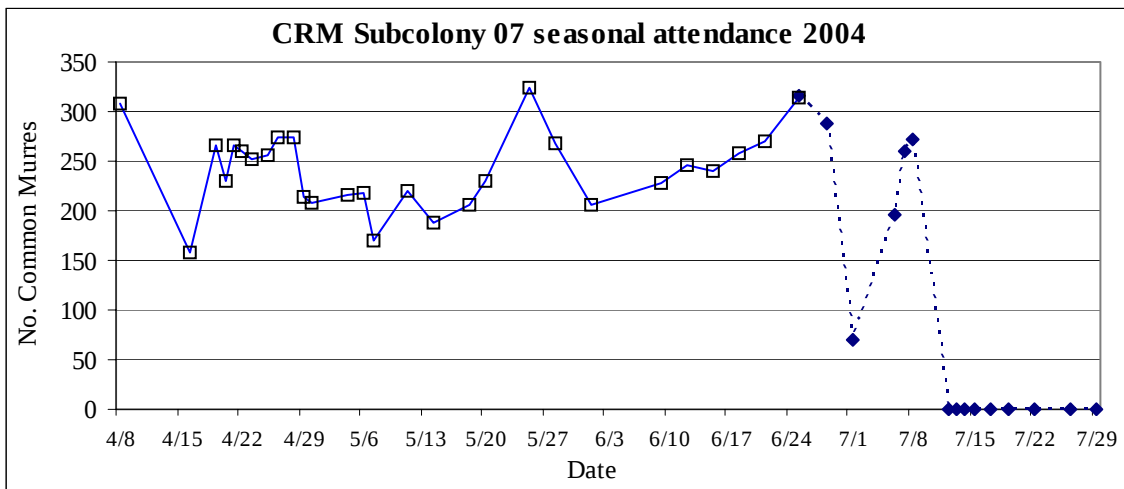
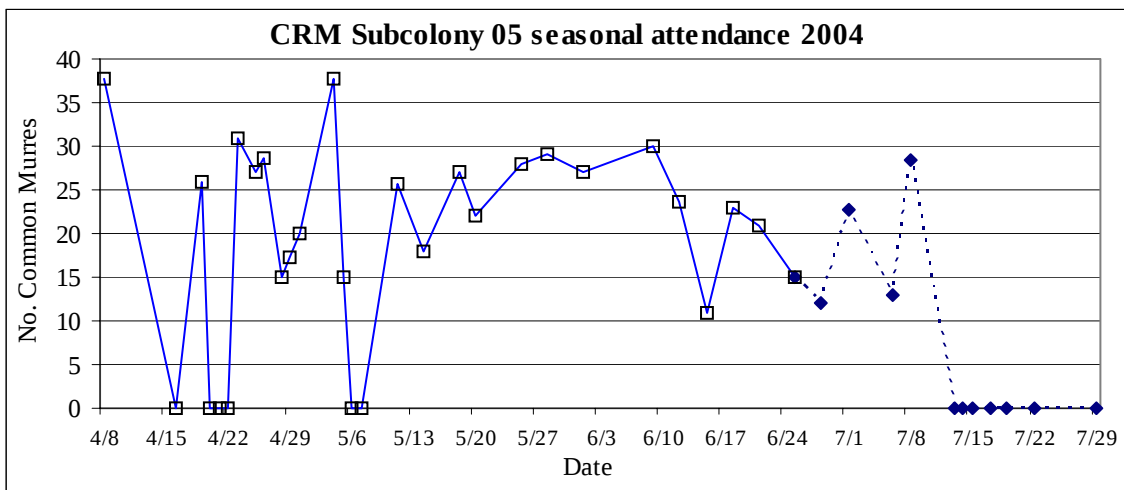
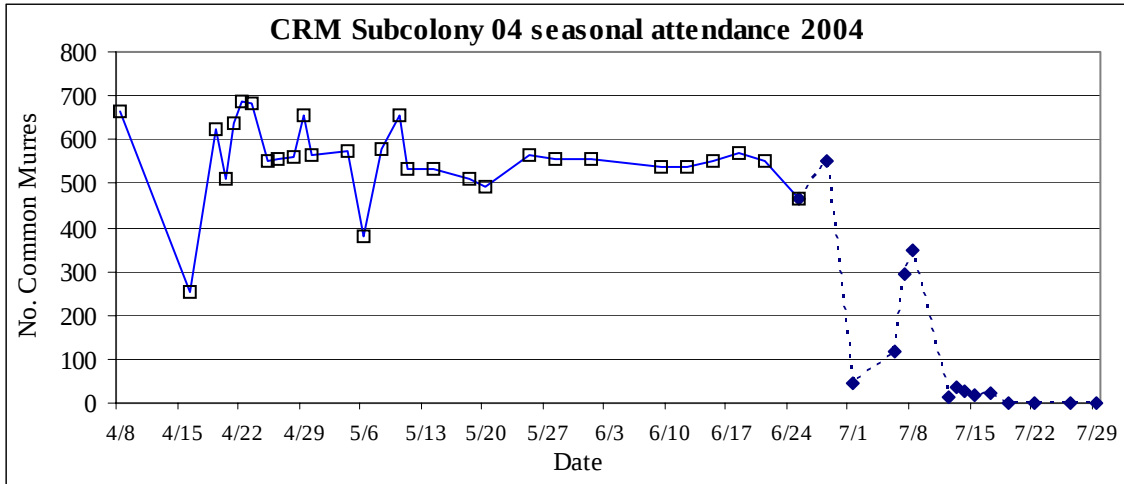


