RESTORATION AND MONITORING OF COMMON MURRE COLONIES IN CENTRAL CALIFORNIA: ANNUAL REPORT 2013

REPORT TO THE

LUCKENBACH TRUSTEE COUNCIL

Allison R. Fuller, Gerard J. McChesney, Crystal A. Bechaver, Jason D. Tappa, Katie L. Percy, Johanna C. Anderson, Lacey F. Hughey, Katrina C. Olthof, and Richard T. Golightly

U.S. Fish and Wildlife Service
San Francisco Bay National Wildlife Refuge Complex
1 Marshlands Road
Fremont, CA 94555 USA

and

Humboldt State University
Department of Wildlife
1 Harpst St.
Arcata, CA 95521

FINAL REPORT
17 December 2014

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[1]U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Road, Fremont, CA 94555 USA
[2]Humboldt State University, Department of Wildlife, Arcata, CA 95521 USA
[3]Mailing Address: U.S. Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Road, Fremont, CA 94555 USA

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Cover photo: Aerial photograph of Devil's Slide Rock, 3 June 2013 by P.J. Capitolo.

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PROJECT ADMINISTRATION

Project Staff

Co-Principal Investigator: Gerard J. McChesney
Co-Principal Investigator: Richard T. Golightly
Wildlife Biologist: Allison R. Fuller
Wildlife Biologist (Point Reyes, Drakes Bay): Jason D. Tappa
Wildlife Biologist (Devil's Slide): Katie L. Percy
Wildlife Biologist (Castle-Hurricane): Crystal A. Bechaver
Wildlife Technician (Point Reyes, Drakes Bay): Lacey F. Hughey
Wildlife Technician (Devil's Slide): Katrina C. Olthof
Wildlife Technician (Devil's Slide): Johanna C. Anderson

***Luckenbach* Trustee Council**

U.S. Department of the Interior

Representative: Janet Whitlock (U.S. Fish and Wildlife Service, Sacramento Field Office, Sacramento, CA)
Alternate: Dave Press (National Park Service, Point Reyes National Seashore, Point Reyes Station, CA)

California Department of Fish and Wildlife

Representative: Steve Hampton (Office of Spill Prevention and Response, Sacramento, CA)
Alternate: Laird Henkel (Office of Spill Prevention and Response, Monterey, CA)

National Oceanic and Atmospheric Administration

Representative: Jennifer Boyce (NOAA Restoration Center, Long Beach, CA)

ABBREVIATIONS USED

BM227X = Bench Mark-227X

CDFW = California Department of Fish and Wildlife

CHCC = Castle-Hurricane Colony Complex, consisting of Bench Mark-227X, Castle Rocks and Mainland, and Hurricane Point Rocks colonies

CMRP = Common Murre Restoration Project

CRM = Castle Rocks and Mainland

DBCC = Drakes Bay Colony Complex, consisting of Point Resistance, Millers Point Rocks, and Double Point Rocks

DPR = Double Point Rocks

DSCC = Devil's Slide Colony Complex, consisting of Devil's Slide Rock & Mainland and San Pedro Rock colonies

DSM = Devil's Slide Mainland

DSR = Devil's Slide Rock

DSRM = Devil's Slide Rock and Mainland

GFNMS = Gulf of the Farallones National Marine Sanctuary

HPR = Hurricane Point Rocks

MPR = Millers Point Rocks

NOAA = National Oceanic and Atmospheric Administration

OSPR = Office of Spill Prevention and Response

PRH = Point Reyes Headlands

PRS = Point Resistance

SPN = Seabird Protection Network

SPR = San Pedro Rock

USFWS = U.S. Fish and Wildlife Service

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ACKNOWLEDGMENTS

In 2013, funding and oversight were provided by the *Luckenbach* Oil Spills Trustee Council comprised of the California Department of Fish and Wildlife (CDFW), the National Oceanic and Atmospheric Administration (NOAA), and the Department of the Interior through the U.S. Fish and Wildlife Service (USFWS) and the National Park Service (NPS).

