RESTORATION OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2003

REPORT TO THE *APEX HOUSTON* TRUSTEE COUNCIL

by

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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), Ed Ueber (NOAA-Gulf of the Farallones National Marine Sanctuary [GFNMS]), Paul Kelly (CDFG-Office of Spill Prevention and Response [OSPR]), Jennifer Boyce (NOAA-Restoration Center), Joelle Buffa (USFWS alternate representative), and Katherine Pease (NOAA 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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Field site monitoring for the Common Murre Restoration Project in 2003 was conducted mainly by: H. Knechtel, A. Robinson, and C. Caurant (Devil's Slide Rock and Mainland, San Pedro Rock); and J. Koepke (Castle/Hurricane Colony Complex). The Education Program was run by J. Stankiewizc.

THE RESTORATION OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2003

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 activities 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. Further cooperation and coordination has been provided by: U.S. Geological Survey, 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 Parks and Recreation. The Refuge is also playing the lead role in the implementation of the environmental education program. This report summarizes the results for year eight (Federal Fiscal Year 2003) 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 continued in 2003. At Devil's Slide Rock on 29 January 2003, 136 adult murre decoys were re-deployed and the sound system turned back on. In addition, a 24" (61 cm) long, 2"x4" (5.1x10.2 cm) wooden board was added in decoy Plot 4 to add simulated "wall" habitat for murres to nest near. Two mirror boxes were lost in early winter storms, and four more were removed. At San Pedro Rock on 4-5 February 2003, 194 adult murre decoys were re-deployed and the sound system turned back on. The mirrors were left turned around so that no reflections could be cast. This was done in 2002 to deter Common Ravens, which were found to spend considerable periods of time viewing themselves in the mirrors. In September 2003, after nesting birds had left the rocks, the decoys were removed to be cleaned and re-painted and sound systems were turned off.

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 2003. Parameters monitored included: seasonal attendance patterns, colony and subcolony populations, breeding phenology, reproductive success, and adult time budgets. Also, data on Brandt's Cormorant attendance and productivity were collected. In addition, aerial photographic surveys of Common Murre, Brandt's Cormorant, and Double-crested Cormorant colonies were conducted in northern and central California. To date, counts from these surveys have been obtained mainly from colonies in central California containing murres. All

information collected is used to help evaluate and refine restoration efforts at Devil's Slide and San Pedro Rocks and other colonies in central California where restoration may be needed. This information will help 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 110 pairs of murres nesting and 70 chicks fledging from Devil's Slide Rock (DSR) in 2003. These numbers represented a decrease of 13 nesting pairs and 28 fledged chicks from the 2002 breeding season. However, the number of breeding and territorial sites combined increased in 2003. This was the third consecutive year that numbers exceeded the 10-year project goal of 100 breeding pairs of murres on DSR, first obtained in year six (2001) of restoration efforts. Reduced breeding effort and success in 2003 was attributed to a combination of factors, including mild to moderate El Niño conditions that likely reduced prey availability, disturbance from roosting pelicans and cormorants, and aircraft disturbance. For the sixth consecutive year since social attraction techniques began at San Pedro Rock, no breeding occurred and murre attendance was low. Murre plots monitored at Castle/Hurricane Colony Complex experienced moderate to low productivity in 2003.

The Environmental Education Program continued for an eighth year in 2003. 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 and San Pedro Rocks by repainting the murre decoys before their re-deployment. Personnel from this year's education outreach project taught approximately 890 students from ten Bay Area schools about the conservation issues impacting seabirds in the student's local area as well as around the world.

PROJECT STRUCTURE AND ADMINISTRATION

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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 Common Murres 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, 2003a). However, after 1989, murre numbers in central California began to increase. The rate of increase for the total population was 5.9% per annum between 1985-1995 (Carter et al. 2001). By the 1995-1997 period, murre population levels had recovered to about 75% of the 1979-1982 level at Point Reyes Headlands and to about 52% of the 1979-1982 level at the Castle/Hurricane Colony Complex (McChesney et al. 1998, 1999). This partial recovery of central California Common Murre population has been attributed to several gill-net fishing closures that have occurred in central California since 1982, as well as reduced oiling from 1986-1995.

Despite the restrictions imposed on the central California gill-net fishery in the 1980s, bycatch continued in the 1990s. Forney et al. (2001) estimated between 5,918-13,060 murres drowned in 1995-1998, and the National Marine Fisheries Service (unpubl. data) estimated that in a one year period from April 1999 to March 2000 as many as 5,000 murres were killed in gill-nets in the Monterey Bay area. However, an extension of recent closures of the gill-net fishery in waters <60 fathoms from Point Reyes to Point Arguello (September 2002) should reduce this mortality factor. In addition to gill-net mortality, oil pollution (e.g., *Command* Oil Spill, and the series of oil releases from the sunken vessel *S.S. Jacob Luckenbach*) has continued to kill thousands of murres in central California (Carter 2003, Carter and Golightly 2003, Hampton et al. 2003, Roletto et al. 2003). This continued mortality, along with other anthropogenic factors (e.g. aircraft and boat disturbances), have probably kept the central California murre population in a depleted state. We hope that our efforts to restore breeding colonies at Devil's Slide Rock (DSR) and San Pedro Rock (SPR), in coordination with reductions in anthropogenic impacts, will allow the eventual recovery of the central California murre population to numbers documented in the early 1980s (if not higher) and maintain the distribution of functional breeding colonies within this population.

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 Murres (Page et al. 1990, Siskin et al. 1993). The murre colony at DSR was subsequently abandoned (Takekawa et al. 1990; Carter et al. 1992, 2001; Swartzman 1996).

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 the U.S. Fish and Wildlife Service 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: 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); CDFG; and California Department of Parks and Recreation.

The primary goal of the Scientific Program is the restoration of extirpated Common Murre colonies at DSR and SPR (Figure 1). Social attraction was selected as the methodology to be used to recolonize DSR and SPR (see Parker et al. 1997, 1998, and 1999 descriptions of the technique) 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; Watanuki and Terasawa 1995).

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 will eventually be phased out.

Common Murres have not been recorded breeding on SPR since 1908 (Ray 1909, Carter et al. 2001). No murres were detected at SPR during ground and boat observations or aerial surveys conducted in 1996, 1997, and in early 1998. 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 amongst the decoys thereafter. Social attraction equipment has been deployed each year since 1998 although recent breeding has still not occurred.

To determine if murres at DSR behave in a manner consistent with an established nearshore breeding colony, murres at Point Reyes Headlands (PRH) within Point Reyes National Seashore were monitored from 1996-2002. However, PRH was not monitored in 2003 in order to focus more effort on restoration sites. Additional data on murre breeding biology at Southeast Farallon Island (SEFI) within the Farallon National Wildlife Refuge has been collected by PRBO. Data from PRH and SEFI provide a measure by which to evaluate the success of our recolonization efforts at DSR and SPR. SEFI data has been summarized in separate reports by PRBO. PRH data from aerial surveys in 1979-1997 have been summarized in a separate report (McChesney et al. 1998). (See section on products available from the *Apex Houston* Trustee Council at the end of this report.)

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 (Figure 3). The CRM and HPR colonies were impacted by the *Apex Houston* spill and declined afterwards (Carter et al. 2001, 2003a). 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 monitoring efforts conducted by the Common Murre Restoration Project at DSR, SPR, CRM, HPR, and BM227X in 2003. 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 29 January 2003, 136 adult murre decoys (122 standing, 14 incubating) were re-deployed and the single sound system turned back on (Figure 5). Decoys had been removed, cleaned, and repaired during the fall of 2002. This was accomplished using the same techniques employed in previous years. The number of decoys originally deployed was 23% lower than in 2002, and this number was reduced further to 124 decoys on 25 March 2003 (see below).

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, the variable density plot treatment method was abandoned 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 within the boundaries of the previous plots. Our strategies involved thinning the decoys in the high-density plots, removing decoys from portions of the rock with no active breeding sites, augmenting some areas around existing breeding sites, and removing mirror boxes that were no longer needed and had become obstructions to monitoring.

The most significant change in decoys in 2003 resulted from the near removal of Plot 3, which had no recent breeding sites. Other plans included the removal of Mirror Boxes 2, 3, 6, and 9 which, in addition to reducing the amount of social attraction equipment on DSR, allowed for better viewing of certain nest sites. As of 9 January (before decoy deployment), Mirror Box 6 was knocked over and Mirror Box 12 had disappeared, the likely result of some powerful storms that had recently moved through the area. Mirrors Boxes 2, 3, and 9 were removed as planned on 29 January, and Mirror Box 1 was also removed by accident. As with previous mirror removals, mirrors 1, 2, 3 and 9 were replaced with three decoys each to fill the "empty" space and serve as landmarks for monitoring.

In 2002, two 24" (61 cm) lengths of 2"x4" (2.1x4.2 cm) wooden boards were added to certain flat areas devoid of breeding murres, one in plot 1 and the other in plot 2, in an attempt to join two groups of breeding murres by creating additional structure for murres to breed near (Knechtel et al. 2003). These boards were left in place for the 2003 season. In addition, another board was placed in Plot 4 to encourage murres to fill in the area between plots 3 and 4 (Figure 5).

We returned to DSR on 25 March 2003 to replace some fallen decoys, check the sound system, and place some better landmarks where mirror boxes once stood. Single, uniquely painted wooden dowels 1.5 feet (0.46 m) in length were placed on existing decoy rods in plots 1, 2, 3, 7, 9, 10 and 12 as markers to identify former mirror locations. Dowels replaced one of three decoys that marked former mirror locations in plots 1, 2, 7, and 9. Dowels were placed on empty rods within 0.5 m of former mirror locations in plots 3, 10, and 12, where dowels could not be placed in the exact mirror location. Following the replacement of some fallen decoys, replacement of four decoys with wooden dowels, and the disappearance of eight decoys since 29 January, 124 decoys were in place on 25 March, with the following breakdown by plot: Plot 1, 20 decoys; Plot

2, 4 decoys; Plot 3, 6 decoys; Plot 4, 7 decoys; Plot 6, 15 decoys; Plot 7, 18 decoys; Plot 8, 17 decoys; Plots 9 and 10 combined, 24 decoys; and Plot 12, 13 decoys.

Monitoring and analysis of murre site locations on DSR was again enhanced this year through the use of GIS data and the integration of this information with aerial photographs. During decoy removal in fall 2001, data on microhabitat characteristics were collected from DSR for addition to our GIS database, with assitance from J. Gawronski (Bestor Engineers) and B. Perry (USGS). This database already included locations of social attraction equipment, murre and cormorant nest sites, and topography. During the breeding season, new nest sites and decoys were added to the database by approximating their locations in the field based on previously mapped (by GPS) sites and equipment, with additional verification using high quality aerial photographs taken during colony surveys on 30 May and 6 June 2003. Numbers of breeding and territorial sites found within decoy areas were compared to numbers outside decoy areas. Murres were determined to be in a decoy area if they were within one murre-width of a decoy.

San Pedro Rock

On 4-5 February 2003, 218 adult-sized murre decoys were re-deployed on SPR (194 standing, 24 incubating), and the sound system playing murre calls was turned on. Decoys were attached to existing rods already in place throughout the various decoy plots. As in 2002, the mirrors in the mirror boxes were left turned around so there reflective sides were not visible. This was done in an attempt to deter predatory Common Ravens *(Corvus corax)* from being attracted to social attraction equipment and possibly deterring murres from attending SPR.

We enhanced social attraction methods on SPR in 2003 by deploying 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 25 standing cormorant decoys and 25 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 6).

To assist monitoring efforts, a remote video monitoring system was developed and installed on SPR by SeeMore Wildlife Systems (Homer, Alaska) on 7 April 2003. 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, which included 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 was needed to enhance our otherwise poor viewing from mainland vantage points, which 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.

Throughout the 2003 field season, the video system was used 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 (before 15 April), DSR was monitored for 68.5 h (74.3 person-hours) between 9 January and 9 April 2003. After 15 April, DSR and Devil's Slide Mainland (DSM) were monitored for a total of 537.10 hours on 111 observation days between 16 April and 7 August (875.46 total person-hours). SPR was monitored for a total of 225.55 hours on 74 observation days between 17 April and 7 August (240.78 total person-hours). CRM/HPR was monitored for a total of 334.25 hours on 74 observation days between 17 April and 4 August (420.13 total person hours). Point Reyes Headlands was visited on one day, 20 May, from 0748 h to 1500 h PDT, to check the status of former monitored subcolonies and the murre productivity plots on Lighthouse Rock.

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 attendance was followed at DSR only, with counts conducted once or twice a week (usually twice) and usually between 0800 and 1100 h, although times ranged from 0700 to 1530 h. Breeding season attendance at CRM, HPR, and BM227X were determined from counts conducted twice per week (weather permitting) between 0730 and 1600 hours. At DSR, counts were conducted every other day between 1000 and 1400 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 from 9 January to 9 April 2003. Breeding season counts were conducted from 16 April to 6 August 2003. Counts were conducted from a standardized observation site (see Parker et al. 1997). Throughout the pre-breeding season and part of the breeding season, multiple counts were made on some days to assess diurnal attendance patterns. In cases where more than one count was made between 1000 and 1400 h, we used the count closest to 1000 h for describing seasonal attendance patterns for better comparability to past years.

San Pedro Rock

At SPR, seasonal attendance patterns were monitored during watches conducted three or more times a week. The length of the watches varied from two to five hours, and were conducted at different time periods throughout the day. The time of day watches were conducted varied with weather and viewing conditions, but was usually between 0700 and 1700 h. Observations were made from a point along Highway 1 known as the "Pipe Pullout" (see Parker et al. 1998), located at a distance of 1,700 m from the rock at an elevation of about 200 m. At the start and end 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 the Questar spotting scope and the new remote video monitoring system. At the beginning of 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 7). When possible, individual murres were followed continuously to determine how long individuals attended SPR, although this was often difficult due to viewing locations and other data collection needs. Murres attending SPR were reported in units as "murre-observations", with each murre seen during a scan constituting one murre observation (see Parker et al. 1997). 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 appears to reduce murre attendance on the rock.

Castle/Hurricane Colony Complex

Seasonal attendance patterns of Common Murres were determined for 13 subcolonies at CRM, HPR, and BM227X (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

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 2002 breeding season. At DSR, locations of murre sites were refined through the interpretation of aerial photographs taken on 30 May and 6 June 2003. We defined a breeding site as any site where an egg was laid. A territorial site was defined as a site that had attendance greater than or equal to 15% of monitored days. Sporadic sites were attended on at least two observation days but on less than 15% of observation days; however, many possible "sporadic" sites were not identified as such because of the frequent movement by apparently visiting birds. New breeding, territorial, and sporadic sites established in 2003 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 breeding status at each site easier to determine. Many observations also were conducted in evening hours after mid-day heat waves dissipated. Each monitoring day, we tried to determine 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 for each plot, 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 northeast 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 two productivity plots: one on CRM-04 (established in 1996); and the other on CRM-03 East (established in 1999). In 2003, the

CRM-04 and CRM-03 East study plots consisted of 105 and 96 sites, respectively. Observations of both plots were conducted from or near the "Castle pullout" located off Highway 1, approximately 300 m from the CRM-04 plot and 150 m from CRM-03 East plot. An additional viewing location, especially helpful for productivity monitoring at CRM-04, was added in 2003 from the private Neukermans property above Funt Cove. Both Questar (65-130x) and Kowa (20x) 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 this 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. However, if a breeding pair lost its chick (i.e., the chick fledged or disappeared), we attempted to monitor a new nearby breeding pair instead. Three continuous watches were conducted between 7-17 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). Whenever possible, two to three observers, including one primary observer and one to two secondary observers, would watch the time budget sites simultaneously in order to collect more accurate data. This marked a departure from the way time budgets have been done in previous years, when data were collected primarily by one observer at a time. Information was recorded on a hand-held tape recorder by the primary observer 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. 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 at a breeding site at the same time.

Disturbance

Disturbance events affecting murres at DSR, SPR, 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 also were 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 also 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 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 productivity has been carried out at DSR and the adjacent mainland. This monitoring is conducted to better understand the influence of decoys on the DSR Brandt's Cormorant colony, the communal relationship between breeding Brandt's Cormorants and Common Murres, and to examine differences in Brandt's Cormorant reproductive performance between years and subcolonies. To determine timing of breeding and productivity, breeding activities were monitored in detail at DSR and a subcolony on DSM. No cormorants bred on Turtlehead in 2003, a traditional cormorant monitoring location. Nests at both monitoring 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 number of chicks fledged. Means were then calculated for each parameter at each subcolony.

Nest Surveys - Castle Rocks

In 2003, Brandt's Cormorant nest surveys were conducted at CRM-03 West once per week during the breeding season. All counts were taken from the Rocky Creek Bridge pullout between 0800 and 1100 h with 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.

Aerial Photographic Surveys

Aerial photographic surveys were conducted at all murre colonies and most (greater than about 10 nests) Brandt's and Double-crested Cormorant colonies in northern and central California from the Oregon border south to Point Conception. These surveys are a continuation of a long-term data set focused on monitoring seabird breeding populations in California (e.g., Takekawa et al. 1990, Carter et al. 2001). Surveys were conducted between 28 May and 11 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 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. However, Devil's Slide Rock and Mainland was photographed twice because of low murre attendance during the first survey. At the South Farallon Islands, overview and closeup photographs were taken on separate days because of fog.