Figure 12. Seasonal attendance patterns of Common Murrels at Castle Rocks and Mainland subcolonies CRM 04, 05, and 07, 8 April to 29 July 2004. Dashed line indicates attendance after arrival of a juvenile Brown Pelican on 24 June (see Disturbance).

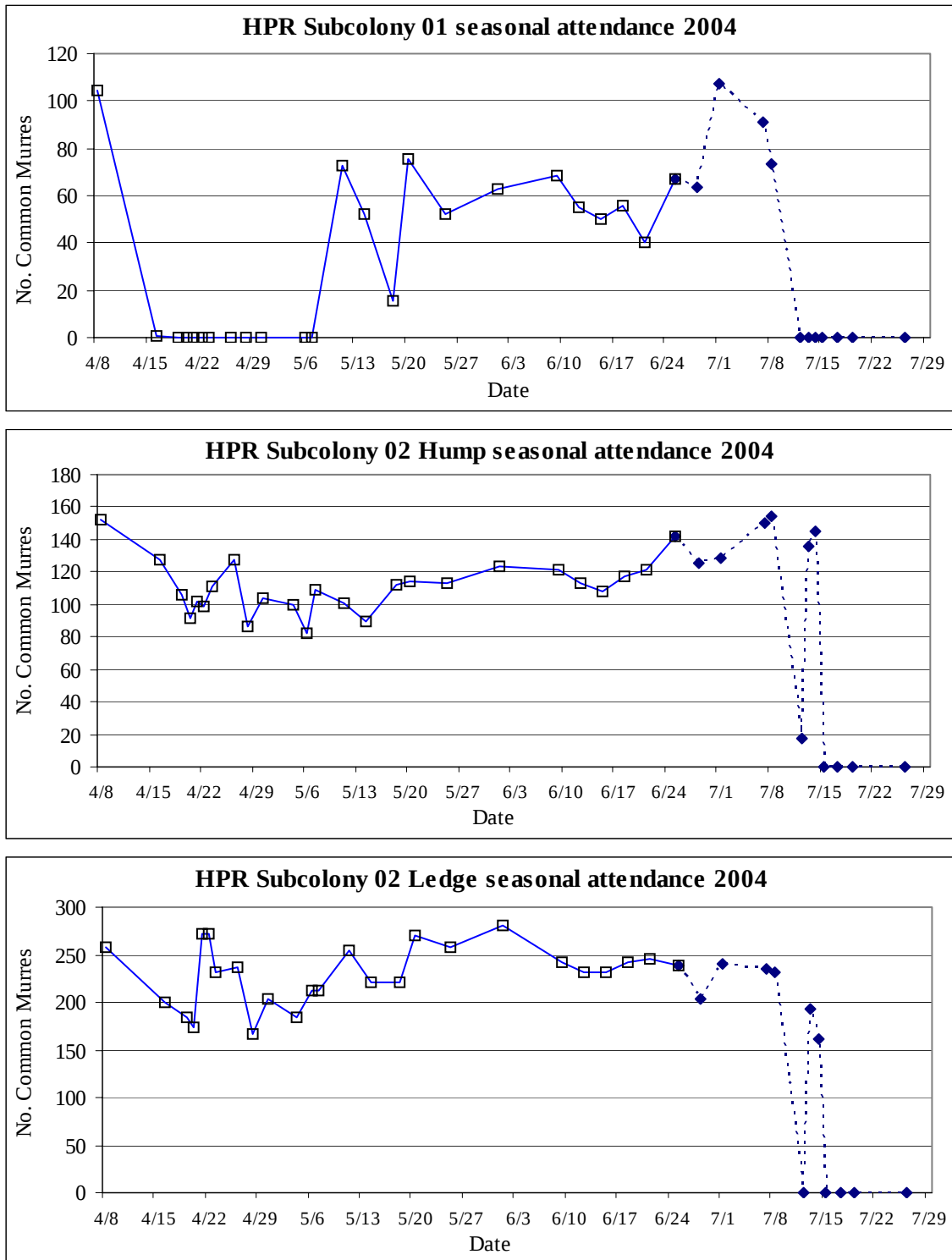


Figure 13. Seasonal attendance patterns of Common Murres at Hurricane Point Rocks subcolony 01, 02 Ledge, and 02 Hump, 8 April to 29 July 2004. Dashed line indicates attendance after arrival of a juvenile Brown Pelican on 24 June (see Disturbance).