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EXECUTIVE SUMMARY

Efforts in 2013 represented the 18th year of restoration and associated monitoring of central California seabird colonies by the Common Murre Restoration Project (CMRP). This project was initiated in 1996 in an effort to restore breeding colonies of seabirds, especially Common Murres (*Uria aalge*), harmed by the 1986 *Apex Houston*, 1998 *Command* and extended *Luckenbach* oil spills, as well as gill net fishing, human disturbance, and other factors. From 1995 to 2005, the primary goals were to restore the previously extirpated Devil's Slide Rock colony using social attraction techniques, and to assess restoration needs at additional central California colonies. Since 2005, efforts have been directed towards surveillance and assessment of human disturbance at central California Common Murre colonies. Additionally, the outcome of initial recolonization efforts at Devil's Slide Rock continues to be monitored. This data informs outreach, education and regulatory efforts by the Seabird Protection Network (coordinated by the Gulf of the Farallones National Marine Sanctuary) and allows for assessment of the success of those efforts. The goal of the Seabird Protection Network is to restore central California seabird breeding colonies primarily through reduction of human disturbance. In this report, we summarize seabird monitoring results from the 2014 breeding season including human disturbance, productivity, relative population sizes, and other data.

At Point Reyes Headlands (PRH), the combined aircraft and watercraft detection rate was less than the baseline mean (average of 2005-2006, including aircraft, watercraft, and other), and less than in 2012. The combined disturbance rate at PRH was less than the baseline mean, but greater than in 2012 – driven by five agitation events caused by helicopters. Detection and disturbance rates at Drakes Bay Colony Complex (DBCC) were also less than the baseline mean, with no observed disturbance events. Devil's Slide Rock and Mainland (DSRM) continued to have the greatest combined aircraft and watercraft detection and disturbance rates of all colonies. However, detection and disturbance rates in 2013 were both less than the baseline mean, and less than in 2012. Agitation events accounted for most disturbances, with only four flushing events observed in 2013. At the Castle Hurricane Colony Complex (CHCC), the combined aircraft and watercraft detection rate was less than the baseline mean and 2012 rates, and none resulted in disturbance.

General aviation planes and helicopters (e.g., private or charter), followed by military helicopters, and the CDFW survey aircraft were the most commonly observed aircraft and caused the majority of disturbances at all monitored colonies. The majority of watercraft observed were private recreational fishing boats, but none caused any disturbance in 2013. Two vessels were recorded inside state Special Closures at Devil's Slide Rock, including a private fishing boat and a kayak. Neither vessel caused any disturbance.

The aerial photograph count of 2,001 Common Murres on Devil's Slide Rock (DSR) was 55% greater than the 2012 count. This was also the greatest count since murres recolonized the rock in 1996, and similar to counts obtained in 1979-1982, prior to previous colony extirpation. The peak land-based count on DSR was 1,527 murres, 1.9% greater than the 2012 peak count of 1,499. Murre productivity, or reproductive success, was greater than average at DSR and Castle Rocks and Mainland (CRM), and near average at PRH. Above average co-attendance of murre

breeding pairs during the chick-rearing period at DSR suggested that prey was abundant near the colony at that time.

There were more Brandt's Cormorant (*Phalacrocorax penicillatus*) nests counted in 2013 than in 2012 at PRH, MPR, DPR and CRM; and fewer nests at PRS and DSRM. However, these counts were incomplete; aerial photograph counts are needed for a better assessment. Brandt's Cormorant productivity in 2013 was greater than long-term means and greater than in 2012 at all monitored colonies. Productivity of Pelagic Cormorants (*Phalacrocorax pelagicus*) was monitored only at DSRM and productivity of Western Gulls (*Larus occidentalis*) and Black Oystercatchers (*Haematopus bachmani*) was monitored only at DSRM and CHCC. Productivity of Pelagic Cormorants at DSRM was 49% greater than the long-term average, and the greatest recorded to date. Western Gull productivity was 56% greater at DSRM and 51% less at CHCC than long-term averages.