Counts at sample colonies were conducted using the "dotting" method and followed a standardized protocol. As in other years since 1996, we obtained counts for all central California murre colonies. Counts of Brandt's and Double-crested cormorants at other northern and central California colonies in 2003 were conducted in a separate HSU and USFWS study (Capitolo et al. 2004) as part of an assessment of west coast populations of these species (Naughton et al. 2004). Counts of murres at other northern and central California colonies (except Castle Rock, Del Norte County) have not yet been obtained.

For murres, only birds were counted since they do not build nests. For cormorants, birds, nests, and territorial sites were counted. Nests and territorial sites were categorized as follows: 1) well-built nest with incubating/brooding adult; 2) nest with 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; 5) poorly built nest; 6) adult on territorial site with little or no nesting material; and 7) undetermined site. We considered categories 1-5 as "nests", and categories 6 and 7 as territorial "sites".

For this report, counts were obtained only at central California murre colonies, including: PRH; Point Resistance; Miller's Point Rocks; Double Point Rocks; North and South Farallon islands; SPR; DSR; BM227X; CRM; and HPR. At each colony, separate counts were obtained for each subcolony following Carter et al. (1992, 1996) and McChesney et al. (1998, 1999). At the South Farallon Islands, counts were broken down into additional subareas (not reported here) following Capitolo et al. (2002).

RESULTS

Social Attraction

Devil's Slide Rock
In 2003, 198 active sites (110 breeding and 88 territorial) plus 40 sporadic sites were recorded on DSR. This was an increase of 32 (19.3%) active sites over the year 2002. The number of breeding sites, however, was 13 (10.6%) less than in 2002 (Figure 8). Of the 110 breeding sites in 2003, 78 (70.9%) were reused breeding sites from 2002, seven (6.4%) were territorial sites in 2002, six (5.4%) were not used in 2002 but were used in previous years, and 19 (17.3%) were new sites in 2003. Of the 198 active sites, 82 (41.4%) occurred within decoy areas (Figure 9).

San Pedro Rock
As in previous years, Common Murres were seen sporadically on San Pedro Rock but did not establish territories or breed. Through a combination of Questar scope scanning and remote video monitoring, murres were sighted on 13 of 61 (21.3%) observation days (Figure 10). On at least seven of the days when murres were observed on SPR, they were visible only with the remote video camera and could not be seen with a spotting scope. This was either because of poor visibility due to fog, heat waves, or because the bird(s) was in a location not visible from our mainland viewing location. Most observations were of single birds. Like past years, most activity occurred during the latter part of the breeding season in late July. Most birds attended a low-level ledge that contained low densities of murre and cormorant decoys and is often used as a roost by pelicans, cormorants and gulls.

The high count for SPR in 2003 was five murres on 25 July at 1745 h. Of all murre observations, 97.1% were within decoy areas, and the remainder were on the "Nose Area" near the decoys. (Figure 7). 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.

Similar to murres, Brandt's Cormorants demonstrated only a low-level response to the cormorant decoys first placed on SPR in 2003. 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), when they were usually observed roosting in small groups. On one occasion, a cormorant was observed and filmed carrying a small amount of nesting material in the upper portion of the decoy area. On another occasion, a single cormorant was observed pulling at the rope of a decoy nest in an apparent attempt to steal nesting material. These were the only breeding-related behaviors observed.

Seasonal Attendance Patterns

Devil's Slide Rock

Murres on DSR were observed on 76 of 82 (92.7%) colony count days between 9 January and 6 August (Figure 11). Additional late fall and early winter counts obtained by P. Capitolo included: 30 November 2002, 50 birds; 24 December 2002, >100 birds; 25, 28, and 29 December 2002, 0 birds; and 1 January 2003, about 125 birds. All counts were between 1000 and 1100 h. In general, murre numbers were relatively high (150-190 birds) in mid-January and low on count days between mid-January and mid-March. Numbers increased in late March, after which numbers varied dramatically from day to day through the remainder of the pre-breeding and breeding seasons. The highest counts occurred during the late pre-breeding season, with a high count of 214 murres on 28 April (first egg on 8 May). During the pre-breeding and early breeding season, murre numbers were often observed to decline substantially between the morning and afternoon. While such behavior is typical during the pre-breeding season, dramatic changes in numbers during the breeding season is unusual. On some days during the early egg-laying period, numbers of murres on the rock would decline through the late morning and early afternoon until only the few birds incubating eggs remained.

To document the unusual diurnal attendance patterns observed, murres were counted 2-4 times throughout the day on several colony count days between 22 May and 25 June. As a representation, Figure 12 shows the typical patterns observed during the mid-to late incubation period, with highest counts during our typical mid-morning count period followed by large declines as the days progressed. Although diurnal attendance declined more dramatically in the early incubation period, the declines in numbers of murres attending the rock at this late stage of the breeding season was unusual.

Devil's Slide Mainland

Small numbers of murres occasionally landed for brief periods among nesting Brandt's Cormorants on the DSM. Murres were recorded on at least six different days between 14 June and 23 July, and ranged from one to six birds including: 14 June, two birds; 15 June, two birds; 16 June, three birds; 18 June, six birds; 5 July, one bird; and 23 July, one bird.

San Pedro Rock

Common Murre - Of the 945 scans completed on SPR, 52 (5.5%) had at least one murre present, resulting in a total of 67 "murre observations" (Figures 10, 13). Forty-two scans (80.8%) recorded one murre, seven scans (13.5%) recorded two murres, one scan (1.9%) recorded three murres, one scan (1.9%) recorded four murres and one scan (1.9%) recorded five murres. The longest any one murre was recorded attending SPR was 31 minutes. Sixty-five of the 67 murre observations occurred in the decoy area, with the remaining two occurring in the Nose Area near decoys. Murres were not seen on SPR until 25 May and the last murre was observed on 30 July. Nearly all murre attendance occurred during the last week of July, at the end of the murre breeding season at other nearby colonies. This late season attendance may have been related to reduced raven attendance (see below), or, more likely, increased visitation by non-breeding subadults or adults, failed breeders, and/or females from nearby colonies (e.g., Devil's Slide Rock) that have finished breeding for the year.

Common Raven - Ravens were seen on SPR on 18 of 61 (29.5%) observation days, and were observed on 57 of 945 (6.0%) scans completed for a total of 65 "raven observations". Of the 65 raven observations, 21 (32.3%) occurred in the Nose Area, 20 (30.8%) occurred in the "West End" where a pair of ravens were thought to be nesting, nine (13.8%) occurred in the "Decoy Area", five (7.7%) occurred in the "Lower Area", and the remaining 10 (15.3%) observations were made on the "East End" of the rock. Forty-nine scans (86.0%) recorded one raven, and eight scans (14.0%) recorded two ravens.

Ravens were observed on SPR throughout the winter (Figure 13), when often a pair of birds were observed in obvious association with one another. After a pair of ravens were removed from the rock on 7 March, raven activity declined somewhat and often only one bird was observed. In May, however, activity on the rock increased, and ravens were observed attending a nest site on the west side of the central peak. After two more ravens were removed from the rock on 24 May, raven activity on SPR nearly ceased.

Castle/Hurricane Colony Complex

Seasonal attendance patterns varied between subcolonies in this colony complex. Only three subcolonies with confirmed breeding in 2003 were attended each count day from the start of observations on April 17 until the start of egg-laying: CRM-02; CRM-03 West; and CRM-04 (Figures 14-16). At Esselen Rock (BM227X-02) and CRM-03 East, attendance was especially sporadic until early May. At Esselen Rock, high counts in late April were associated with a group of courting Brandt's Cormorants that did not remain to breed. No murres were observed on either of the Hurricane Point Rocks until 1 May (HPR-01) and 13 May (HPR-02), although birds might have been present earlier in the year or on non-count days. The high counts on HPR-02 on 13 May were actually estimated, as just before a count was to be conducted the entire subcolony flushed off in response to a low flying Turkey Vulture (*Cathartes aura*) and did not return during the count period.

During May (early to mid-incubation period), attendance was somewhat variable at most subcolonies, followed by less variability in June and early July during the late incubation and early chick periods. This pattern of seasonal attendance is typical for murres in California. Notable exceptions were at both Hurricane Point Rocks, which had fairly variable attendance throughout the breeding season. Numbers increased in early to mid-July (late chick period), then declined rapidly in mid-July to early August as the last chicks fledged and adults departed the colony. The timing of the increase appeared to be associated with the timing of colony departure; i.e., subcolonies with earlier increases had earlier colony departures. This was likely related to differences in nesting phenology between subcolonies.

Of interest was murre attendance in a discrete portion of CRM-04 known as the "South Finger." This area had fairly large numbers of murres in the late 1970s and early 1980s but has only been attended sporadically since that time (McChesney et al. 1999; USFWS, unpubl. data). In 2003, small numbers of murres attended this area regularly among a group of nesting Brandt's Cormorants.

Two other subcolonies had recorded murre attendance but no breeding. At CRM-06 South (Area 1), an "ephemeral" breeding location, up to eight murres were observed on three days in early to mid-May. At CRM-06 North, one murre was observed on 20 May among a group of courting Brandt's Cormorants.

Productivity - Common Murre

Devils Slide Rock

Of the 251 sites monitored at DSR in 2003, 110 (43.8%) were egg-laying, 88 (35.0%) were territorial, 40 (15.9%) were sporadically attended, and 13 (5.2%) were sites (breeding, territorial, or sporadic) in previous years that were unattended this season.

The first murre egg on DSR was seen on 8 May and the first chick was observed on 29 May. Based on first eggs (n=90), mean egg laying date was 1 June (range = 8 May-27 June). The last replacement egg was laid 3 July. Mean hatching and fledging dates were 8 July (n=47) and 31 July (n=55), respectively (Table 1). Chicks that fledged remained on the rock for an average of 23.6 days after hatching and the last chick was seen on DSR on 6 August.

A total of 133 eggs were laid, including 23 replacement eggs. A total of 74 eggs hatched (overall hatching success of 55.6%) and 70 chicks fledged (94.6% fledging success). The number of chicks fledged per breeding pair was 0.64 (Table 1). Of the 110 first eggs laid, 59 hatched (53.6% hatching success) and 57 chicks fledged (96.6% fledging success). Of the 23 replacement eggs, 15 hatched (65.2% hatching success) and 13 chicks fledged (86.7% fledging success). One of these replacement eggs was recorded as the second relay (third breeding attempt). Though there was some confusion as to whether all three eggs were correctly identified, if in fact three eggs were laid at one site hatching and fledging success for second eggs would be 63.6% and 85.7% respectively. Both hatching and fledging success for the single third egg would be 100%.

Castle/Hurricane Colony Complex

Of 105 monitored sites in the CRM-04 plot in 2003, 84 (80.0%) were egg-laying and 21 (20%) were territorial. There was only one replacement egg laid. Of the 96 sites monitored in the CRM-03 East plot, 77 (80.2%) were egg-laying, 19 (19.8%) were territorial, and none were considered to be sporadic.

At CRM-04 productivity plot, the first egg was seen on 5 May and the first chick was observed on 9 June. Based on first eggs only, the mean egg-laying date was 16 May (range= 5 May-10 July; n=67), mean hatch date was 16 June (n=51), and the mean fledge date was 11 July (n=56). At CRM-03 East, the first egg was observed on 9 May and the first chick was observed on 11 June. The mean egg-laying date was 22 May (range= 9 May-13 June; n=62), mean hatch date was 22 June (n=49), and the mean fledge date was 12 July (n=36). The last replacement egg was laid on 25 June. When combining data from both productivity plots, the mean egg-laying date was 19 May (n=129), mean hatch date was 19 June (n=100), and the mean fledge date was 12 July (n=92). Chicks that fledged remained for an average of 23.7 days (n=91). The last chicks were seen on 16 and 19 July on CRM-03 East and CRM-04, respectively.

Of the 84 eggs laid (including one replacement egg) in the CRM-04 plot, 63 (75.0%) hatched and 60 (95.2%) chicks fledged. The number of chicks fledged per breeding pair was 0.72 (Table 1). Of the 79 eggs laid (including 2 replacement eggs) in the CRM-03 East plot, 56 (70.9%) hatched and 37 (66.0%) chicks fledged. The number of chicks fledged per breeding pair was 0.48.

Although productivity was not monitored on all of the CRM/HPR subcolonies, other subcolonies with confirmed breeding in 2003 were: BM227X subcolony 02 (Esselen Rock); CRM subcolonies 02, 03 West, 05, and 07; and HPR subcolonies 01 and 02 (both Ledge and Hump). All but one of these are established subcolonies with annual breeding in recent years. At Esselen Rock, breeding has occurred in only some years since 1996. In previous years, including 2002, murres bred on this rock in association with Brandt's Cormorants. Interestingly, in 2003 probably no more than 2-3 pairs of murres bred on the upper west portion of the rock where they were barely visible from our mainland vantage point. No Brandt's Cormorants bred on Esselen Rock in 2003. Murre breeding also occurred among nesting Brandt's Cormorants on the "South Finger" of CRM-04 and probably on the upper slope of CRM-03 West (also see Seasonal Attendance Patterns, above). These are discrete portions of the rocks with only occasional attendance in recent years, although South Finger may have been an established breeding area in the late 1970s and early 1980s (McChesney et al. 1999).

Adult Time Budgets - Common Murres

Devil's Slide Rock

Co-attendance of breeding sites by pairs of mated murres during chick-rearing was determined from observations conducted between 7 July and 17 July. Twelve to thirteen breeding sites were monitored from dawn to dusk on three days, resulting in a total of 37 site-days monitored. The average time spent by murre pairs in co-attendance at a site was 63.35 minutes per day (range 6-216 min/site; n=37). On average, mates arrived at their sites 5.5 times per day (range 2-10; n=37). These mate arrivals resulted in prey deliveries 81.0% of the time. Chicks were fed on average 4.49 times a day per site (range 2-9; n=166). Of the 166 prey deliveries observed, 160 resulted in chick-feeding. Two prey items were stolen by a neighboring murre and four prey items were eaten by the adult that brought it in.

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 2003, we incidentally observed 50 non-anthropogenic disturbances at the two monitoring sites. Eighteen disturbances were recorded at DSR, none at SPR, and 32 at CRM/HPR.

Devil's Slide Rock

There were 18 non-anthropogenic disturbance events observed at DSR (Table 2). This resulted in an average of 0.034 disturbances per observation hour. Eleven of these disturbances were prey stealing or prey stealing attempts that resulted in prevention of chick feeds. These were caused by roosting gulls, cormorants and a Brown Booby (*Sula leucogaster*) that visited the rock for several days in July. These events occurred near the end of the chick rearing period, primarily in the "Bridge" area. The remaining disturbances were displacements or flushings of adult murres, none of which were observed to result in egg or chick loss.

Castle/Hurricane Colony Complex

Thirty-two non-anthropogenic disturbance events were recorded, resulting in 0.10 disturbance events per observation hour (Table 3). Twenty-seven events caused murres to flush, six caused murres to be displaced, and one event caused an egg depredation. Common Ravens were responsible for the most non-anthropogenic disturbance events, contributing to 11 flushing (40.7%) and 6 displacement events, and on two occasions were observed feeding on murre chicks on CRM-03 East (also, see Discussion). Brown Pelicans (*Pelecanus occidentalis*) were responsible for 9 flushing events (33.3%), Western Gulls (*Larus occidentalis*) caused four flushing events (14.8%) and one egg predation, and Turkey Vultures (*Cathartes aura*) contributed to 3 flushing events (11.1%). The flushing of nest-building Brandt's Cormorants at CRM-06 North by a Turkey Vulture that fed on a dead cormorant resulted in the abandonment of this subcolony.

Brown Pelicans and Common Ravens flushed an average of 10 murres per event, while Western Gulls and Turkey Vultures flushed on average 98 and 230 murres, respectively.

Anthropogenic Disturbance

During 2003, we observed nineteen aircraft disturbances and no boat disturbances at the two monitored colonies. The disturbance rate at CRM/HPR was slightly higher than at DSR. No disturbances were recorded at SPR. Of the three sites, DSR had the greatest number of aircraft and boats seen per observation hour (0.549), followed by SPR (0.133) and CRM/HPR (0.075; Figure 17).

Devil's Slide and San Pedro Rocks
A total of 295 aircraft and boats were incidentally observed near DSR: 230 (78.2%) were planes; 37 (12.6%) were helicopters; and 27 (9.2%) were boats (Table 4). Eleven of these craft caused birds to be flushed from DSR, resulting in an average of 0.020 disturbances per hour. Nine of the 11 disturbances were caused by helicopters (4 of which belonged to the Coast Guard) and 2 by planes. The greatest number of birds were disturbed on 5 May by a U.S. Coast Guard (USCG) helicopter that flushed 10 murres and 30 cormorants. Many of the planes were recorded on 27 April during the "Dream Machines" auto and air show at Half Moon Bay Airport. During the course of the day, 87 low overflights were recorded; over 60 were by one aircraft that repeatedly flew only 200-400 feet (61-122 m) over the rock although no birds were recorded flushing. These overflights were halted after we succeeded in contacting the pilot. Additional disturbance may have occurred on the morning of 25 April, when two USCG helicopters responded to a false alarm and apparently circled the Devil's Slide area just off our observation sites for about two hours. However, no personnel were on site to record effects of this event.

A total of 30 aircraft and boats were seen near SPR (Table 5). Seventeen (56.7%) were planes, two (6.7%) were helicopters and 11 (36.7%) were boats.