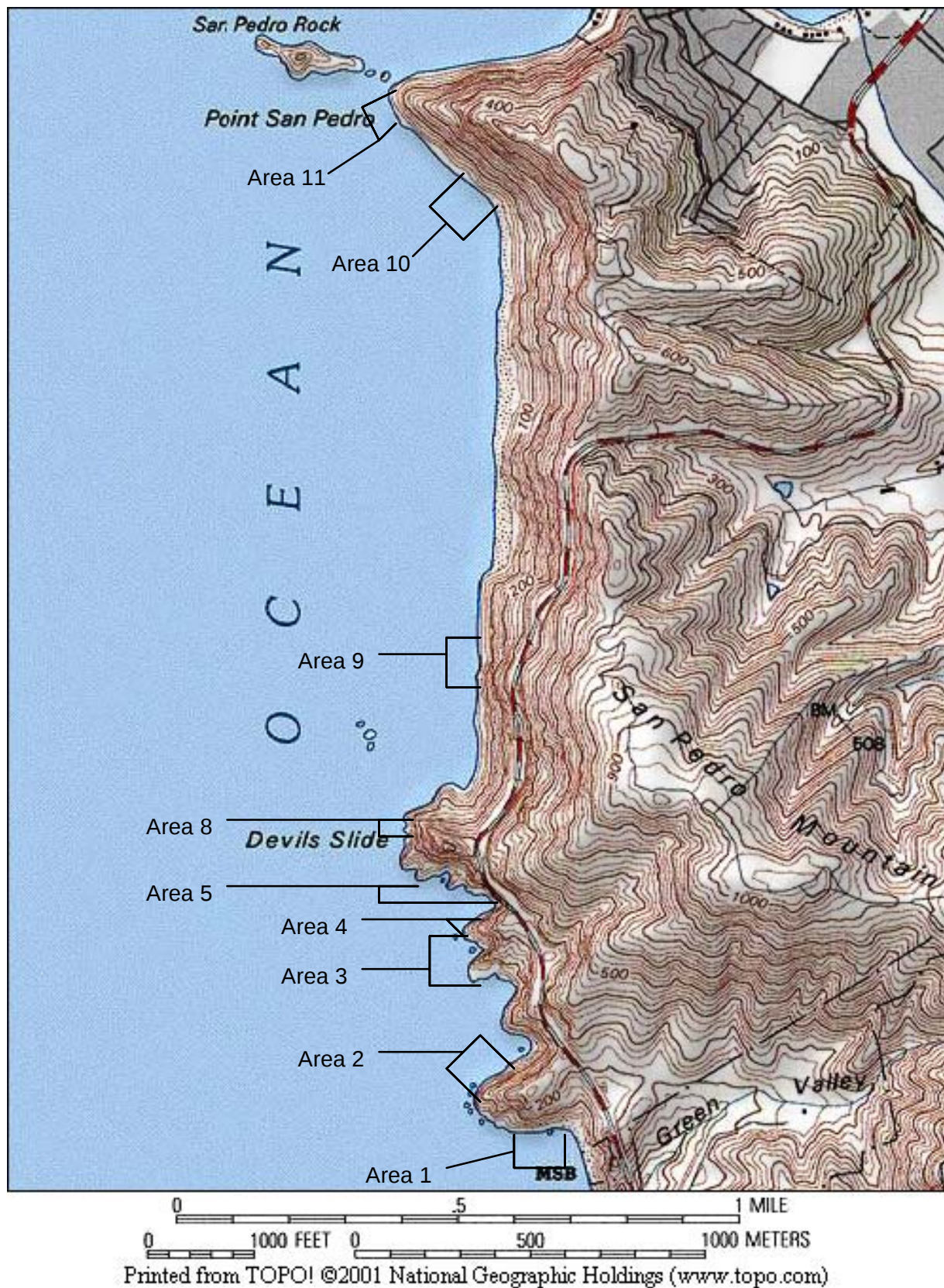


Figure 14. Survey areas from boat survey of seabird colonies in the San Pedro Rock to Devil's Slide areas, 18 June 2004.

2004 PICTORIAL HIGHLIGHTS



Figure 15. Aerial overview photograph of Devil's Slide Rock, 3 March 2004.



Figure 17. Prospecting Common Murre among decoys on San Pedro Rock, 21 June 2004.



Figure 16. Aerial overview photograph of Devil's Slide Rock, 25 May 2004.



Figure 18. Pair of Common Ravens attracted to mirrors on San Pedro Rock, 6 June 2004.



Figure 19. View to southwest from Castle Pullout of raven nesting cliff at Castle Mainland, 2004. Arrow indicates approximate location of nest.



Figure 21. "Right" side of CRM-04 productivity plot, 12 June 2004.



Figure 20. Common Raven with a murre egg, Castle Rocks subcolony 04, May 2004.



Figure 22. Juvenile Brown Pelican on "right" side of CRM-04 productivity plot during disturbance event, late June 2004. Note the murre chick near the pelican's tail.

Table 1. Common Murre productivity at Devil's Slide Rock (DSR) and Castle Rocks and Mainland (CRM), 2004.

Colony/ Plot	# of Sites Monitored	# of Egg Laying Sites	# of Eggs Laid	# of Eggs Hatched	Hatching Success ¹	# of Chicks Fledged	Fledging Success ²	Chicks Fledged per Pair
DSR	313	190	201	142	70.6%	133	93.7%	0.70
CRM- 03 East	0	0	0	0	0	0	0	0
CRM- 04	106	85	89	54	60.7%	1	1.9%	0.01