INTRODUCTION

In central California, Common Murre (*Uria aalge*) breeding colonies occur on near-shore rocks and adjacent mainland cliffs between Marin and Monterey counties as well as the North and South Farallon Islands, 20 to 40 km offshore of San Francisco (Carter et al. 1992, 2001). A steep decline in the central California population between 1980 and 1986 was attributed primarily to mortality in gill nets and oil spills, including the 1986 *Apex Houston* oil spill (Page et al. 1990; Takekawa et al. 1990; Carter et al. 2001, 2003). Between 1982 and 1986, a colony of about 3,000 breeding murres on Devil's Slide Rock in northern San Mateo County was extirpated. Since 1995, the Common Murre Restoration Project (CMRP) has sought to restore this and other central California colonies using several techniques, including social attraction. Social attraction techniques were utilized at Devil's Slide Rock (DSR) between 1996 and 2005 (McChesney et al. 2006; Parker et al. 2007), and was discontinued after the colony appeared to be self-sustaining. Restoration efforts at other colonies in central California have focused on documenting the impacts of human disturbance, gill-net mortality, and other threats to murre colonies, as well as working with government agencies and the public to reduce these impacts.

Since the early 1990s, the central California murre population has shown an increasing trend due to restrictions on gill-net fishing, favorable prey conditions, and other factors (Carter et al. 2001; USFWS, unpublished. data). However, anthropogenic impacts to murres continue to occur and may continue to impact the population. Gill-net mortality continued until the California Department of Fish and Wildlife (CDFW) enacted an emergency closure of the gill-net fishery in September 2000, followed by a permanent closure in September 2002 of waters less than 110 meters deep (60 fathoms), from Point Reyes to Point Arguello (Forney et al. 2001). Extensive oil pollution (e.g., 1998 *Command* oil spill and a series of oil releases from the sunken vessel *S.S. Jacob Luckenbach* from the early 1990s to the early 2000s) continued to kill thousands of murres in central California (Carter 2003; Carter and Golightly 2003; Hampton et al. 2003; Roletto et al. 2003). Disturbances from aircraft and watercraft have affected colonies as well (Rojek et al. 2007; USFWS, unpubl. data).

Beginning in 1995, restoration and associated monitoring of Common Murre colonies in central California have been funded largely through oil spill restoration plans and associated trustee councils, including the *Apex Houston* (1995-2009), T/V *Command* (2005-2009), and, beginning in 2010, the *Jacob Luckenbach*. On 14 July 1953, the *S.S. Jacob Luckenbach* collided with another vessel and sank in 55 meters of water approximately 27 kilometers southwest of San Francisco. The *S.S. Jacob Luckenbach* was loaded with 457,000 gallons of bunker fuel which subsequently leaked periodically during winter storms. Using chemical analysis, oil that was associated with several mystery spills was linked to this vessel, including the Point Reyes tar ball incidents of winter 1997-1998 and the San Mateo Mystery Spill of 2001-2002. In the summer of 2002, the U.S. Coast Guard and the *Luckenbach* trustees removed much of the oil from the vessel and sealed the remaining oil inside (Hampton et al. 2003). An estimated 51,569 seabirds were killed between 1990 and 2003 from Bodega Bay to Monterey Bay, including 31,806 Common Murres (*Luckenbach* Trustee Council 2006).

The U. S. Coast Guard's National Pollution Funds Center (NPFC) awarded $22.7 million to implement 14 restoration projects. The award was a result of a claim filed by the *Luckenbach* trustees in 2006 for funding from the Oil Spill Liability Trust Fund. While the company responsible for the *Luckenbach* no longer exists, the Oil Spill Liability Trust Fund pays for oil spill cleanup and restoration of impacted natural resources when there is no responsible party. The fund is sustained by fees from the oil industry and managed by the NPFC. The Central California Seabird Colony Protection Project, now called the Seabird Protection Network (SPN), was initiated by the *Command* Oil Spill Restoration Fund (Command Trustee Council 2004) in 2005 and was extended in 2010 with *Luckenbach* funds. The SPN is implemented by Gulf of the Farallones National Marine Sanctuary (GFNMS) and CMRP to restore seabird colonies harmed by these oil spills mainly by focusing on human disturbance reduction. GFNMS focuses on the outreach, education and regulatory components, while the CMRP conducts the colony surveillance and monitoring component of the program. Surveillance and monitoring data from these colonies are utilized to guide education and outreach efforts and to assess the success of those efforts.