Castle/Hurricane Colony Complex
A total of 25 boats and aircraft were recorded at CRM/HPR: ten (40%) were planes; fourteen (56%) were helicopters; and one (4%) was a boat (Table 6). Eight of these vessels caused disturbance to seabirds, for an average of 0.024 disturbances per hour. Seven of these disturbances were caused by helicopters and one by a plane. Two of the helicopter disturbances were caused by the USCG and resulted in birds being flushed from CRM-02 (10 murres) and CRM-04 (20 murres). During the Big Sur Marathon on 27 April, a civilian helicopter flushed a total of 48 murres from CRM-04 over three separate flyovers. On 7 May, two U.S. Navy or National Guard double-bladed helicopters flushed 120 murres from CRM-04 and CRM-03 East.

Productivity - Brandt's Cormorants

Devil's Slide Rock and Mainland

In 2003, Brandt's Cormorants bred on DSR and the southwest side of the DSM promontory (Figure 2). All egg-laying sites on DSR were monitored, and a sample of nests on the mainland were monitored. Cormorants did not breed on Turtlehead where cormorants have been monitored in most years since 1996.

On DSR, there were cormorants attending approximately 25 territorial sites throughout most of April. However, on the morning of 27 April, a large disruption occurred which resulted in many cormorants stealing nesting material from neighboring birds. Following this outbreak, most cormorants departed the rock. The majority of these territorial birds did not continue breeding on DSR, and might have moved to the adjacent mainland where breeding activities began shortly after this event.

By early May, only eight pairs of cormorants remained on DSR. Seven of these bred (Table 7). The mean lay date on DSR was 9 May (n=7 nests), with a range from 4 May to 14 May. On average, 3.1 eggs were laid per clutch. The mean hatching date was 9 June (n=7), with a range from 4 June to 12 June. Chicks hatched and fledged at 100% of breeding sites, and hatching success of all eggs was 90.9%. On average, 2.9 chicks hatched and 2.6 chicks fledged per breeding pair. Overall fledging success was 90%, and breeding success (number of chicks fledged per egg laid) was 81.8%. No replacement clutches were observed.

On DSM, 85 egg laying sites were monitored (Table 7). The mean lay date on DSM was 15 May (n=51), with a range from 8 May to 25 May. On average, 3.1 eggs were laid per clutch (n=85). The mean hatching date was 14 June (n=36), with a range from 8 June to 22 June. Chicks hatched at 65% (n=85) and fledged at 45.9% (n=74) of breeding sites. Hatching success was 48.7%, fledging success 70.6%, and breeding success 31.3%. On average, 1.5 chicks hatched (n=85) and 1.0 chick fledged (n=74) per breeding pair. No replacement clutches were observed.

Low breeding success on DSM was largely caused by high rates of nest abandonment. Nest abandonment was highest during the late incubation period but also persisted through the chick period. Some abandonment might have been caused by some form of disturbance, possibly land-based. In particular, a discrete sub-group of 14 nests on the highest part of the slope was found to be completely abandoned on 18 June, while other areas of the colony appeared unaffected at that time. This abandoned portion could have been accessed (or nearly so) from the bluff top, either by a human or other mammal. The remainder of the colony was probably inaccessible because of a sharp "cut" in the slope between the upper and lower nesting groups.

Following the 18 June abandonment event, abandonment also began in the lower portion of the DSM. This nest loss continued through much of the remaining breeding season.

Castle/Hurricane Colony Complex

We observed well-built Brandt's Cormorant nests at CRM-02, CRM-03 East, CRM-03 West, CRM-04, and CRM-05. However, nest counts were only conducted on CRM-03 West, where a high count of 61 well-built nests and 46 large chicks were recorded on 25 June. As a representation of breeding phenology, we examined the progression in nest building on the rock (Figure 18). Egg laying likely began in early to mid-May, as indicated by the first well-built nests observed, and probably continued into early June. Higher nest counts in July may have been due to continued egg-laying, but was more likely influenced by easier viewing of certain nests that became built up high enough to permit viewing, and possibly by the difficulty in counting nests with large, wandering chicks.

Common Raven Management - San Pedro Rock

Active management of Common Ravens was conducted at SPR in 2003, in accordance with the San Pedro Rock Raven Management Plan of 2002 (see Knechtel et al. 2003). Ravens, including a probable nesting pair, are believed to partially affect the low success of social attraction efforts for murres on SPR. The Raven Management Plan includes measures for the collection of ravens from SPR when non-lethal methods of removal are deemed unobtainable. Non-lethal methods have included turning social attraction mirrors so they cannot reflect images. This was done in early 2002 because ravens were found to be highly attracted to the mirrors (Knechtel et al. 2003). Hazing was deemed not feasible because of the frequent and difficult access to SPR that would be required.

In 2003, we began periodic monitoring of raven activity in January (Figure 13), when a pair of birds were spending a considerable amount of time on the "Nose" of the rock near the decoy area. In an attempt to thwart a nesting attempt in 2003, we first escorted personnel from the U.S. Department of Agriculture-Wildlife Services to the rock on 5 February. While a pair of ravens was observed, none were collected. We again escorted Wildlife Services personnel to the rock on 7 March, when two ravens were shot and collected, although we were uncertain if collected birds were members of the resident pair.

Soon after the 7 March removal, raven activity on SPR declined. However, a single raven still frequented the Nose area, giving the appearance that at least one member of the resident pair was still present. Another collection attempt on 7 April was unsuccessful.

Raven activity increased again in mid-April to mid-May, and in mid-May a pair of ravens were observed attending a mostly hidden nest site on the central peak of the rock. A fourth trip to the rock on 24 May resulted in the collection of two more ravens. After the removal of these birds, ravens were observed on only one more day (6 June) for the remainder of the season, and nesting activities ceased. Thus, it appears that this last effort resulted in the removal of the resident nesting pair.

All collected ravens were turned over to CDFG for analyses of stomach contents and sexing.

Aerial Photographic Surveys

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

Compared to 2002 (Knechtel et al. 2003), Common Murres showed little change at most central California colonies. Changes in bird numbers at individual colonies ranged from -45.8% at Miller's Point Rocks to +26.2% at CRM. Despite lower numbers of breeding pairs at DSR in 2003, the 6 June count was only one bird less than 2002 but the 30 May count was 25% lower. Higher numbers at CRM were somewhat offset by 19.3% lower numbers at HPR, resulting in a combined change of +13.3% for the Castle/Hurricane Colony Complex. Despite the large decline at Miller's Point Rocks, the combined Drake's Bay Colony Complex (including Point Resistance, Miller's Point Rocks, and Double Point Rocks) declined only 6.3%. Counts at the two largest central California murre colonies were essentially unchanged: South Farallon Islands,

+1.2%; and North Farallon Islands, +0.5%. Numbers of murres at all colonies combined were 0.7% lower than in 2002.

Numbers of Brandt's Cormorant nests declined somewhat at most colonies. Changes at individual colonies ranged from -100% to +100%. Within colony complexes, changes ranged from -18.6% at Drake's Bay to 0% at the North Farallon Islands. At all colonies combined, nest numbers declined 9.6%. However, this total does not include all Brandt's Cormorant colonies in the region. Inclusion of all colonies will be needed to further assess overall population changes for this species in 2003 (see Capitolo et al. 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 15.6% lower than in 2002. All other Double-crested Cormorant colonies in northern and central California were counted in a separate study (Capitolo et al. 2004).

DISCUSSION

The 2003 breeding season marked the eighth consecutive year of social attraction and monitoring efforts for seabirds in central California by the Common Murre Restoration Project. While our social attraction efforts continued on DSR and SPR, one major project change was the elimination of Point Reyes Headlands from our monitoring efforts. This change was made so we could focus more effort on our primary goal of restoring murre colonies most damaged by the *Apex Houston* oil spill and other anthropogenic impacts. While the information made available from our monitoring at Point Reyes will be missed, data collected there from 1996-2002 will still be valuable for comparisons to DSR and CRM/HPR. We continue to monitor murre and cormorant populations at Point Reyes with aerial surveys, and Point Reyes was visited one day in 2003 to provide a rough comparison to other monitored colonies.

A major project goal was to obtain 100 breeding pairs of murres within 10 years. The 2003 breeding season marked the third consecutive year this goal was reached since 113 pairs bred in year six of the project (2001). While the success of our restoration efforts on DSR continued, the 2003 season was characterized by some unusual patterns and events that differed from past years. This was the first year of the project that numbers of murre breeding pairs did not increase compared to the previous year. However, the slight decrease in breeding pairs from 2002 (123) to 2003 (110) was offset by 105% and 19% increases in territorial and total sites (not including sporadic sites), respectively, a sign of continued increasing activity by murres on the rock.

Social attraction efforts on DSR were modified to some extent in 2003. In 2002, the randomized block plot design on DSR was abandoned in favor of adaptive management of the growing murre colony. We continued this effort in an attempt to increase numbers and densities of murres in established nesting areas. Adaptive management in 2003 largely resulted in reductions of social attraction equipment, including reduced numbers of decoys deployed and the removal of most of the remaining mirror boxes. While the mirrors served an important function early in the project when numbers of murres were low (e.g., Parker et al. 1997, 1998, 1999), murres no longer appear to be attracted to the mirrors. With growing numbers of birds nesting on the rock, the mirrors had become a hindrance to monitoring efforts, and the loss of the mirrors probably did not affect murre behavior. The placement of colored wooden dowels where mirrors once stood served the purpose of replacing these important landmarks with something much less obstructive.

While the number of decoys on DSR was ultimately reduced by 30% from 2002, the relative distribution of remaining decoys on the rock was similar. The only easily discernible difference was the elimination of the lower (southern) portion of Plot 3, where no recent murre breeding had occurred. After initial success in 2002, a third 2"x4" wooden board was added in hopes of attracting additional breeding sites and closing gaps between groups of breeding murres. We had only limited success with the 2"x4" boards this year. One new site was established within two murre widths of the new board added to plot 3, and two additional sites were established near the old boards in plots 1and 2. Despite the removal of most decoys from Plot 3, one new breeding site was established in that now cleared area.

The effects of social attraction changes on DSR breeding murres in 2003 are unclear. While it is possible that reductions in decoy numbers had some effect leading to lower numbers of breeding pairs, this seems unlikely. Although attendance from day to day was more variable, numbers of birds attending DSR generally were similar to 2002 (see Knechtel et al. 2003). The relative distribution of breeding and territorial sites, at least early in the season, was also similar to 2002. However, this distribution changed as murres from the far east side of the rock (plots 10 and 12) were displaced by roosting pelicans and cormorants, an impact that decoys did not halt.

The high number of territorial sites on DSR in 2003 reflected both new sites and a large number of returning birds that did not breed (including some that were displaced by roosting Pelecaniformes). This suggested further that murres did not abandon the rock because of reductions in decoy numbers. In 2003, approximately 41% of active sites were located near (within one-murre width of) decoys. This marks the first year of the project that more sites were outside the decoy areas than within them. Of 31 new active sites, 14 occurred near decoy areas. Reductions in sites near decoys likely reflected the removal of decoys near established sites and the growing importance of live murres on the placement of new breeding sites.

This was the sixth year of social attraction efforts at SPR, where murres have not been recorded breeding since the early 1900s (Ray 1909, Carter et al. 2001). Changes at SPR in 2003 included the installation of 50 Brandt's Cormorant decoys and an active raven management program that resulted in the removal of a nesting pair of ravens. These ravens may have deterred murres from visiting SPR. Although the first murre of the season was observed the day following removal of the raven pair, murre activity on the rock was similar to past years. Only small numbers of birds visited the decoy area, and most were late in the breeding season. Cormorants also responded little to the cormorant decoys, which were deployed in hopes of attracting cormorants to nest, which would then assist attraction efforts for murres. Most cormorant activity near the decoys involved roosting birds, although a few birds engaged in low effort nest building activities in late July. While these results were disappointing, the installation of a remote-controlled video system greatly enhanced our abilities to monitor birds on SPR. Several murre observations were made that would have been missed with just spotting scopes. If birds should nest on SPR in future years of the project, productivity, behavior, and other monitoring will now be possible.
The 2003 breeding season was almost certainly affected to some extent by environmental factors.

The winter of 2002-2003 was marked by a mild to moderate El Niño that peaked off the California coast in early 2003 and then subsided rapidly (Venrick et al. 2003). The short duration of this El Niño event differed from many past events (e.g., 1982-83, 1992-93, 1997-98), which often last at least through the spring. During El Niños, warm sub-tropical waters enter the California Current System, resulting in reduced upwelling and low primary productivity. This can have dramatic effects on the entire ecoystem of the North Pacific Ocean. For seabirds, this can include reduced prey resources that leads to delayed breeding, low breeding effort, low breeding success, and decreased survival (e.g., Ainley and Boekelheide 1990, Nur and Sydeman 1999).

At our central California study sites, effects of this El Niño event were not entirely clear but appeared to be evident, especially at DSR. At DSR, attendance of murres during most of the winter was moderate to low (typically less than 50 birds) after high attendance in mid-January. Attendance increased in mid- to late March, but remained highly variable through the breeding season, particularly in April and May. Day to day attendance patterns typically vary little during the incubation and early chick stages (Takekawa et al. 1990). Daily attendance patterns also were unusual; during the early incubation period, attendance was usually high in the morning but most birds departed the rock by early to mid-afternoon. Breeding phenology also was delayed in 2003. The first egg date of 8 May was at least one week later than any other since 1998. Egg abandonment was very prevalent throughout the first half of the egg-laying period, resulting in low hatching success (55.6%), and the 0.68 chicks per pair was the lowest breeding success on DSR since the severe El Niño event of 1998. In addition, co-attendance by murre breeding pairs during the chick period was less than half that recorded during any other year since data were first collected in 1999. This indicated that birds were likely having to spend more time foraging to obtain enough prey to maintain body condition and feed their developing young. Despite this, however, high fledging success indicated that prey resources were still adequate at that time to successfully raise young.

In addition to these factors, several other indications of low prey resources or other perturbations were evident, particularly at DSR, in spring 2003: 1) after considerable pre-breeding courtship activities on DSR, most nesting Brandt's Cormorants apparently moved from DSR in late April to nest on the adjacent mainland at DSM; 2) the cormorants in our mainland monitoring sample suffered from high abandonment rates and low breeding success; 3) high numbers of roosting Brown Pelicans on both DSR and SPR; 4) high numbers of California sea lions (*Zalophus californianus*) hauled out on DSR throughout the spring, a phenomenon last observed during the 1998 El Niño (M. W. Parker, pers. obs.); 4) one to two Brown Boobies that visited DSR in both April and July. Brown Pelicans and California sea lions breed on islands off southern California and Mexico, and typically do not arrive to central California in significant numbers until late June or July. Brown Boobies occur mostly in the tropics and subtropics and only rarely stray to central California, usually during warm water periods.

Some of these same factors also impacted breeding efforts by murres on DSR. Large numbers of pelicans and cormorants roosted on the eastern one-fifth or so of the top peak of DSR. By early June, these birds essentially took over murre decoy plots 10 and 12, excluding murres from breeding on established nest sites in those areas. Although a few murres laid eggs there earlier in the month, this resulted in the displacement of just over 20 breeding sites. Roosting cormorants and the booby were observed attempting to steal fish from adult murres trying to feed their chicks. While it is not unusual for pelicans and cormorants to roost on the upper portion of DSR, numbers typically are insignificant until later in the breeding season. Also, the lack of cormorant nests in this area probably made it easier for roosting birds to utilize space. Because of their larger size, nesting cormorants tend to be more aggressive and effective at warding off potential invading roosting birds (McChesney, pers. obs.).

At CRM, the main effect of El Niño and other conditions in 2003 was likely the delayed onset of egg-laying, which was about one week later than most years at both monitored subcolonies (based on earliest egg dates). Breeding success measures at CRM did not strongly indicate low prey resources. The number of chicks per pair at CRM-04 was high compared to other years since 1996, although CRM-03 East was below average (possibly for other reasons, see below). This colony suffers from chronic low breeding success for reasons not fully understood, but likely related to high levels of both anthropogenic and non-anthropogenic disturbance (see past reports). As in most previous years, low productivity at CRM-03 East was attributed to high egg and chick losses that accrued steadily over time and were not attributable to a single event. Although this subcolony was active in certain past years (McChesney et al. 1999), since this project began in 1996 breeding has occurred only in 1999-2003. In 1999-2002, murres bred among nesting Brandt's Cormorants, but no cormorants bred on CRM-03 East in 2003. Thus, the return of murres to these breeding sites as a monospecific group might signal the establishment of a long-term breeding subcolony.

Another weather factor that might have influenced the seabird breeding season was rain in the late pre-egg laying period. After below average precipitation in January to March, April 2003 was unusually wet. For example, San Francisco Airport recorded 13 days of rain in April that amounted to over four inches (3.2 inches above average; NOAA, National Weather Service, unpubl. data). Ainley et al. (1990) found that non-breeding season attendance by murres at the South Farallon Islands was reduced during storms. It is possible that this unusually wet spring weather affected both murre and cormorant breeding activity to some extent, such as disrupting attendance patterns, courtship, and delayed egg laying.

Aerial photographic survey results also provided mixed signals related to oceanographic conditions. At counted central California colonies, both Brandt's and Double-crested cormorant numbers were lower overall than in 2002, although not dramatically. Brandt's Cormorants, in particular, are known to respond to El Niño conditions by reducing breeding effort (Boekelheide and Ainley 1989, Boekelheide et al. 1990, McChesney 1997). Despite differences between colonies, murre numbers changed little from 2002, a sign that many birds at least attended colonies. Increased numbers of murres recorded at the Castle/Hurricane Colony Complex raises hopes of further recovery of this struggling colony.