¹ Hatching success is defined as the number of eggs hatched per eggs laid (includes both first and replacement clutches).

² Fledging success is defined as the number of chicks fledged per eggs hatched (includes both first and replacement clutches).

Table 2. Non-anthropogenic disturbances incidentally observed at the Castle/Hurricane Colony Complex, 2004. Data listed includes: mean number and range of murres/eggs/chicks disturbed or lost per event, and the number of events.

Source	Disturbance Events	Average # of Murres Disturbed (range)	Egg Loss	Chick Loss	# of Disturbance Events/hr
Common Raven	184	89.5 (1-350)	37	7	0.397
Brown Pelican	97	111.3 (12-400)	6 ¹	21 ²	0.209
Western Gull	4	35.5 (31-40)	2	0	0.008
Peregrine Falcon	2	120 (40-200)	0	0	0.004
Turkey Vulture	1	50 (50)	0	0	0.002
Unknown	14	37.2 (15-85)	0	0	0.03
Total	302	93.7 (1-400)	45	28	0.653

¹ Egg loss due to Common Raven and Western Gull predation (see Table 3)

² Chick loss due to Common Raven, Western Gull and Brown Pelican predation (see Table 3).

Table 3. Common Murre egg and chick loss on Castle Rocks and Mainland, subcolony 04 during Brown Pelican disturbances, 24 June to 2 July 2004.

Source	Egg Depredation	Chick Depredation	Chick Displacement
Common Raven	5	15	0
Western Gull	1	3	0
Brown Pelican	0	2	1 ¹
Total	6	20	1

¹ Chick was kicked from the rock by a murre during a flushing event.