Colony surveillance and monitoring efforts have been focused at three colonies or colony complexes established as Common Murre restoration or reference sites in 1996: Point Reyes Headlands, Devil's Slide, and Castle-Hurricane Colony Complex. Since 2005, less intensive surveys have been conducted at three additional colonies in the Drakes Bay area: Point Resistance (PRS), Millers Point Rocks (MPR), and Double Point Rocks (DPR). In 2013, colony count surveys were also conducted twice per week at Bird Island (near Point Bonita) in Marin County to document potential murre attendance and breeding at that recently colonized site.

Here we summarize colony surveillance and monitoring efforts conducted at central California near-shore murre colonies in 2013. Similar to past years, data were gathered on aircraft, watercraft and other disturbances to seabirds; Common Murre seasonal attendance patterns; productivity (or reproductive success); and adult co-attendance (the percentage of observation time that both parents are present at a nest site) and chick provisioning rates (at DSR only). We also recorded Brandt's Cormorant (*Phalacrocorax penicillatus*) relative breeding population sizes and productivity, as well as population sizes and/or productivity of Pelagic Cormorants (*P. pelagicus*), Black Oystercatchers (*Haematopus bachmani*), Western Gulls (*Larus occidentalis*), and Pigeon Guillemots (*Cepphus columba*).

METHODS

Study Sites

Five colonies or colony complexes were monitored in 2013 (Figure 1). Point Reyes Headlands (PRH; Figure 2), Point Resistance (PRS), Millers Point Rocks (MPR), and Double Point Rocks (DPR; Figure 3) are located within the Point Reyes National Seashore, Marin County; the latter three colonies are often grouped into the Drakes Bay Colony Complex (DBCC). Bird Island is located near the mouth of the Golden Gate within Golden Gate National Recreation Area, Marin County. The Devil's Slide Colony Complex (DSCC), located in San Mateo County, consists of

the colonies Devil's Slide Rock and Mainland (DSRM) and San Pedro Rock (Figure 4). The Castle-Hurricane Colony Complex (CHCC) in Monterey County consists of the colonies Bench Mark-227X (BM227X), Castle Rocks & Mainland (CRM), and Hurricane Point Rocks (HPR; Figure 5). The offshore rocks of DSCC and CHCC are within the California Coastal National Monument, while adjacent mainland areas are either privately or state-owned. At each colony, individual rocks and mainland cliffs with nesting seabirds were identified by their recognized subcolony number, subcolony name, or subarea. In this report, colonies are ordered north to south within each section. All means are reported as the mean plus or minus one standard error, unless otherwise noted.

Disturbance

Anthropogenic and non-anthropogenic (e.g., avian-caused) disturbance events affecting murres or other seabirds were recorded at each study colony. Disturbance events included any instances in which adult birds were alarmed or agitated (e.g., head-bobbing in murres, raised head or wing-flapping in cormorants), displaced (i.e., birds moved from breeding or roosting site but did not fly away) or flushed (i.e., birds left the rock). Numbers of disturbed seabirds within each disturbance category were recorded. Numbers of eggs or chicks exposed, displaced, or depredated were also recorded. When seabirds were displaced or flushed by a traceable human source (e.g., helicopter with recorded tail number), a wildlife disturbance report was filed with the Seabird Protection Network (SPN; NOAA) and applicable law enforcement authorities. These reports included photos and maps documenting the disturbance event, including: aircraft or watercraft type, direction of travel, activity (e.g., fishing, transiting, hovering, etc.), estimated distance from the nearest seabird nesting or roosting area, and aircraft/boat identification number or name (when possible).