Aircraft disturbance was another factor that likely affected murre attendance and breeding success in 2003, especially on DSR . Despite recent outreach efforts with the public and USCG (see below), this year had the highest number of recorded disturbances on DSR since monitoring began in 1996. In previous years, murres on DSR showed less response to low flying aircraft than other monitored colonies at CRM/HPR and Point Reyes, although the numbers of low overflights were often higher. It is uncertain why murres were more prone to disturbance in 2003. Possible explanations include: 1) reduced body condition; 2) lower numbers of breeding birds attending the rock; 3) failure of the sound system; and 4) increased overflight activity. Reduced body condition because of low prey resources may have led to higher stress levels, thus causing birds to be more susceptible to disturbance. Non-breeding birds are also more likely to flush than those incubating eggs or brooding chicks (McChesney, pers. obs.). Although the many live murres on the rock are likely much noisier than the sound system, the constant colony sounds emanating from the sound system may reduce the disturbing effects of low flying aircraft (Caurant et al. 2002). While the sound system was functioning when last inspected on 25 March, it was off when decoys were removed in September. It is possible the sound system went off early in the breeding season. The relative lack of nesting cormorants on DSR also might have influenced the murres reactions to passing aircraft.

Low flying aircraft also continued to be a conservation problem at CRM, with several low overflights from both civilian and military helicopters resulting in flushing events. This colony, in particular, has suffered from aircraft and boat disturbance in past years. While no eggs or chicks were observed to be lost due to aircraft disturbance, breeding activities still may have been affected, such as by disrupted courtship, delayed egg-laying, or reductions in breeding attempts.

We continued outreach efforts to educate the public and other agencies about the project and effects of human disturbance on seabirds. On 12 October 2002, McChesney and Knechtel attended a booth containing project outreach materials at the Farallones Marine Sanctuary's

Oceanfest event at Crissy Field, San Francisco. A letter to educate aviators about aircraft disturbance to seabirds was mailed to 128 San Francisco Bay area pilots, pilot organizations, and airports in late April 2003. Increased outreach to USCG included a brief presentation by McChesney, Joelle Buffa, and Knechtel on 9 April 2003 to pilots of USCG - Group San Francisco and attendance by McChesney and Buffa at a USCG marine protected species forum on 14 May 2003. As in past years, we continued working with organizers of the Big Sur Marathon to reduce aircraft disturbance from that event.

A new major concern at CRM was the apparent establishment of a pair of Common Ravens in the area. Until 2003, ravens were rarely observed in the Castle/Hurricane area by our observers. Despite dramatic increases in other parts of coastal California in recent years, ravens are still considered scarce on the Big Sur Coast (Kelly et al. 2002). Beginning in the late incubation period for murres, these ravens began landing on the murre subcolonies of CRM-03 East and CRM-04, sending murres scurrying and flushing from the rocks. Ravens were observed on 27 of 74 observation days on or near the CRM/HPR colony. On 11 of those days, ravens were observed on Castle Rocks actively harassing breeding murres. Two murre chicks were observed to be eaten by ravens on CRM-03 East, where raven efforts were more focused. Low breeding success at this subcolony may have resulted partly from this and other undocumented raven predation. The arrival of ravens in this area could dramatically exacerbate existing problems at this colony in future years.

Although we did not continue studies of murre and cormorant interactions begun as a pilot effort in 2002 (Knechtel et al. 2003) , additional incidental information was obtained on the apparent benefits of cormorants as social attractants for murres. Small numbers of murres occasionally visited the cormorant subcolony on DSM, the first time we have documented murres in this area. Murres also bred in two areas at CRM where breeding has only been recorded in certain past years (e.g., McChesney et al. 1999): the upper slope of CRM-03 West; and the "South Finger" of CRM-04. Both of these groups of murres were associated with nesting Brandt's Cormorants.

ENVIRONMENTAL EDUCATION PROGRAM

OVERVIEW

The environmental education component of the Common Murre Restoration Project continued for the eighth 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 2003, thirty-one classes ranging from Kindergarten to fifth grade participated in the program. Approximately 5,390 students from the San Francisco Bay Area (Montara, Pacifica, Half Moon Bay, San Leandro, Fremont, San Jose, El Granada) 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 sea birds, 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 food webs. All presentations were given between September 18 and October 29.

PARTICIPANTS

In 2003 ten schools from five school districts with 32 teachers and approximately 890 students participated in the education program. Cabrillo, Ocean Shore and James Monroe Elementary Schools participated for the first time. There also were 9 new teachers participating.

Cabrillo Unified School District

El Granda Elementary
- Jennifer Austin, 3rd grade, 26 students
- Pauline Shue, 3rd grade, 28 students

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

Hatch Elementary
- Ann Mangold, 4th grade, 32 students
- Lyn Kelly, 5th grade, 32 students
- Kate Rogan, 5th grade-immersion, 32 students
- Amy Rhodes, 5th grade, 32 students

San Leandro Unified School District

James Monroe School
- Alice Pegram, 5th grade, 32 students

Pacifica Union School District

Cabrillo ElementarySchool
Dwan Padilla, 4th grade, 32 students
Tiffany Leung, 4th grade, 32 students
Linda Mar Elementary
Nora Chikhale, 3rd grade, 20 students
Gretchen Delman, 4th grade, 28 students
Sandi Jaramillo, 5th grade, 32 students
Sharon Walker, 2nd grade, 18 students
Ocean Shore Elementary
Sheila Gamble, 3rd grade, 32 students
Jonathon Harris, 4th/5th grade, 40 students
Vallemar Elementary
Natalie Taylor, 1st grade, 20 students
Anne Haas, 1st grade, 20 students
Alyce Wassall, 1st grade, 20 students
Tami Taylor, 3rd grade, 20 students
Elizabeth Meyers, 3rd grade, 20 students
Cheryl Bingham, 3rd grade, 20 students
Jean McMartin, 5th grade, 32 students
Doreen Barnes, 5th grade, 32 students

Union School District

Oster School
Maryann Sears, 3rd grade, 26 students
Barbara Finkle, 4th grade, 30 students
Jason Tarshis, 5th grade, 28 students

Fremont Unified School District

Warwick Elementary
Jonathon Greathouse, 4th grade, 64 B 2 classes
Melanie Moreno, 4th grade, 64 B 2 classes

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 19995b)
  - 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 2003.

During and following the decoy painting period, repairs were made to decoys in need. Some wooden decoys needed head reattachment, bill repair, metal rod removal, or additional touch up painting. This year a wooden dowel was used in re-attaching heads to provide extra support. Although drilling holes into the body and head can be difficult, the large number of headless decoys this year required a more stable re-attachment. Some plastic decoys needed replacement of the threaded rod inserts. Inserts with heavier threads were used as the old inserts were unavailable.

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. One 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 Common Murre eggs also were 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 fifteen minutes of the presentations. This slide show gave an overview of the Common Murre Restoration project including: the natural history of the Common Murres; 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 ten or more minutes were devoted to questions and answers after the presentation.

Assistants

A Murre Project staff member, an SCA intern, and the Environmental Education Specialist from the Refuge's Visitors Center each attended an initial visit for observation and assistance. A Refuge volunteer, SCA intern or Murre Project Staff member attended almost every painting visit.

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. In the context of guano as an adaptation, the Common Murre food web was reviewed. To complete the food web activity, teamwork among the students was essential. The food web consisting of phytoplankton, zooplankton, squid, fish, and the Common Murre was built piece by piece as the students recalled the information with verbal cues.

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 three or 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. In teams the students were asked to build 'graphs' with their pieces to compare the number of each color, and then to try to explain the results.
Finally, the students painted the decoys working in pairs. Each pair received one decoy to paint. One student painted the white underside, while their partner painted the upper dark brown. 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 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 eighth 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 for this year and years past. 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 praise the project as an essential part of their curriculum. The 2003 education program was highly successful, reaching nearly 900 students, recruiting three new schools and welcoming nine new teachers. Future improvements might include modifying the accompanying curriculum to directly correlate with California educational standards, and to better reflect California seabirds and marine life instead of those from Alaska or elsewhere. Also, an additional activity could be developed for the second "painting" presentation as less time is now spent painting decoys. This activity could supplant the food chain activity concept, and expand to be more engaging for the students. Finally, a public outreach program should be initiated utilizing biologists and volunteers for informational presentations at local functions and local community centers such as libraries.

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REPORTS AND PRODUCTS AVAILABLE
FROM THE *APEX HOUSTON* TRUSTEE COUNCIL

Contact: Gerry McChesney, San Francisco Bay National Wildlife Refuge Complex, P.O. Box 524, Newark, CA 94560.

1. Restoration of Common Murre Colonies in Central California: Annual Report 1996
2. Restoration of Common Murre Colonies in Central California: Annual Report 1997
3. Restoration of Common Murre Colonies in Central California: Annual Report 1998
4. Restoration of Common Murre Colonies in Central California: Annual Report 1999
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6. Restoration of Common Murre Colonies in Central California: Annual Report 2001
7. Restoration of Common Murre Colonies in Central California: Annual Report 2002
8. Restoration of Common Murre Colonies in Central California: Annual Report 2003
9. Colony Formation and Nest Site Selection of Common Murres on Southeast Farallon Island, California
10. Attendance Patterns and Development of Correction Factors at Southeast Farallon Island, California
11. Subcolony Use and Population Trends of Common Murres and Brandt's Cormorants at Point Reyes Headlands, California, 1979-1997
12. Subcolony Use and Population Trends of Common Murres and Brandt's Cormorants at the Castle/Hurricane Colony Complex, California, 1979-1997
13. Returning Home: Bringing the Common Murre Back to Devil's Slide Rock. 24 minute video
14. Common Murre Breeding Season Attendance Patterns at Southeast Farallon Island, California, 1996-1998
15. Statistical Analysis of the "k" Correction Factor Used in Population Assessments of Murres: Implications for Monitoring
16. Biology and Conservation of the Common Murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural History and Population Trends.
17. Protocol for Identification of Areas Used for Counting Seabirds from Aerial Photographs at the South Farallon Islands, California

Contact: Paul Kelly, Department of Fish and Game -OSPR, P.O. Box 922209, Sacramento, CA 94244-2090.

1. Gazos Creek Marbled Murrelet Monitoring Program - Annual Report 1999

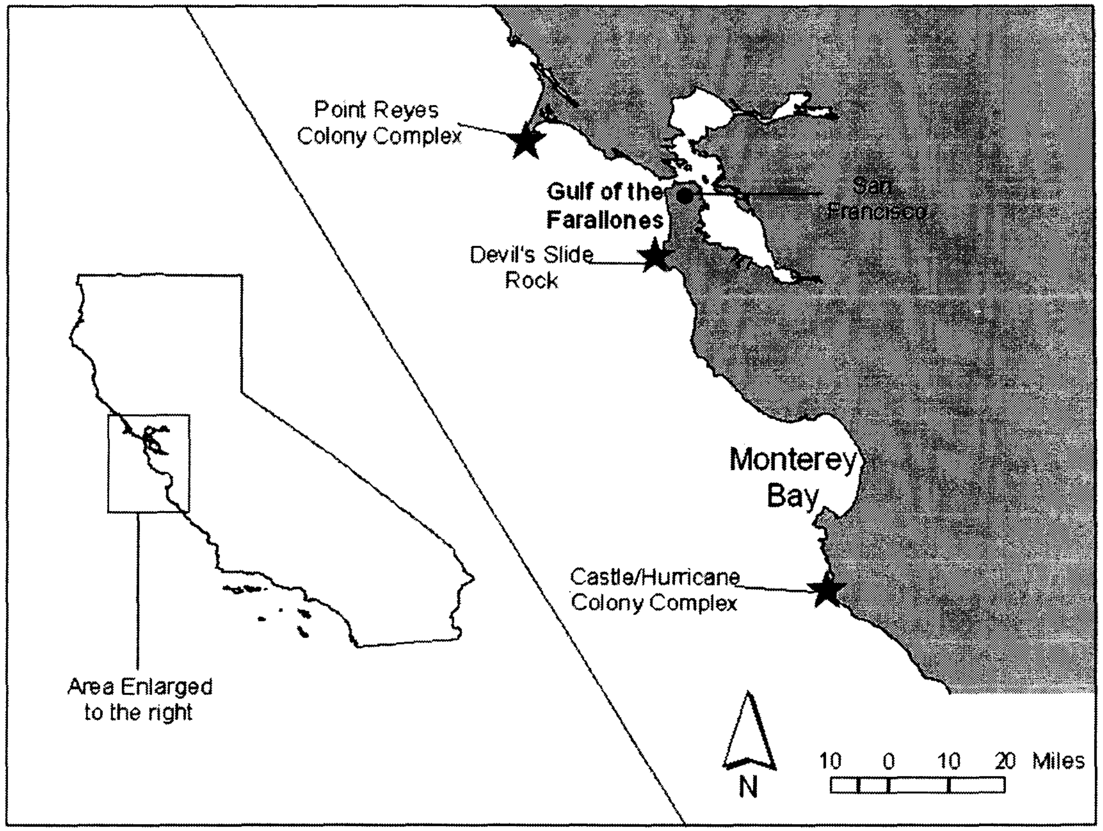


Figure 1. Map showing the location of the three study sites along the central California coast. Devil's Slide Rock and San Pedro Rock are located within the Devil's Slide Colony Complex.

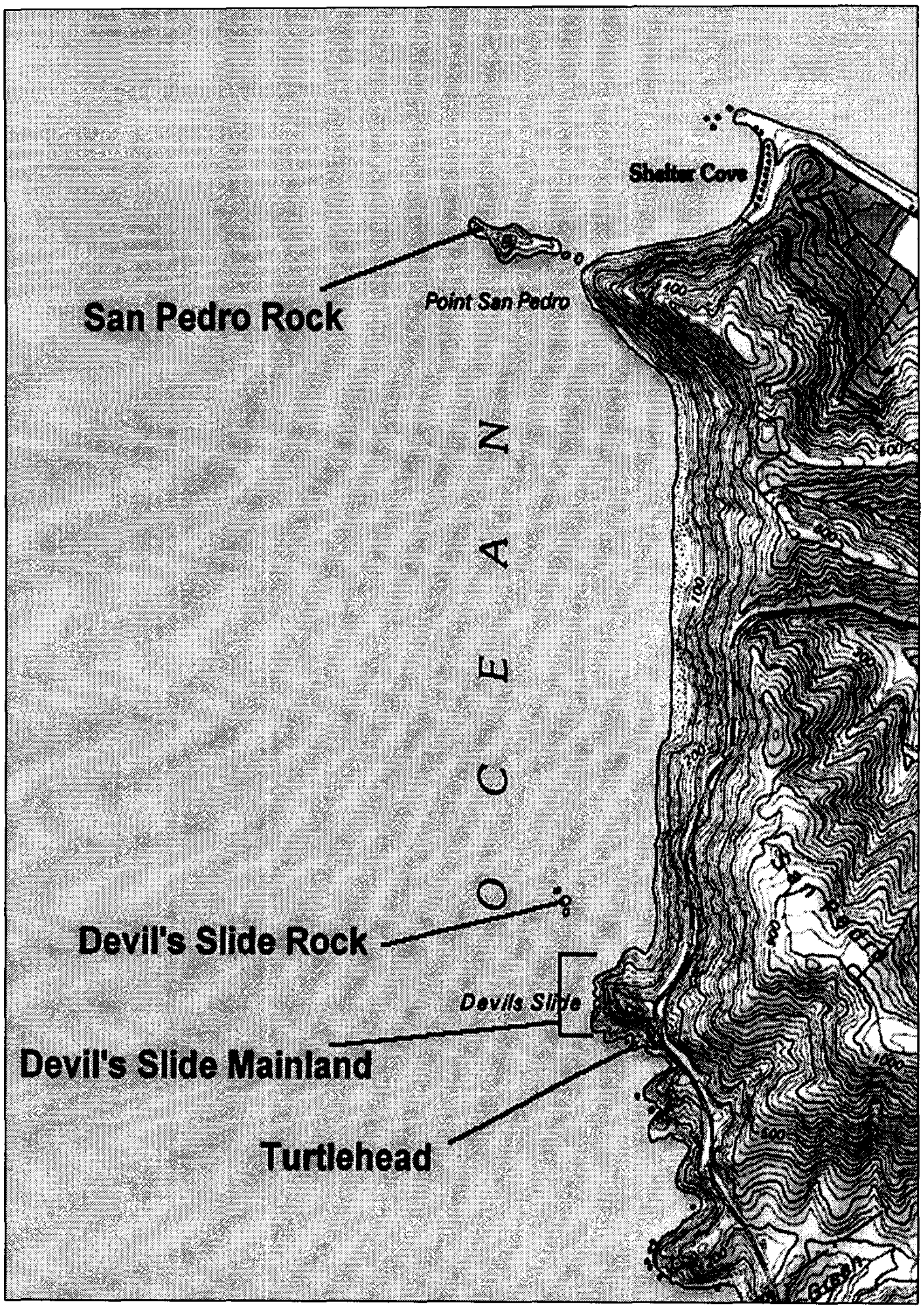


Figure 2. Devil's Slide Colony Complex including colonies and subcolonies monitored by the Common Murre Restoration Project.