Table 4. Aircraft sightings, boat sightings, and resulting disturbances incidentally observed at Devil's Slide Rock, 2004.

Source	# of Aircraft or Boats in area	# of Aircraft or Boats/hr	# of Disturbance Events	# of Disturbance Events/hr	Average # of Birds Disturbed (range)
Plane	66	0.107	0	0	0
Helicopter	58	0.094	7	0.011	11.7 (2-50)
Boat	23	0.037	1	0.002	3
Total	147	0.238	8	0.013	10.6 (2-50)

Table 5. Brandt's Cormorant breeding phenology and reproductive success at Devil's Slide Rock and Mainland, 2004.

Subcolony	# of sites monitored	Mean laying date (range; n)	Mean hatching date (range; n)	Mean # of eggs per site (range; n)	Mean # of chicks per site (range; n)	Mean # of chicks fledged per site (range; n)
Devil's Slide Rock	91	12 May (15 Apr - 26 June; n=82)	10 June (23 May - 17 June; n=74)	3.3 (2-4; n=63)	2.3 (0-4; n=90)	1.9 (0-4; n=90)
Mainland South	61	4 May (10 Apr - 29 May; n=57)	5 June (14 May - 28 June; n=56)	3.4 (2-5; n=59)	2.7 (0-4; n=59)	2.4 (0-4; n=61)
Turtlehead	24	6 May (12 Apr - 21 May; n=24)	7 June (27 May - 21 June; n=24)	3.7 (2-5; n=23)	2.9 (1-4; n=24)	2.3 (1-4; n=24)
Total	176	8 May (10 Apr - 26 June; n=163)	7 June (14 May - 28 June; n=154)	3.4 (2-5; n=145)	2.5 (0-4; n=173)	2.1 (0-4; n=175)

Table 6. Numbers of Brandt's Cormorant poorly-built nests (PBN), fairly-built nests (FBN), and well-built nests (WBN) counted at the Devil's Slide Rock and Mainland colony, 2004.

Subcolony	Nest type	17 Apr	27 Apr	9 May	17 May	31 May	10 Jun	22 Jun	30 Jun	12 Jul
DSR	PBN	5	8	3	2	0	7	1	1	0
	FBN	4	3	8	2	0	4	1	1	0
	WBN	8	4	44	48	65	66	79	71	59
Mainland South	PBN	7	5	1	1	0	1	0	0	0
	FBN	12	7	8	5	0	0	1	0	0
	WBN	3	7	64	67	81	78	83	97	74
April's Finger	PBN	0	n/a	2	2	0	0	0	0	0
	FBN	1	n/a	3	1	0	0	0	0	0
	WBN	0	n/a	4	6	8	9	8	8	8
Turtlehead	PBN	2	0	1	0	0	0	0	0	0
	FBN	0	0	4	2	0	0	0	0	0
	WBN	0	0	20	22	24	24	25	24	24

Table 7. Numbers of Brandt's Cormorant poorly-built nests (PBN), fairly-built nests (FBN), and well-built nests (WBN) counted at the Castle/Hurricane Colony Complex, 2004. Not all subcolonies were counted on each day.

Subcolony	Nest type	16 Apr	22 Apr	30 Apr	7 May	14 May	18 May	20 May	9 Jun	18 Jun	25 Jun	1 Jul	8 Jul
CR06S-S	PBN	3	n/a	0	0	0	n/a	0	n/a	0	n/a	n/a	n/a
	FBN	2	n/a	0	0	0	n/a	0	n/a	0	n/a	n/a	n/a
	WBN	3	n/a	9	29	18	n/a	21	n/a	20	n/a	n/a	n/a
CR07	PBN	1	0	0	0	0	n/a	n/a	0	0	0	0	0
	FBN	2	2	0	0	0	n/a	n/a	0	0	0	0	0
	WBN	1	3	6	6	6	n/a	n/a	6	6	4	2	0
CR09	PBN	11	0	0	n/a	0	n/a	0	0	0	n/a	n/a	n/a
	FBN	14	4	2	n/a	0	n/a	0	0	0	n/a	n/a	n/a
	WBN	4	11	24	n/a	15	n/a	62	58	41	n/a	n/a	n/a
BM227X-02	PBN	21	1	0	1	0	0	2	1	0	n/a	0	n/a
	FBN	19	2	1	7	5	2	3	0	0	n/a	0	n/a
	WBN	52	19	34	59	42	44	120	101	94	n/a	12	n/a
H02	PBN	3	0	0	0	0	0	0	1	0	0	n/a	0
	FBN	7	4	0	4	0	0	1	0	0	0	n/a	0
	WBN	7	15	17	18	19	20	20	27	25	19	n/a	4