Monitoring effort was calculated for each colony and colony complex except for Bird Island (Table 1). In order to compare disturbance among colonies and among years, disturbance rates were calculated. Anthropogenic disturbance rates were calculated during the breeding season (in 2013, 16 April until the end of monitoring) as the number of disturbance events per hour of observation (monitoring effort) at each colony complex. Disturbance rates from 2013 were compared to baseline means (the average of disturbance rates from 2005 to 2006) for each colony or colony complex. Subsequent to 2006, an education and outreach program led by the SPN was implemented with the goal of reducing human-caused disturbance to seabird colonies in central California. Baseline means were reported. For non-anthropogenic disturbances, we also reported the species that caused disturbance(s) and summarized major events.

In addition to disturbance events, all aircraft flying at or below 1,000 ft (305 m) above sea level and watercraft within about 1,500 ft (458 m) of the nearest seabird breeding or roosting area were recorded to highlight use patterns of potential sources of anthropogenic disturbance. Detection rates were calculated as the number of aircraft or watercraft observed within these given zones per observation hour, using monitoring effort for each colony complex. In 2013, additional overflights outside of the designated disturbance area were tallied in order to establish a baseline of daily aircraft use at Devil's Slide Rock and Mainland only. All aircraft above 1,000 feet and within one mile of shore were recorded. All watercraft entering Special Closure areas

were recorded and reported to Cal-TIP ("Californians Turn in Poachers"; CDFW) and to the Seabird Protection Network. Special Closures are no-entry zones designated by CDFW under the California Marine Life Protection Act (MLPA), to protect important seabird and marine mammal colonies from disturbance. Four of six Special Closures in the North Central Coast Study Region (Point Arena to Pigeon Point) abut CMRP-monitored colonies: Point Reyes Headlands (1000 ft closure), Point Resistance (300 ft closure), Stormy Stack/Double Point (300 ft closure), and Egg Rock/Devil's Slide Rock (300 ft closure on the west side and complete closure on the east side of the rock) (http://www.dfg.ca.gov/marine/mpa/nccmpas_list.asp).

Common Murre Seasonal Attendance Patterns

Seasonal attendance of Common Murres at each colony was monitored from standardized mainland vantage points using 65-130X or 15-60X spotting scopes. Attending murres were counted at each colony, subcolony, or index plot. Three consecutive counts were conducted and counts were averaged on most surveys, except for certain subcolonies at PRH (see below). Seasonal attendance data were collected regularly at all colonies throughout the breeding season (22 April until all chicks fledged and adult attendance ceased). Breeding season counts were conducted during a standardized period between 1000-1400 h.

Point Reyes Headlands

Seasonal attendance at PRH was recorded at all murre subcolonies visible from mainland observation sites once per week from 24 April to 8 August (Figure 1-2). Attendance was recorded at established Type II index plots (see Birkhead and Nettleship 1980) on Lighthouse (Ledge, Edge, and Dugout plots), Boulder, Flattop, Middle, Beach, and Cone Rocks. Counts of these index plots were conducted three times per survey and averaged. Plots on Flattop and Middle Rocks were only counted once per survey. All other subcolonies were counted once per survey of entire visible areas.

Drakes Bay Colony Complex

Murre attendance was monitored about twice per week at DPR, PRS and MPR from 23 April to 6 August (Figure 3). Four index plots (Club, Grotto Ledge, Lower Ledge, and Cup Plots) were used at PRS, and five plots (Lower Left, Lower Right, Crack Pot, Pond, and Cliff Plots) on Stormy Stack (within DPR) because of the large numbers of murres attending these colonies.

Bird Island

Murres were first recorded attending Bird Island among nesting Brandt's Cormorants in 2007 (McChesney et al. 2008), and breeding was first confirmed in 2008 (McChesney et al. 2009). In 2013, monitoring of this recent colonization continued and observations were conducted by trained volunteers twice per week. From 21 April to 10 July, counts were conducted during two time periods: early morning (0700-0900 h) and late afternoon (after 1500 h).