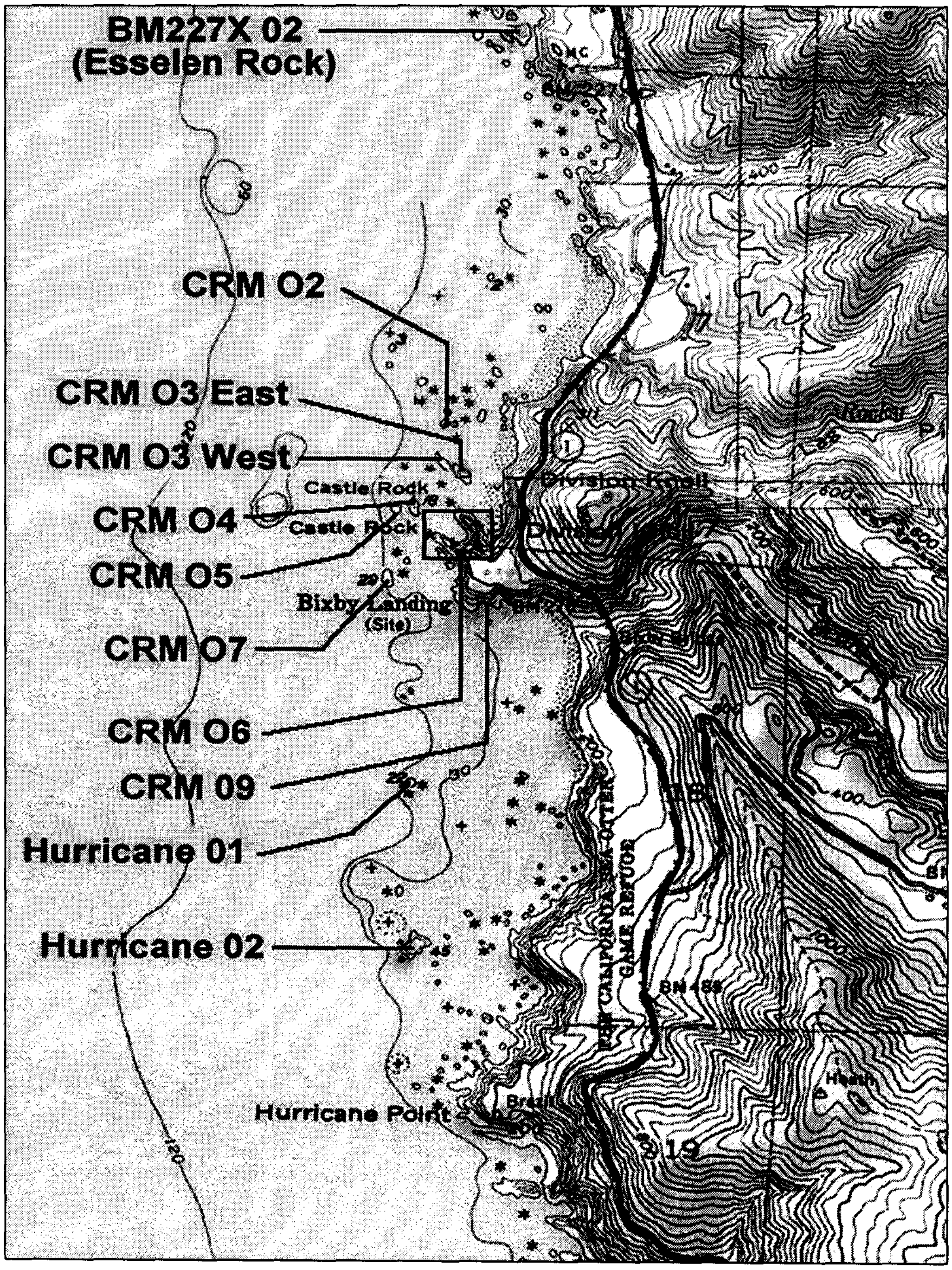


Figure 3. Castle/Hurricane Colony Complex, including Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (Hurricane). Rocks labeled are subcolonies mentioned in the text.

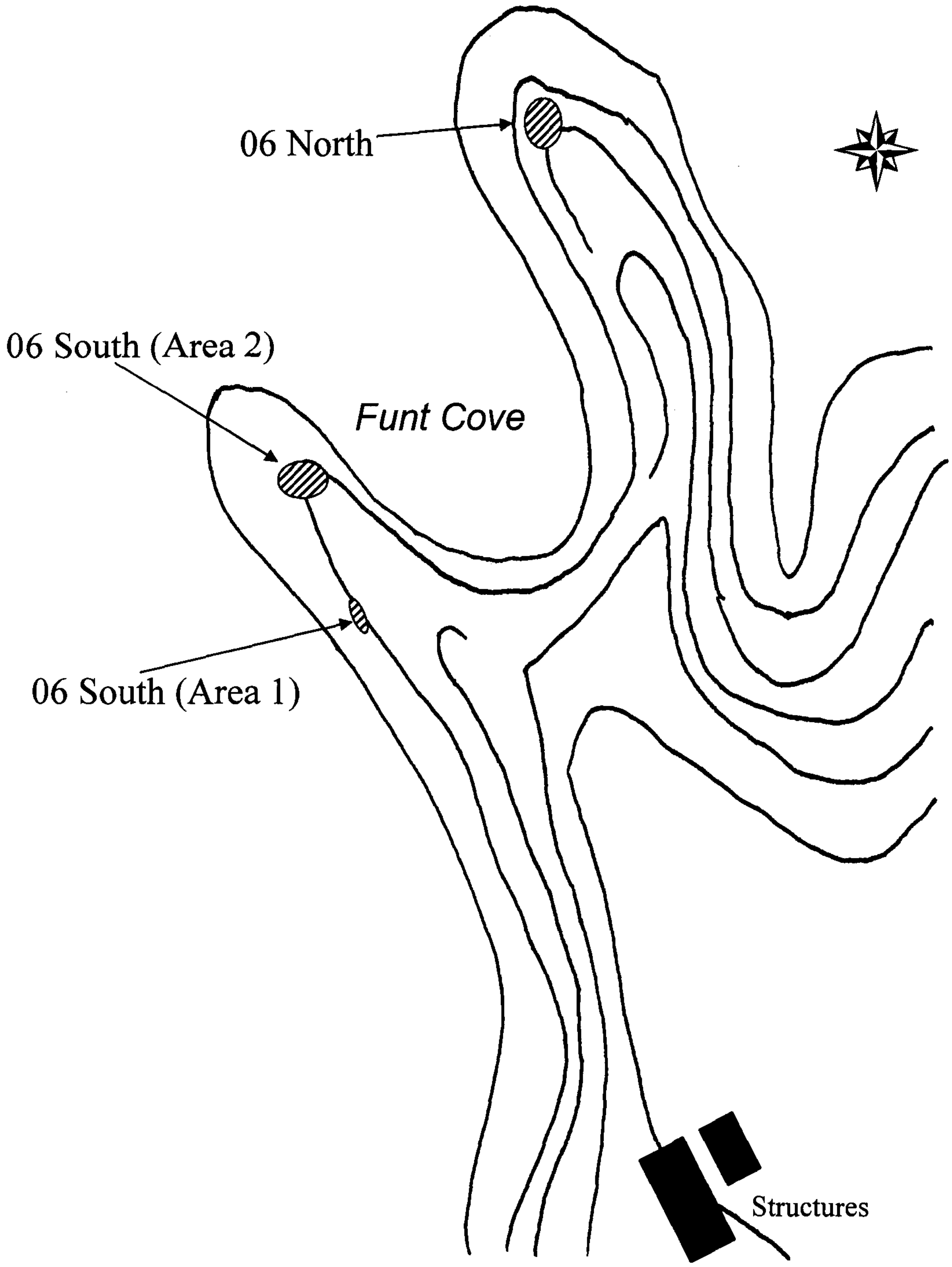


Figure 4. Murre attendance areas at subcolony 06, Funt Peninsula, Castle Rocks and Mainland in 2002-2003. Contour interval 40 feet (from USGS map "Point Sur"). Map is modified from McChesney et al. (1999).

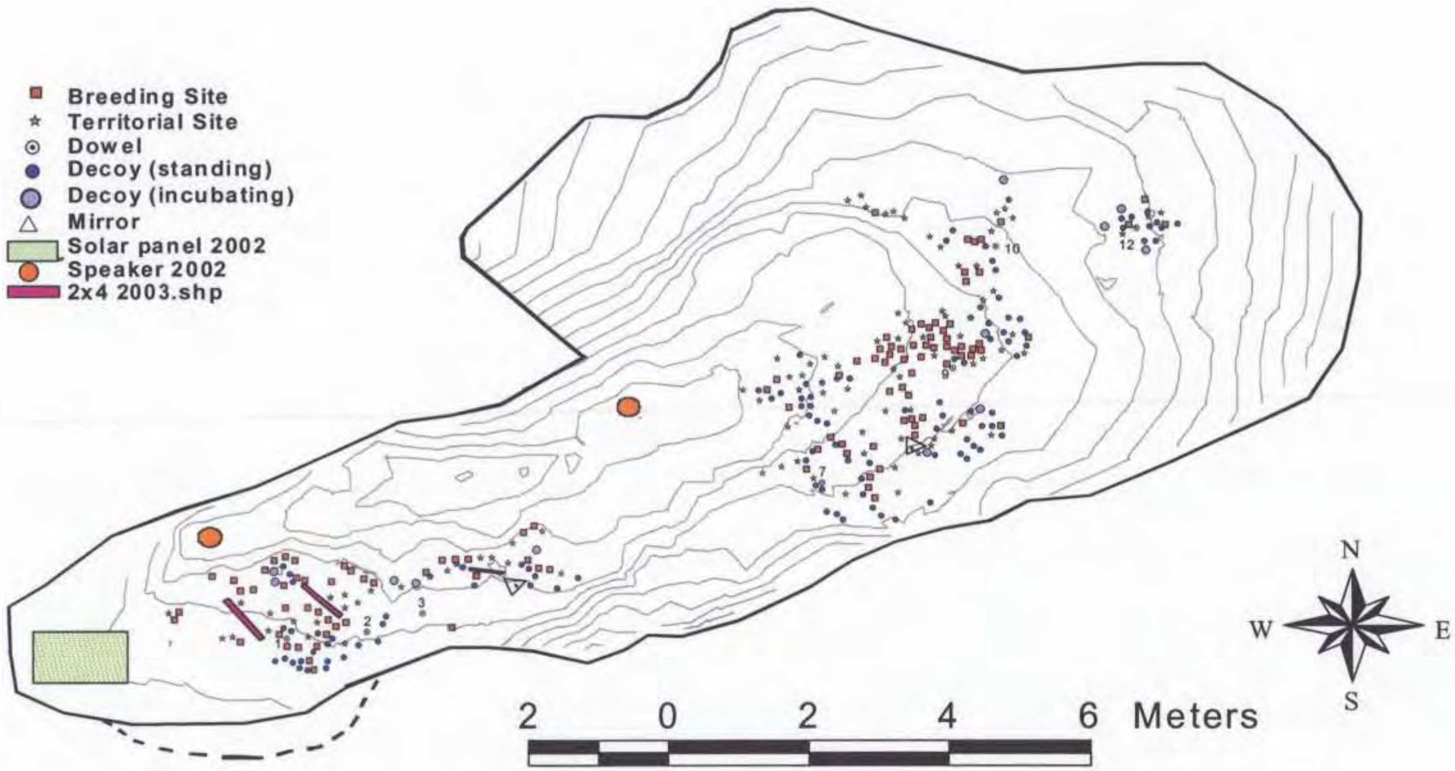


Figure 5. GIS map of Devil's Slide Rock, 2003. Common Murre breeding and territorial sites are shown in relation to social attraction equipment.

Figure 6. Photograph of Brandt's Cormorant decoy with decoy nest.

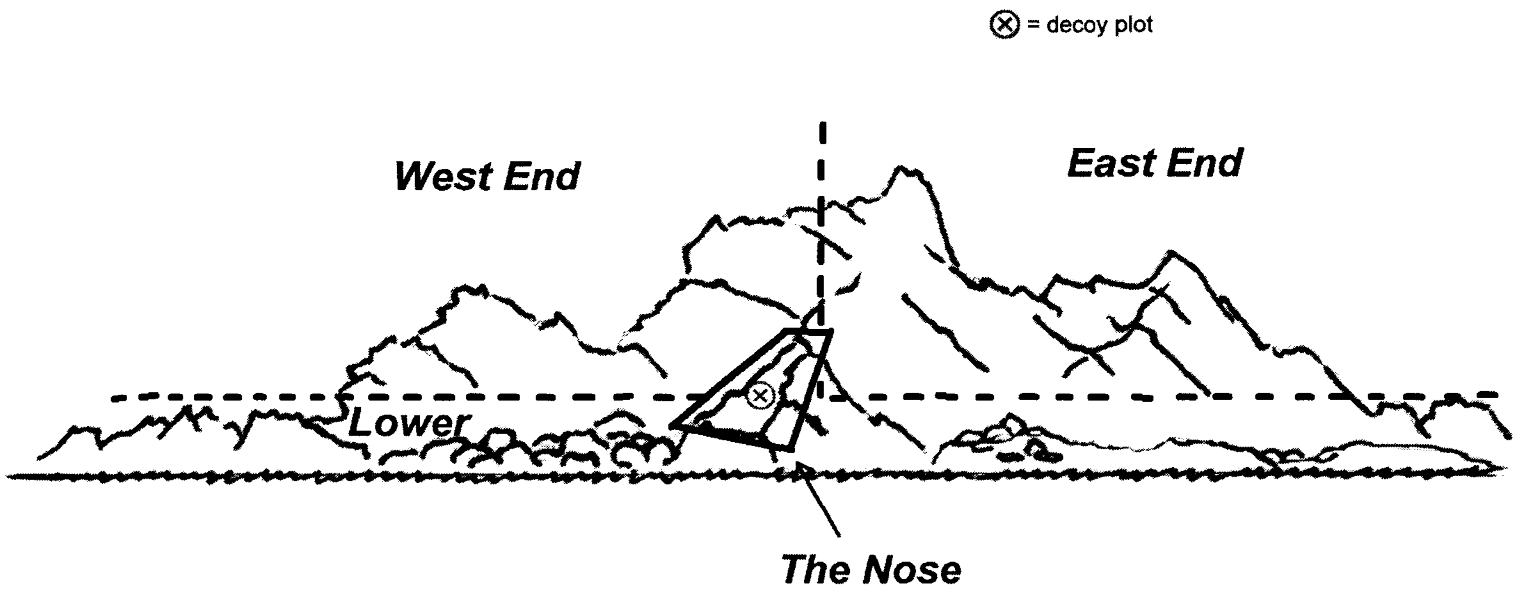


Figure 7. San Pedro Rock (South side) as it appears from the viewing location along Highway 1. The rock is divided into five sections for recording bird and marine mammal locations (West End, East End, Lower, The Nose, Decoy Area). Drawing by N. Jones.

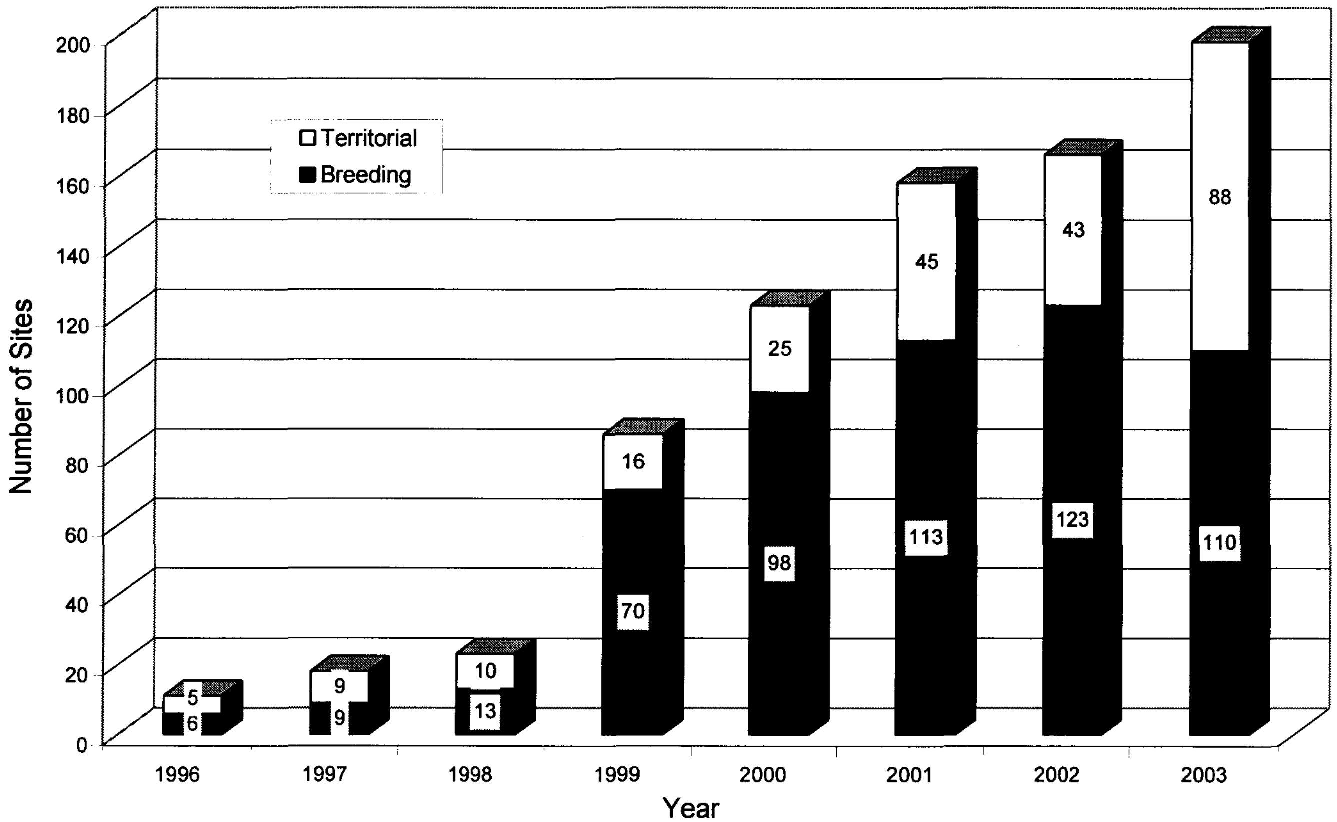


Figure 8. Number of Common Murre breeding and territorial sites at Devil's Slide Rock, 1996-2003.