Table 8. Summary of aerial photograph counts of Common Murres (COMU), Brandt's Cormorants (BRCO), and Double-crested Cormorants (DCCO) at sample central California breeding colonies, 2004.

Colony Name	CCN ¹	USFWSCN ²	Date	COMU	Brandt's Cormorant			Double-crested Cormorant		
				Birds	Nests	Sites	Birds	Nests	Sites	Birds
Point Reyes	MA-374-01	429-001	05/25/04	24,437	580	61	721	0	0	0
Point Resistance	MA-374-03	429-024	05/25/04	4,246	14	0	33	0	0	0
Miller's Point Rocks	MA-374-04	429-002	05/25/04	904	148	9	191	0	0	0
Double Point Rocks	MA-374-05	429-003	05/25/04	9,472	164	11	334	0	0	0
North Farallon Islands	SF-FAI-01	429-051	05/25/04	43,071	51	9	139	0	0	0
South Farallon Islands	SF-FAI-02	429-052	05/24/04	76,287	8,507	347	10,677	561	2	606
Alcatraz Island	SFB-SF-11	429-036	05/25/04	0	789	0	993	0	0	0
Lobos Rock & Land's End	SF-374-02	429-029	05/25/04	0	119	0	185	0	0	0
Seal Rocks	SF-374-03	429-009	05/25/04	0	0	0	131	0	0	0
Devil's Slide Rock & Mainland	SM-372-03	429-014	05/25/04	291	346	11	502	0	0	0
Año Nuevo Island	SM-370-04	429-023	05/27/04	0	1,639	9	2,486	0	0	0
Bench Mark-227X	MO-362-18	454-029	05/27/04	323	222	2	237	0	0	0
Castle Rocks & Mainland	MO-362-19	454-010	05/27/04	1,737	171	0	198	0	0	0
Hurricane Point Rocks	MO-362-20	454-011	05/27/04	804	34	1	39	0	0	0
TOTAL				161,572	12,784	460	16,866	561	2	606

¹ CCN = California Colony Number

² USFWSCN = U.S. Fish and Wildlife Service Colony Number.

Table 9. Numbers of Pelagic Cormorants, Western Gulls, Pigeon Guillemots, and Black Oystercatchers counted at breeding colonies on a boat survey between San Pedro Rock and Pillar Point, 18 June 2004. ND, no data.

Colony Name Area	Pelagic Cormorant		Western Gull		Pigeon Guillemot			Black Oystercatcher			
	Nest	Bird	Nest	Bird	Land	H ₂ O	Total	Nest	Bird (land)	Bird (fly)	Bird (total)
San Pedro Rock											
North side	0	0	1	1	ND	37	37	0	0	0	0
South side	0	0	5	ND	0	40	40	1	ND	3	0
Total	0	0	6	ND	ND	77	77	1	0	3	0
San Pedro Point											
South side	0	0	0	0	2	0	2	0	0	0	0
Area 10	0	0	0	0		4	4	0	0	0	0
Total	0	0	0	0	2	4	6	0	0	0	0
Devil's Slide Rk. & Mainland											
Area 9 ("Pipe Point")	0	0	0	0		8	8	0	0	2	2
Area 8	0	0	1	2	0	0	0	0	0	0	0
Turtlehead	3 ¹	1	0	0	0	0	0	0	0	0	0
Devil's Slide Rock	0	0	2	2	0	0	0	0	0	0	0
Area 5 (Turtlehead Cove)	7	10	0	0	ND	62	62	0	0	4	4
Area 4	2	4	1	2	0	0	0	0	0	0	0
Area 3	4	7	0	0	0	0	0	0	0	0	0
Area 2	22	28	0	2	0	19	19	0	0	0	0
Area 1	19	33	0	0	0	8	8	0	0	1	1
Total	57	83	4	8	---	97	97	0	0	7²	7²
Pillar Point	0	0	0	0	0	1	1	0	0	0	0

¹ Seasonal total. One active nest remained 17 June.

² May include double counts of some birds since all birds were flying.

Table 10. Numbers of Pelagic Cormorant, Western Gull, and Black Oystercatcher nests and Pigeon Guillemot birds counted at the Castle/Hurricane Colony Complex, 2004.¹

Colony/ Subcolony	Pelagic Cormorant	Western Gull	Black Oystercatcher	Pigeon Guillemot
Bench Mark- 227X				
BM-02 (Esselen Rk.)	0	2	0	0
BM-05 (Rk. W. of Sub. 02)	0	1	0	0
BM-06 (Slea Stack)	0	1	0	0
Total	0	4	0	0
Castle Rocks & Mainland				
CRM-01	0	1	1	-
CRM-02	0	1	0	-
CRM-03A (Rock 03 West)	0	0	0	-
CRM-03B (Rock 03 East)	0	1	1	-
CRM-04	0	1	0	-
CRM-05	0	1	0	-
CRM-06	0	1 ²	0	-
CRM-07	1	0	0	-
CRM-09	4	0	0	-
CRM-10 (Rk. SE of CRM-01)	0	1	0	-
CRM-11 (Rk. E. of CRM-03B)	0	1	0	-
Total	5	7	2	13³
Hurricane Point Rocks				
HPR-01 (North Rock)	0	1	0	0
HPR-02 (South Rock)	1	12	0	4 ³
HPR-03	0	4	0	0
Total	1	17	0	4³

¹ Cormorant, gull, and oystercatcher nest counts from 9 June 2004 survey, unless otherwise indicated.

² Count from aerial photographic survey, 27 May 2004.

³ Seasonal high total from sea surface scans and colony counts. High count at CRM from 1 July and at HPR 12 July, respectively.

Appendix 1. Raw counts by subcolony of Common Murre birds and Brandt's and Double-crested Cormorant nests, sites, and birds from aerial photographic surveys of central California colonies, 2004. SC# = Subcolony Number.

Date	Colony Name	SC#	Subcolony Name	Common Murre	Brandt's Cormorant			Double-crested Cormorant		
					Nest	Site	Bird	Nest	Site	Bird
5/25/2004	Point Reyes	03B	Lighthouse Rock	15100	0	0	0	0	0	0
5/25/2004	Point Reyes	03C	NW Lighthouse Cliffs	1049	0	0	0	0	0	0
5/25/2004	Point Reyes	03D	Aalge Ledge	0	0	0	0	0	0	0
5/25/2004	Point Reyes	03E	The Bulb	309	0	0	0	0	0	0
5/25/2004	Point Reyes	03F	SW Lighthouse Cliffs	94	0	0	0	0	0	0
5/25/2004	Point Reyes	04	S Lighthouse Cliffs	296	0	0	1	0	0	0
5/25/2004	Point Reyes	05B	Boulder Rock	1807	0	0	0	0	0	0
5/25/2004	Point Reyes	05C	Pebble Point	327	0	0	0	0	0	0
5/25/2004	Point Reyes	08A	Trinity Point	15	247	44	316	0	0	0
5/25/2004	Point Reyes	09A	Cliff Colony West	104	255	2	278	0	0	0
5/25/2004	Point Reyes	10A	Northwest Rock	150	0	0	0	0	0	0
5/25/2004	Point Reyes	10B	Flattop	1040	0	0	0	0	0	0
5/25/2004	Point Reyes	10C	Middle Rock	874	0	0	0	0	0	0
5/25/2004	Point Reyes	10D	East Rock	246	0	0	0	0	0	0
5/25/2004	Point Reyes	10E	Beach Rock	257	0	0	0	0	0	0
5/25/2004	Point Reyes	10H	Tim Tam	229	0	0	0	0	0	0
5/25/2004	Point Reyes	11B	Face Rock	429	0	0	0	0	0	0
5/25/2004	Point Reyes	11E	Mainland E. of Spine	0	10	5	20	0	0	0
5/25/2004	Point Reyes	13	Cone Rock	2028	0	0	0	0	0	0
5/25/2004	Point Reyes	14B	Subcolony 14B	78	3	7	16	0	0	0
5/25/2004	Point Reyes	14D	Miwok Rock	5	42	1	53	0	0	0
5/25/2004	Point Reyes	14E	Miwok Mainland	0	23	2	33	0	0	0
5/25/2004	Point Reyes	19	Subcolony 19	0	0	0	4	0	0	0
5/25/2004	Point Resistance	02	Point Resistance	4246	14	0	33	0	0	0
5/25/2004	Miller's Point Rocks	01	North Rock	203	2	0	2	0	0	0
5/25/2004	Miller's Point Rocks	02	South Rock	701	146	9	189	0	0	0
5/25/2004	Double Point Rocks	01	Stormy Stack	9472	164	11	295	0	0	0
5/25/2004	Double Point Rocks	99	Rock N. of Stormy Stack	0	0	0	39	0	0	0
5/25/2004	North Farallon Islands	01	North Islet	6955	0	7	24	0	0	0
5/25/2004	North Farallon Islands	02	West Islet	13682	30	1	67	0	0	0
5/25/2004	North Farallon Islands	03	East Islet	14729	19	1	26	0	0	0
5/25/2004	North Farallon Islands	04	South Islet	7705	2	0	22	0	0	0
5/25/2004	South Farallon Islands	01	Southeast Farallon Island	31908	5966	273	7357	0	0	0
5/25/2004	South Farallon Islands	02	West End Island	30416	2479	71	3219	561	2	606
5/25/2004	South Farallon Islands	03	The Islets	12156	62	3	95	0	0	0
5/25/2004	South Farallon Islands	04	Saddle Rock	1807	0	0	6	0	0	0