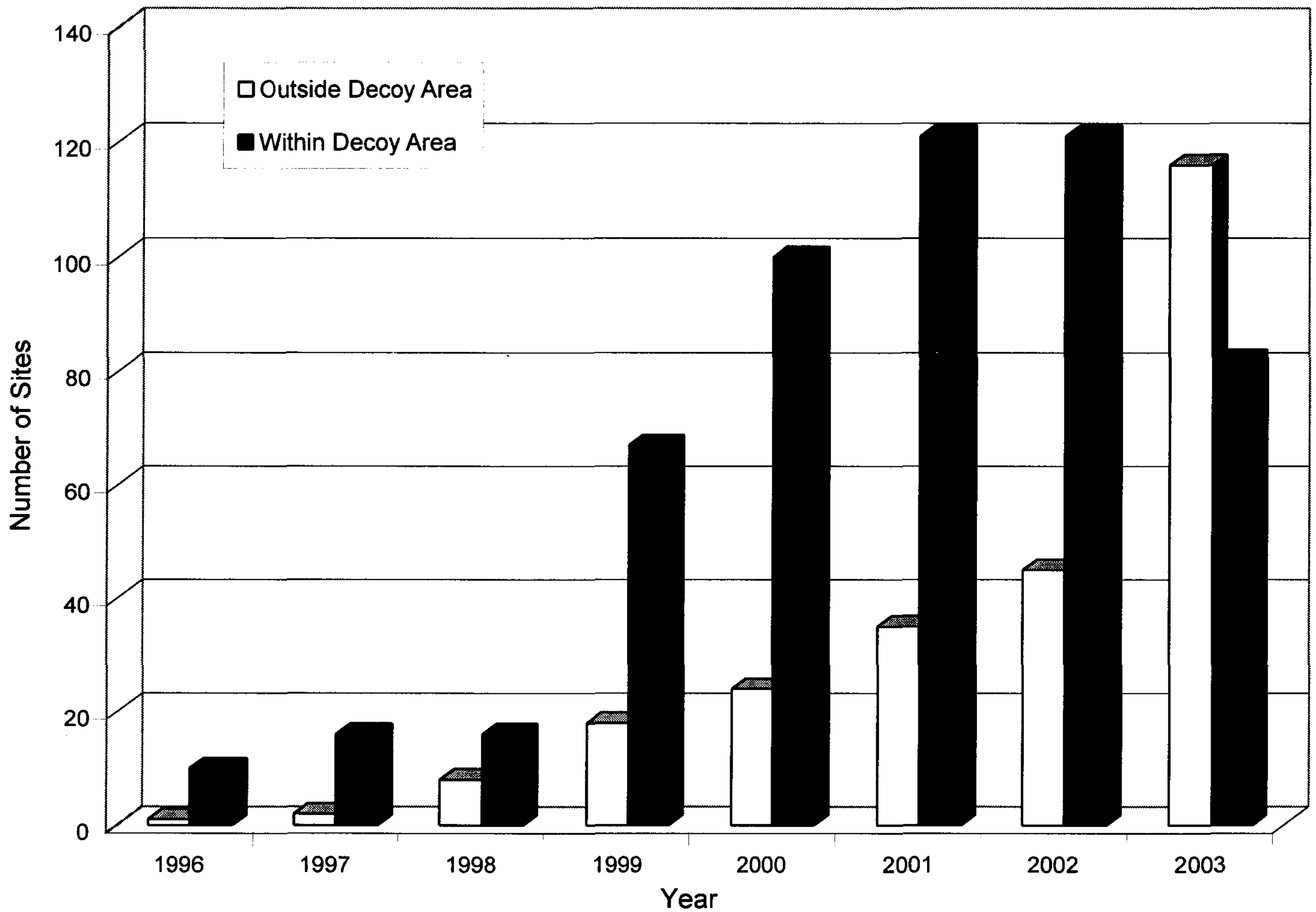


Figure 9. Number of Common Murre breeding and territorial sites within and outside of decoy plots on Devil's Slide Rock, 1996-2003.

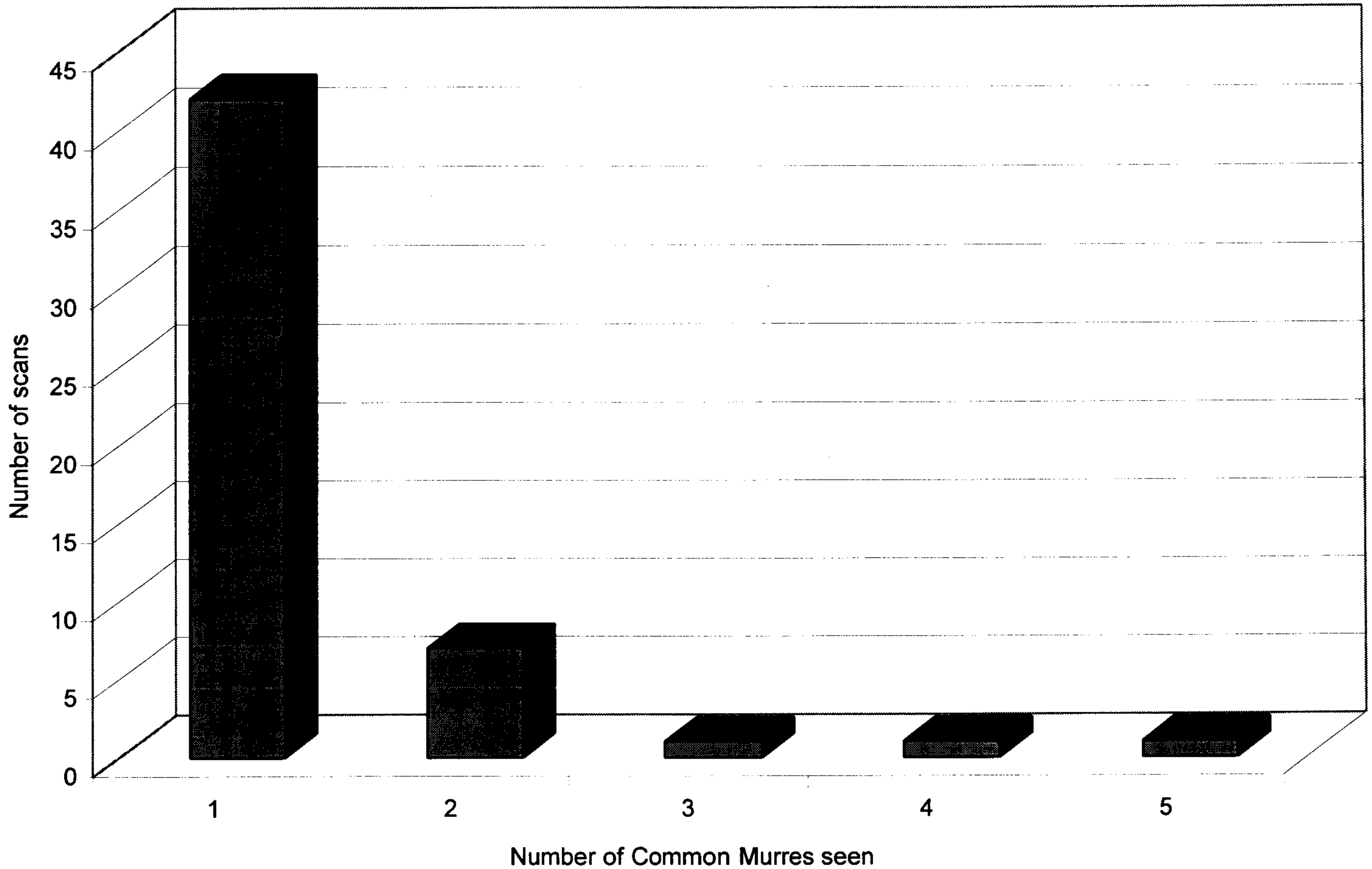


Figure 10. Number of scans resulting in Common Murre observations on San Pedro Rock, 17 April to 7 August 2003.

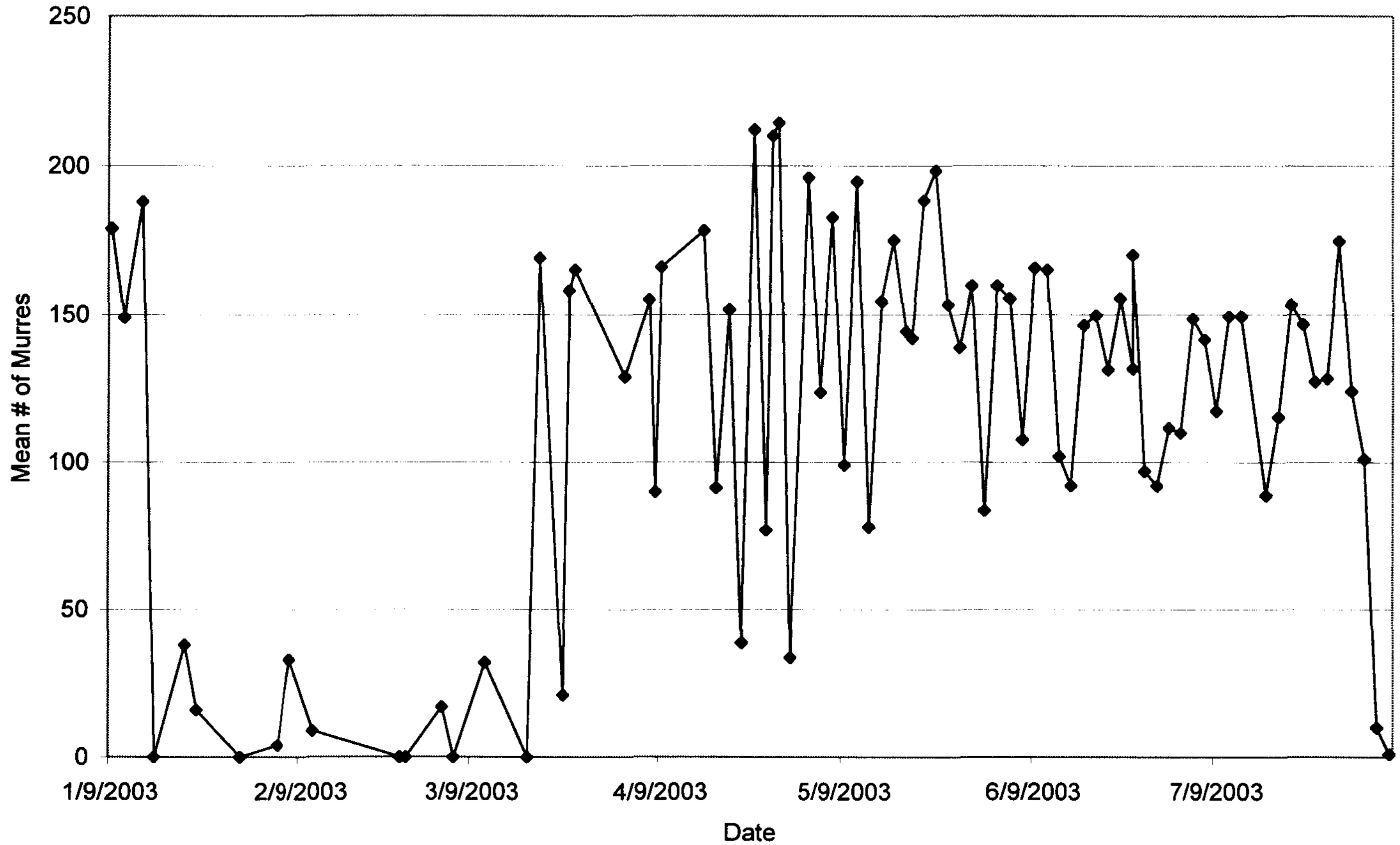


Figure 11. Seasonal attendance of Common Murres at Devil's Slide Rock, 9 January to 6 August, 2003. Attendance is reported as an average of three consecutive counts.

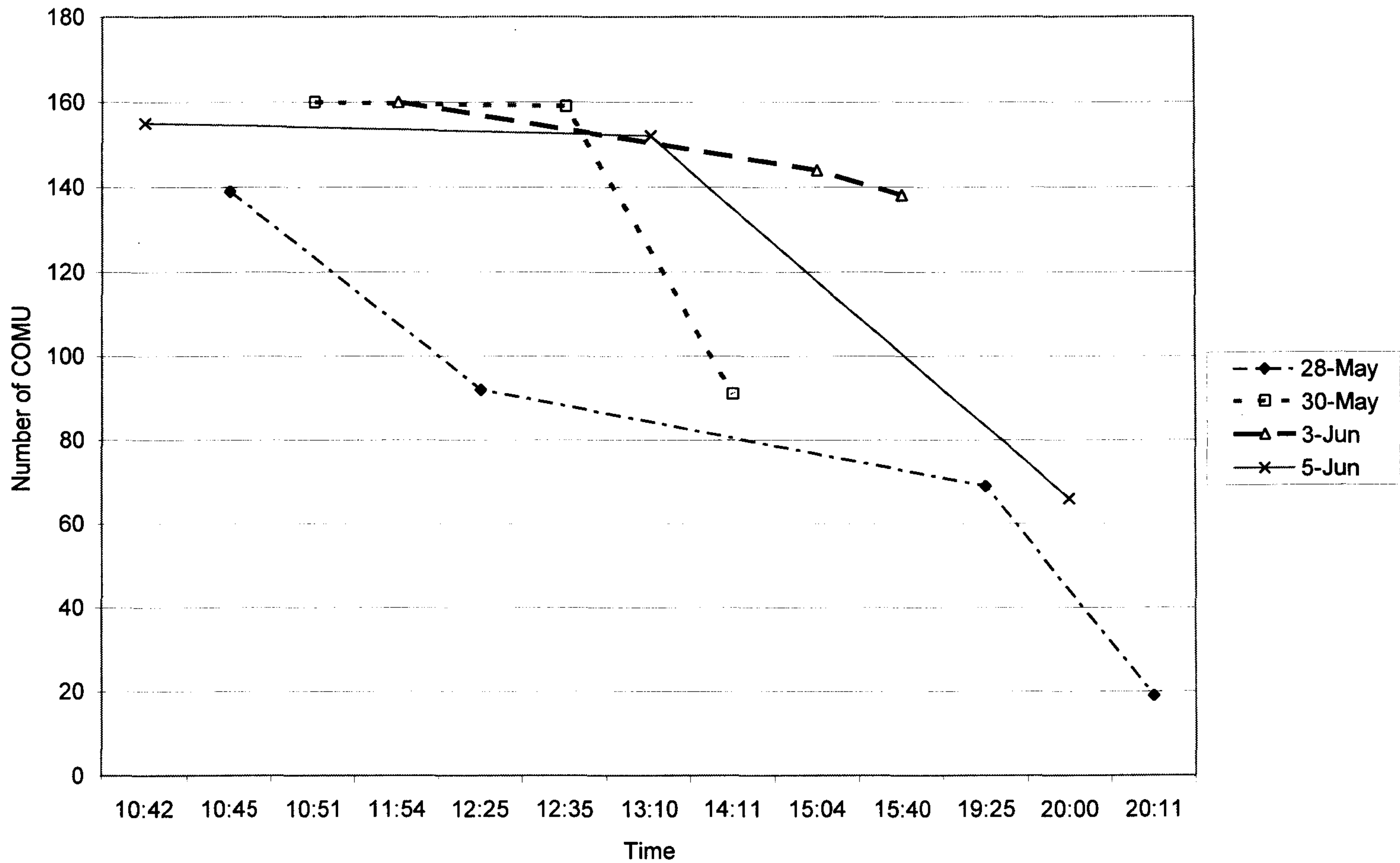


Figure 12. Diurnal attendance of Common Murres on Devil's Slide Rock on four days between 28 May and 5 June 2003, showing decline in numbers in the afternoon on most days.