Appendix 1 (continued).

<u>Date</u>	<u>Colony Name</u>	<u>SC#</u>	<u>Subcolony Name</u>	<u>Common Murre</u>	<u>Brandt's Cormorant</u>			<u>Double-crested Cormorant</u>		
					<u>Nest</u>	<u>Site</u>	<u>Bird</u>	<u>Nest</u>	<u>Site</u>	<u>Bird</u>
5/25/2004	Alcatraz Island	01	Alcatraz Island	0	789	0	993	0	0	0
5/25/2004	Lobos Rock and Lands End	04	Lobos Rock	0	0	0	14	0	0	0
5/25/2004	Lobos Rock and Lands End	06	Nearshore Rock	0	119	0	171	0	0	0
5/25/2004	Seal Rocks	01	Seal Rocks	0	0	0	131	0	0	0
5/25/2004	Devil's Slide Rock & Mainland	01	Devil's Slide Rock	291	105	0	153	0	0	0
5/25/2004	Devil's Slide Rock & Mainland	02	April's Finger	0	11	0	12	0	0	0
5/25/2004	Devil's Slide Rock & Mainland	05	Mainland South/Turtlehead	0	230	11	303	0	0	0
5/25/2004	Devil's Slide Rock & Mainland	99	Elizabeth Rock	0	0	0	34	0	0	0
5/27/2004	Año Nuevo Island	01	Año Nuevo Island	0	1639	9	2486	0	0	0
5/27/2004	Bench Mark-227X	02	Esselen Rock	323	222	2	237	0	0	0
5/27/2004	Castle Rocks & Mainland	02	Rock 02	297	0	0	0	0	0	0
5/27/2004	Castle Rocks & Mainland	03A	Rock 03 West	123	0	0	0	0	0	0
5/25/2004	Castle Rocks & Mainland	03B	Rock 03 East	0	0	0	0	0	0	0
5/27/2004	Castle Rocks & Mainland	04	Rock 04	675	0	0	0	0	0	0
5/27/2004	Castle Rocks & Mainland	05	Rock 05	27	0	0	0	0	0	0
5/27/2004	Castle Rocks & Mainland	06B	Mainland 06 South	0	47	0	53	0	0	0
5/27/2004	Castle Rocks & Mainland	07	Rock 07	615	18	0	25	0	0	0
5/27/2004	Castle Rocks & Mainland	08	0	0	32	0	35	0	0	0
5/27/2004	Castle Rocks & Mainland	09	0	0	74	0	85	0	0	0
5/27/2004	Hurricane Point Rocks	01	Rock 01	157	0	0	0	0	0	0
5/27/2004	Hurricane Point Rocks	02	Rock 02	647	34	1	39	0	0	0