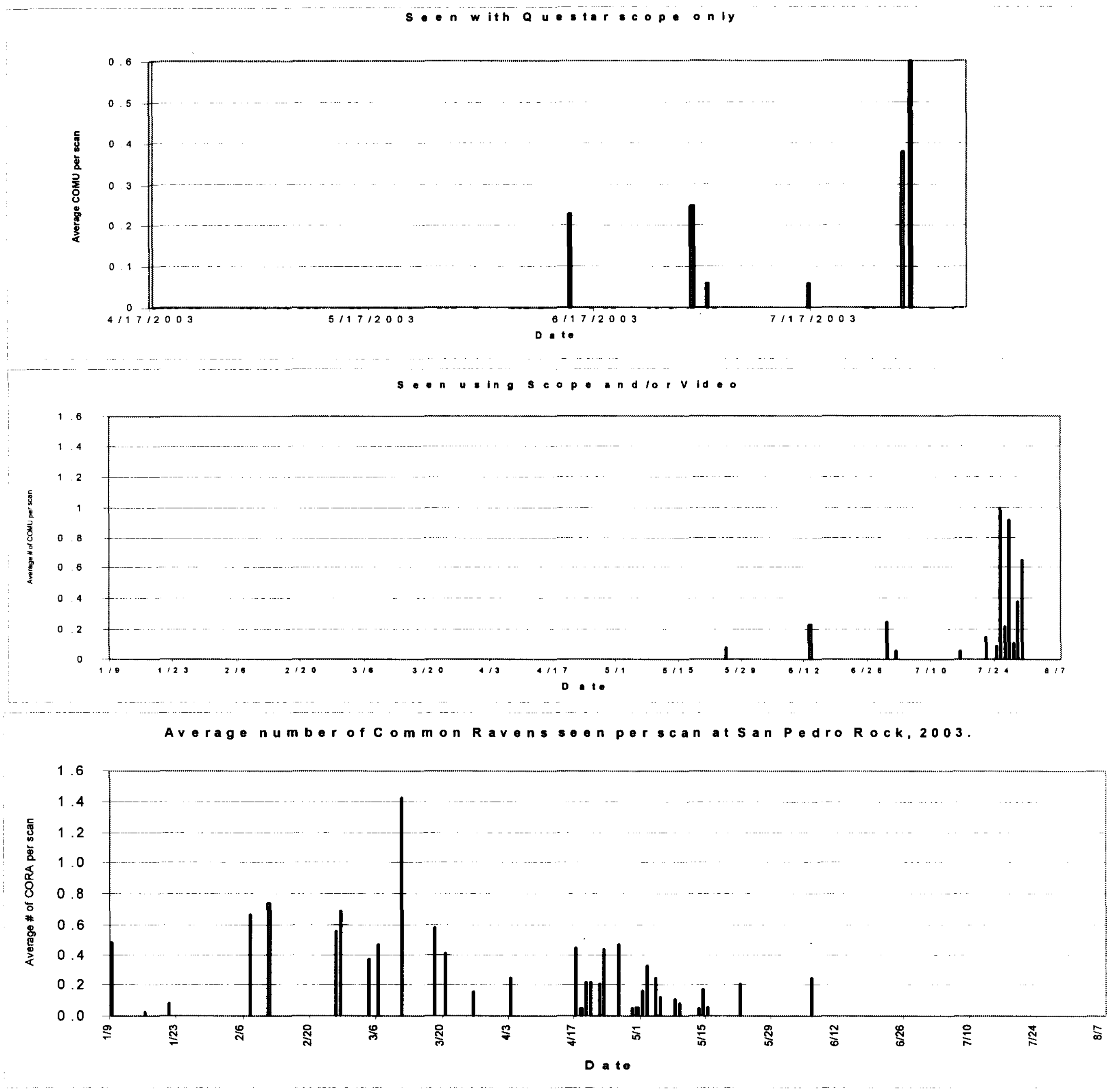
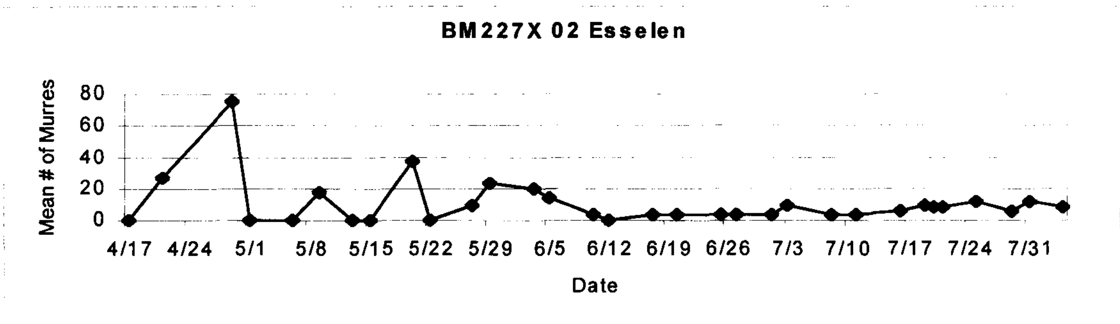
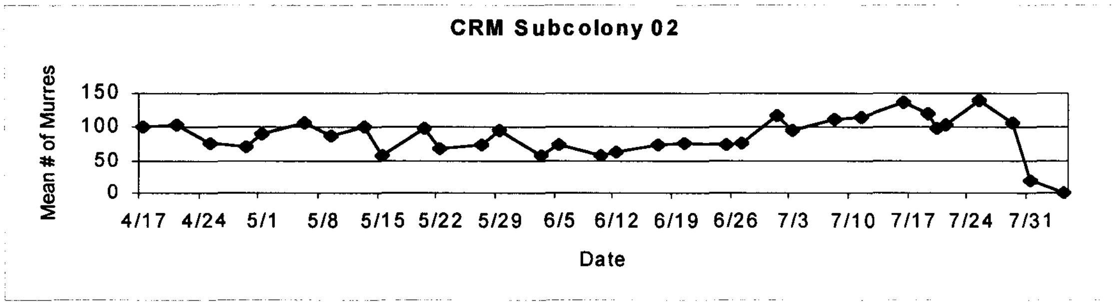
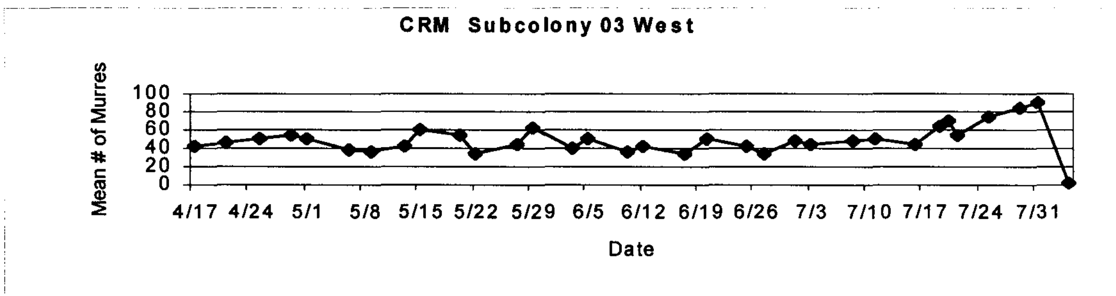


Figure 13. Seasonal attendance of Common Murres (COMU) and Common Ravens (CORA) at San Pedro Rock, 2003. Data are recorded as an average number of birds seen per 10-minute scan during 2-3 hour watches. Top and middle charts compare COMU observed with the Questar scope only (top) and scope and/or video system (middle).







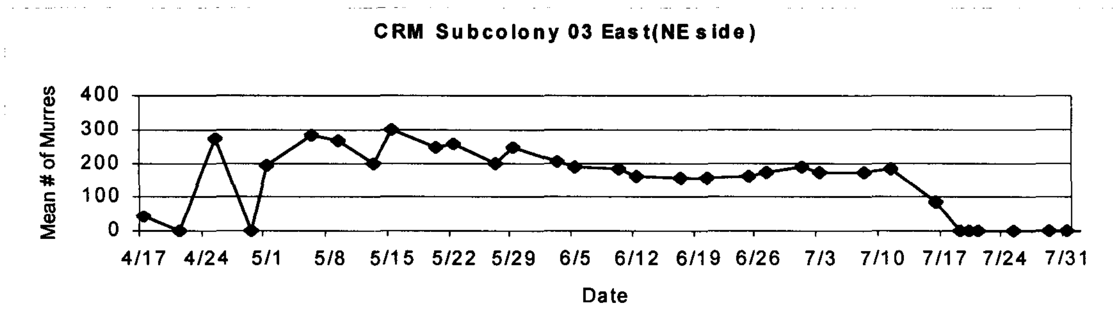


Figure 14. Seasonal attendance patterns of Common Murres at BM227X subcolony 02 (Esselen Rock), and Castle Rocks subcolonies 02, 03 West and East (Northeast side), 17 April to 04 August 2003.

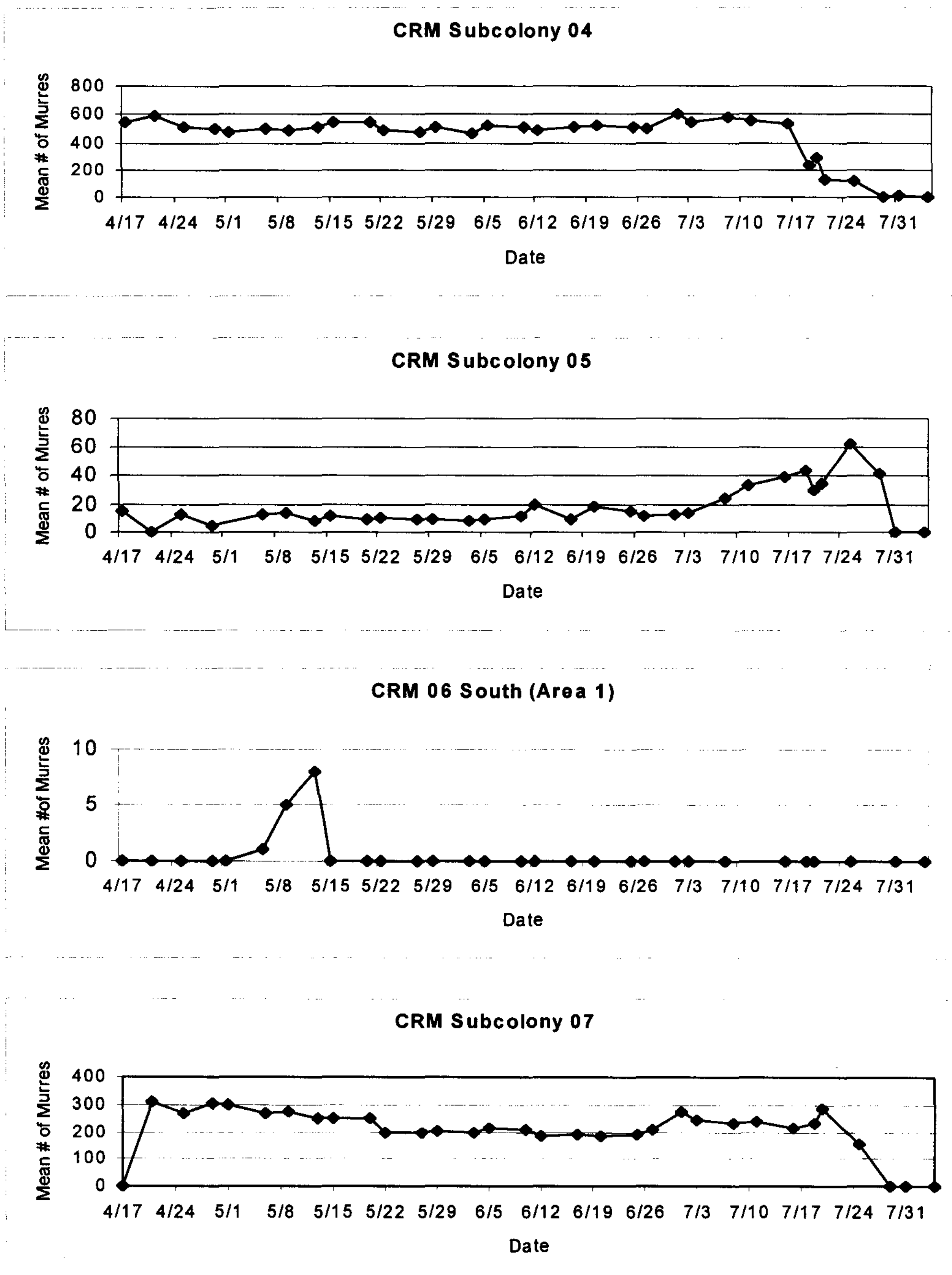


Figure 15. Seasonal attendance patterns of Common Murres at Castle Rocks and Mainland subcolonies CRM 04, 05, 06 South (Area 1), and 07, 17 April to 04 August 2003.

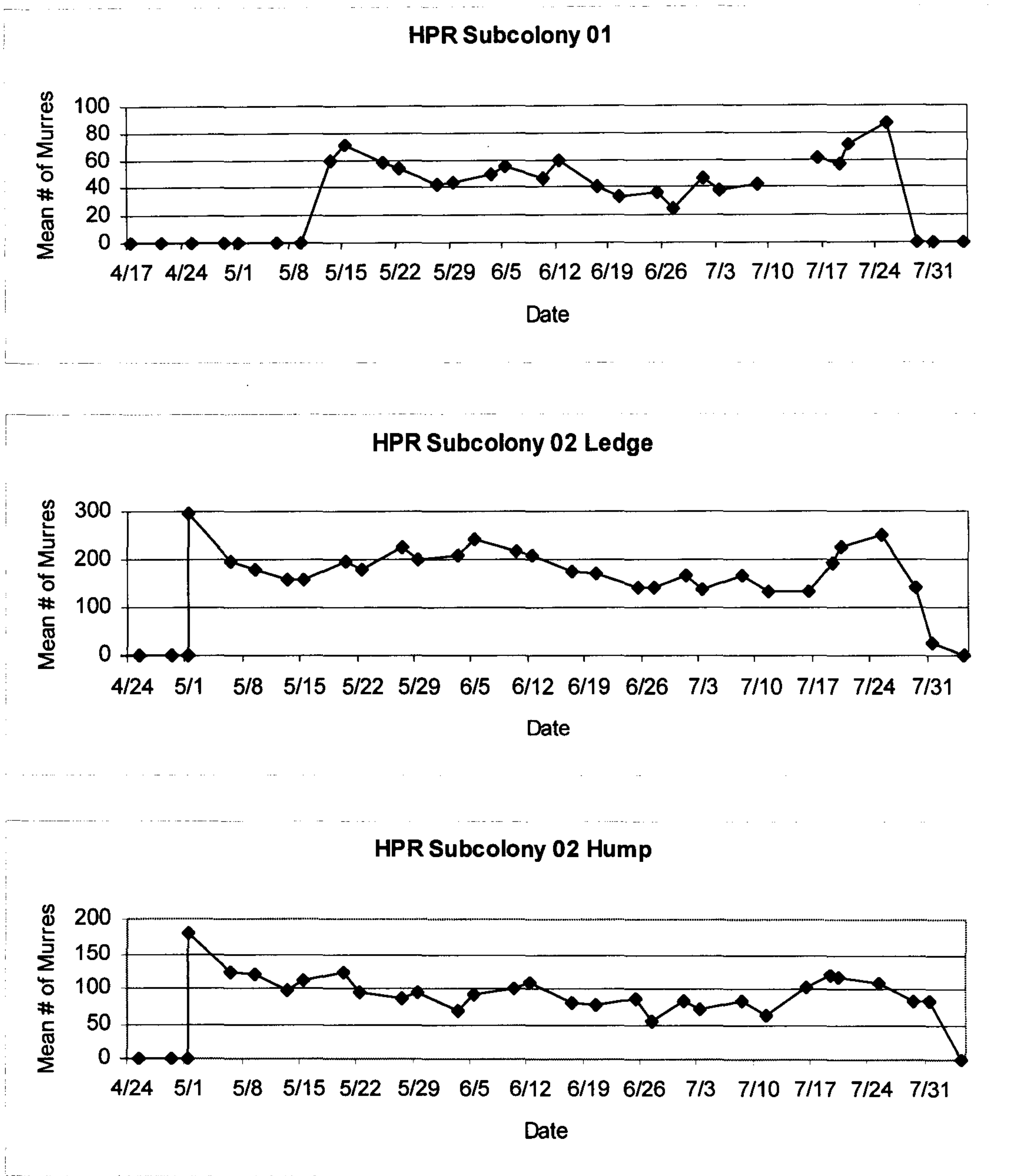


Figure 16. Seasonal attendance patterns of Common Murres at Hurricane Point Rocks subcolony 01, 02 Ledge, and 02 Hump, 17 April to 04 August 2003.

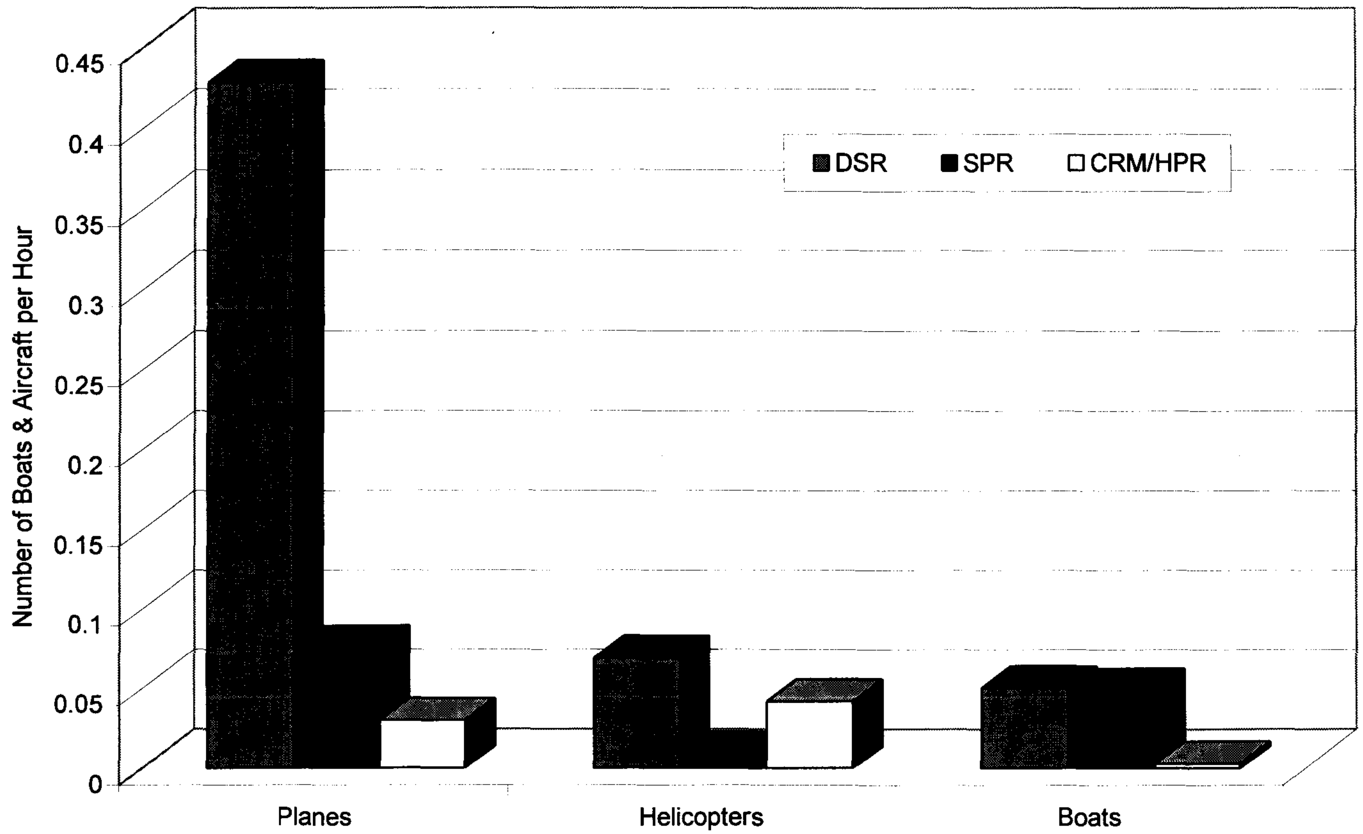


Figure 17. The number of planes and helicopters seen at or below 1000 feet above sea level, and the number of boats seen within 1500 feet of a subcolony at Devil's Slide Rock (DSR), San Pedro Rock (SPR) and Castle/Hurricane (CRM/HPR) colonies in 2003.

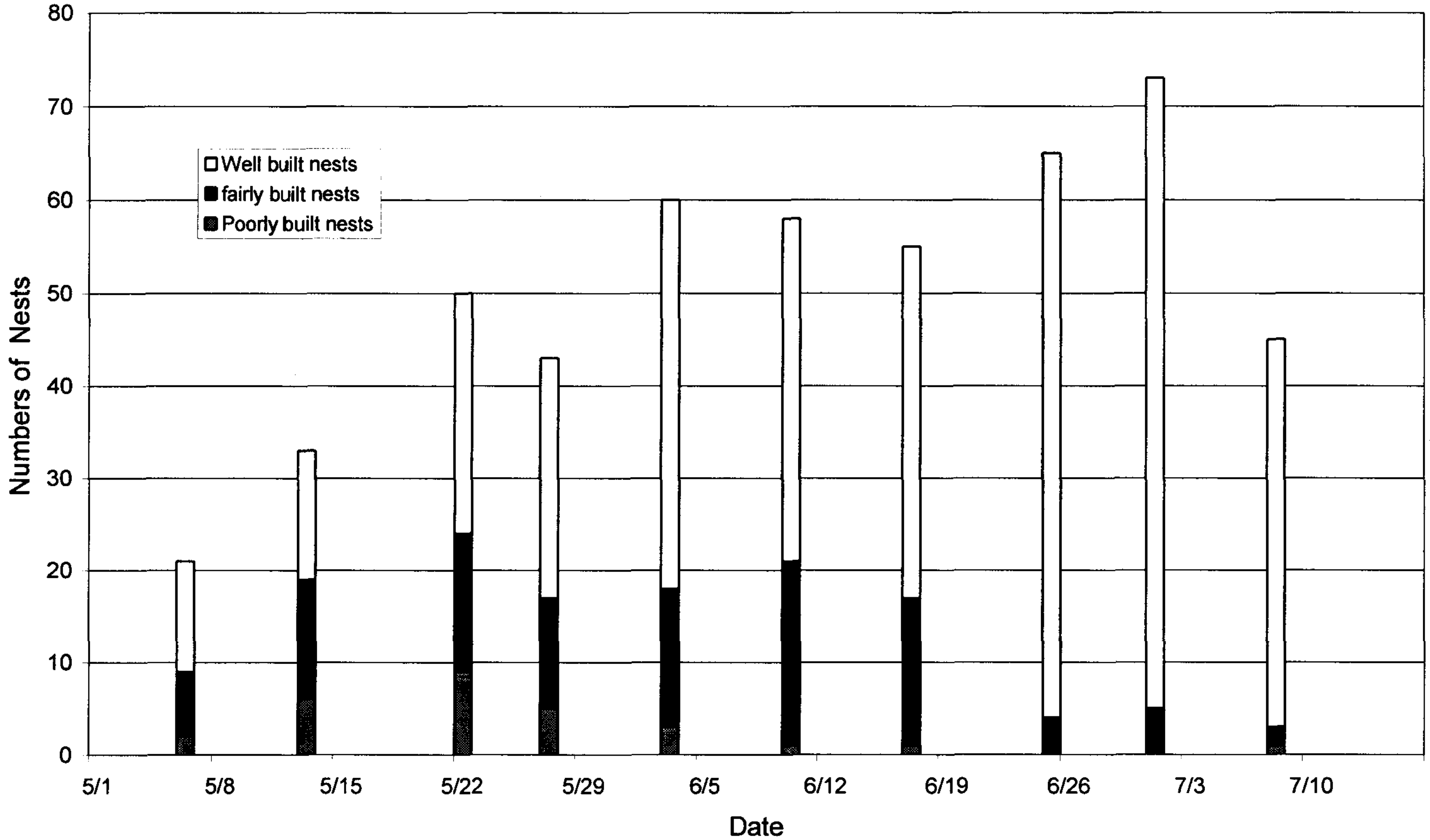


Figure 18. Numbers of Brandt's Cormorant poorly-built, fairly-built, and well-built nests counted on CRM-03 West in 2003.

Table 1. Common Murre productivity at Devil's Slide Rock (DSR) and Castle Rocks and Mainland (CRM) in 2003.

Colony/Plot	# of Sites Monitored	# of Egg Laying Sites	# of Eggs Laid	# of Eggs Hatched[1]	Hatching Success	# of Chicks Fledged	Fledging Success[2]	Chicks Fledged per Pair
DSR	251	110	133	74	55.6%	70	94.6%	0.64
CRM-03 East	96	77	79	56	70.9%	37	66.0%	0.48
CRM-04	105	84	83	63	75.9%	60	95.2%	0.71

[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 Devil's Slide Rock in 2003. Data listed includes: mean number and range of murres/eggs/chicks disturbed per event, and the number of events.

Source	Murres Flushed		Murres Displaced		Eggs Exposed		Eggs Displaced		Eggs Taken		Chicks Exposed		Chicks Taken		Prey stealing	
	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events
Brown Pelican	0	0	7 (3-11)	2	0	0	0	0	0	0	0	0	0	0	0	0
Brandt's Cormorant	0	0	8 (1-15)	2	0	0	0	0	0	0	0	0	0	0	1	6
Brown Booby	0	0	10	1	0	0	0	0	0	0	0	0	0	0	1	3
Heerman's Gull	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	2
Western Gull	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Non-anthropogenic disturbances incidentally observed at Castle/Hurricane colonies in 2003. Data listed includes: mean number and range of murres/eggs/chicks disturbed per event, and the number of events.

Source	Murres Flushed		Murres Displaced		Eggs Exposed		Eggs Displaced		Eggs Taken		Chicks Exposed		Chicks Taken	
	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events	Average (range)	# of events
Brown Pelican	10 (1-30)	9	0	0	0	0	0	0	0	0	0	0	0	0
Common Raven	10 (1-40)	11	23 (10-40)	6	0	0	0	0	0	0	3	2	0	0
Western Gull	98 (10-300)	4	0	0	2	1	1	1	1	1	0	0	0	0
Turkey Vulture	230 (10-500)	3	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Aircraft, boat sightings, and resulting disturbances incidentally observed at Devil's Slide Rock in 2003.

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	230	0.428	2	0.004	1.5 (1-2)
Helicopter	37	0.069	9	0.017	8.1 (1-40)
Boat	27	0.050	0	0.0	0
Total	295	0.549	11	0.020	6.9 (1-40)

Table 5. Aircraft, boat sightings, and resulting disturbances incidentally observed at San Pedro Rock in 2003.

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	17	0.075	0	0	0
Helicopter	2	0.009	0	0	0
Boat	11	0.049	0	0	0
Total	30	0.133	0	0	0

Table 6. Aircraft, boat sightings, and resulting disturbances incidentally observed at Castle Rocks and Mainland and Hurricane Point Rocks in 2003.

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	10	0.024	1	0.002	2
Helicopter	14	0.033	8	0.019	26.6 (3-120)
Boat	1	0.002	0	0	0
Total	25	0.060	9	0.021	23.8 (2-120)

Table 7. Brandt's Cormorant nesting phenology and productivity at Devil's Slide Rock and Devil's Slide Mainland in 2003.

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	8	9 May (4-14 May; n=7)	9 June (4-12 June; n=7)	3.1 (2-4; n=7)	2.9 (2-4; n=7)	2.6 (2-4; n=7)
Devil's Slide Mainland	90	15 May (8-25 May; n=51)	14 June (8-22 June; n=36)	3.1 (1-4; n=85)	1.5 (0-4; n=85)	1.0 (0-4; n=74)

Table 8. Summary of aerial photograph counts of Common Murres (COMU), Brandt's Cormorants (BRCO), and Double-crested Cormorants (DCCO) at central California murre colonies, 2003.

Colony Name	CCN[1]	USFWS CN[2]	Date	COMU	Brandt's Cormorants			Double-crested Cormorants		
				Birds	Nests	Sites	Birds	Nests	Sites	Birds
Point Reyes	MA-374-01	429-001	05/28/03	21,518	439	10	649	0	0	0
Point Resistance	MA-374-03	429-024	05/28/03	3,800	26	2	52	0	0	0
Miller's Point Rocks	MA-374-04	429-002	05/28/03	615	29	0	40	0	0	0
Double Point Rocks	MA-374-05	429-003	05/28/03	6,012	125	1	172	0	0	0
North Farallon Islands	SF-FAI-01	429-051	05/28/03	43,364	98	5	289	0	0	0
South Farallon Islands	SF-FAI-02	429-052	05/30/03	76,827	6,801	93	9,547	439	0	485
San Pedro Rock	SM-372-02	429-013	05/30/03	0	0	0	0	0	0	0
Devil's Slide Rock[3]	SM-372-03	429-014	05/30/03	144	7	0	12	0	0	0
Devil's Slide Rock & Mainland	SM-372-03	429-014	06/06/03	192	263	2	642	0	0	0
Bench Mark-227X	MO-362-18	454-029	05/29/03	0[4]	0	0	0	0	0	0
Castle Rocks & Mainland	MO-362-19	454-010	05/29/03	2,187	333	0	440	0	0	0
Hurricane Point Rocks	MO-362-20	454-011	05/29/03	555	0	0	0	0	0	0

[1] CCN = California Colony Number
[2] USFWSCN = U.S. Fish and Wildlife Service Colony Number
[3] Mainland not counted on 5/30/03 due to incomplete coverage.
[4] Small numbers of murres nested on Esselen Rock (subcolony 02) that were not photographed on the aerial survey.

Appendix 1. Raw counts of Common Murre birds, and Brandt's and Double-crested cormorant nests, sites and birds from aerial photographic surveys of central California murre colonies, 2003. Results are reported by colony and subcolony. ND - No Data.

Colony Name	Subcolony Name	Subcolony Number	Date	Common Murre	Brandt's Cormorant			Double-crested Cormorant		
				Birds	Nests	Sites	Birds	Nests	Sites	Birds
Point Reyes	Lighthouse Rock	03B	05/28/03	13155	0	0	0	0	0	0
Point Reyes	NW Lighthouse Cliffs	03C	05/28/03	615	1	0	1	0	0	0
Point Reyes	Aalge Ledge	03D	05/28/03	199	0	0	0	0	0	0
Point Reyes	The Bulb	03E	05/28/03	264	0	0	0	0	0	0
Point Reyes	SW Lighthouse Cliffs	03F	05/28/03	51	0	0	0	0	0	0
Point Reyes	S. Lighthouse Cliffs	04	05/28/03	326	0	0	0	0	0	0
Point Reyes	Boulder Rock	05B	05/28/03	1490	0	0	0	0	0	0
Point Reyes	Pebble Point	05C	05/28/03	168	73	0	168	0	0	0
Point Reyes	Trinity Point	08A	05/28/03	0	6	0	6	0	0	0
Point Reyes	Greentop	08B	05/28/03	5	80	1	100	0	0	0
Point Reyes	Cliff Colony East	09B	05/28/03	0	48	0	52	0	0	0
Point Reyes	Northwest Rock	10A	05/28/03	149	0	0	0	0	0	0
Point Reyes	Flattop Rock	10B	05/28/03	1240	0	0	0	0	0	0
Point Reyes	Middle Rock	10C	05/28/03	883	0	0	0	0	0	0
Point Reyes	East Rock	10D	05/28/03	212	65	0	88	0	0	0
Point Reyes	Beach Rock	10E	05/28/03	181	52	0	84	0	0	0
Point Reyes	Tim Tam	10G	05/28/03	87	0	0	0	0	0	0
Point Reyes	Chip Rock	11A	05/28/03	71	0	0	0	0	0	0
Point Reyes	Face Rock	11B	05/28/03	321	0	1	17	0	0	0
Point Reyes	Cone Rock	13	05/28/03	2097	30	5	66	0	0	0
Point Reyes	Rock A	14A	05/28/03	0	14	0	19	0	0	0
Point Reyes	Sub-col. 14B	14B	05/28/03	4	19	3	43	0	0	0
Point Reyes	Border Rock	14C	05/28/03	0	28	0	34	0	0	0
Point Reyes	Rock 69	19	05/28/03	0	23	0	27	0	0	0
Point Reyes	Unknown Rock	99	05/28/03	0	0	0	13	0	0	0
Point Resistance	Point Resistance	02	05/28/03	3800	26	2	52	0	0	0
Miller's Point Rocks	Miller's Point North	01	05/28/03	389	0	0	0	0	0	0
Miller's Point Rocks	Miller's Point South	02	05/28/03	226	0	0	0	0	0	0
Miller's Point Rocks	Southeast Rock	04	05/28/03	0	29	0	40	0	0	0

Appendix 1 (cont'd).

Colony Name	Subcolony Name	Subcolony Number	Date	Common Murre	Brandt's Cormorant			Double-crested Cormorant		
				Birds	Nests	Sites	Birds	Nests	Sites	Birds
Double Point Rocks	Stormy Stack	01	05/28/03	6012	125	1	172	0	0	0
Double Point Rocks	Roost Rock North of Stormy Stack	99	05/28/03	0	0	0	12	0	0	0
North Farallon Islands	North Islet	01	05/28/03	7385	0	0	112	0	0	0
North Farallon Islands	West Islet	02	05/28/03	14445	84	2	143	0	0	0
North Farallon Islands	East Islet	03	05/28/03	14365	8	0	24	0	0	0
North Farallon Islands	South Islet	04	05/28/03	7169	6	5	10	0	0	0
South Farallon Islands	Southeast Farallon Island	01	05/30/03	34222	4442	47	5941	0	0	0
South Farallon Islands	West End Island	02	05/30/03	28758	2325	42	3324	485	439	0
South Farallon Islands	The Islets	03	05/30/03	11793	45	3	122	0	0	0
South Farallon Islands	Saddle Rock	04	05/30/03	2054	3	1	160	0	0	0
San Pedro Rock	San Pedro Rock	01	05/30/03	0	0	0	ND	0	0	ND
Devil's Slide Rock & Mainland[1]	Devil's Slide Rock	01	05/30/03	144	7	0	12	0	0	0
Devil's Slide Rock & Mainland	Devil's Slide Rock	01	06/06/03	192	9	1	125	0	0	0
Devil's Slide Rock & Mainland	Devil's Slide Mainland	05A	06/06/03	0	254	1	517	0	0	0
Devil's Slide Rock & Mainland	Turtlehead	05B	06/06/03	0	0	0	0	0	0	0
Bench Mark-227X	Esselen Rock	02	05/29/03	0	0	0	0	0	0	0
Bench Mark-227X	Esselen Mainland	03	05/29/03	0	0	0	0	0	0	0
Castle Rocks & Mainland	Rock 02	02	05/29/03	280	66	0	99	0	0	0
Castle Rocks & Mainland	Rock 03 West	03A	05/29/03	230	0	0	0	0	0	0
Castle Rocks & Mainland	Rock 03 East	03B	05/29/03	157	148	0	168	0	0	0
Castle Rocks & Mainland	Rock 04	04	05/29/03	769	71	0	103	0	0	0
Castle Rocks & Mainland	Rock 05	05	05/29/03	9	0	0	0	0	0	0
Castle Rocks & Mainland	06 South	06B	05/29/03	0	48	0	59	0	0	0
Castle Rocks & Mainland	Rock 07	07	05/29/03	502	0	0	0	0	0	0
Hurricane Point Rocks	Hurricane 1	01	05/29/03	140	0	0	0	0	0	0
Hurricane Point Rocks	Hurricane 2	02	05/29/03	655	0	0	11	0	0	0

[1]Mainland not counted on 5/30/03 due to incomplete coverage.