Devil's Slide Rock & Mainland, San Pedro Rock

Murres on Devil's Slide Rock (DSR) were counted every other day from 22 April to 7 August from the Traditional Pullout. On Devil's Slide Mainland (DSM), attendance patterns were monitored once per week for six subareas from PEFA Point (Figure 4): Mainland North (DSR-

07), April's Finger (DSR-05), Upper Mainland South (DSR-05), Lower Mainland South (DSR-05), Mainland South Roost (DSR-05), and South Bunker (DSR-04). No surveys were conducted from the Turtlehead Cove overlook to minimize disturbance to nesting Peregrine Falcons (*Falco peregrinus*). At SPR, bird counts were conducted once per week throughout the breeding season from Pipe Pullout.

Castle-Hurricane Colony Complex

Seasonal attendance of murres was monitored for all active subcolonies visible from accessible standard mainland vantage points (Figure 5). Counts were conducted twice per week during the breeding season from 24 April to 1 August. At four subcolonies, separate subarea counts were also conducted: CRM-04 (productivity plot and entire rock), CRM-03B (south and east sides), CRM-06South (north and south sides), and HPR-02 (Ledge and Hump plots). In 2013, counts were not conducted from the Rocky Creek Bridge and Wood Rat Bluff vantage points because of intensive road construction to rebuild a section of Highway 1. Thus, no counts were obtained of BM-227X-02, CRM-03A, or CRM-06 North side.

Common Murre Productivity

As in previous years, productivity (chicks fledged per pair) of Common Murres was monitored at PRH, DSRM, and CRM almost daily (at least every two to three days; weather permitting) from standardized mainland vantage points using either 65-130x or 15-60x spotting scopes. At PRH and CRM, locations of returning or new breeding and territorial sites were identified using maps and photographs updated from the 2012 breeding season. At DSR, all sites were mapped and numbered using aerial photographs from previous years. A breeding site was defined as a site where an egg was observed or inferred based on adult behaviors. A territorial site was defined as a location with attendance greater than or equal to 15% of monitored days but where an egg was not observed or inferred based on adult behaviors. Some territorial sites were likely breeding sites where eggs were lost at the time of laying, or shortly after without detection. A sporadic site was defined as a location attended for at least two days but for less than 15% of monitored days. Many possible sporadic sites were not identified because of frequent movement by visiting birds. Chicks were considered to have fledged if they survived at least 15 days. Results from 2013 were compared to previous long-term means: DSR and CRM, 1996-2012 (n = 17 years); and PRH, 1996-2002 and 2005-2012 (n = 15 years).

Point Reyes Headlands

Murre productivity was monitored at PRH within two established Type I plots on Lighthouse Rock (LHR). Ledge Plot and Edge Plot were located in the interior and edge of the colony, respectively. All active, visible sites in the plots were monitored beginning 22 April.

Devil's Slide Rock and Mainland

Due to widespread colony growth and the increasing difficulty of monitoring the entire colony, three Type I plots (A, B and C) were established on DSR in 2006 (McChesney et al. 2006; Figure 7). Boundary adjustments were made to plots A and C in 2007, and difficult sites were dropped from plots B and C in 2012. These adjusted plots (A, B, and C) were utilized for monitoring in 2013. At DSM, visible sites were monitored at one active subarea: South of

Turtlehead Cliffs (DSR-05C). Colony observations began during the third week of April. Because of difficult viewing conditions and crowding in Plot C, only sites with adequate views were monitored resulting in only a small sample of breeding sites followed.

Castle-Hurricane Colony Complex

Monitoring began on 22 April when it was found that egg-laying had already begun. All active murre breeding and territorial sites were monitored within a standardized plot on CRM-04 (established in 1996). The ephemeral subcolony CRM-03B also hosted breeding murres in 2013, where a subset of active sites was monitored.

Common Murre Co-attendance and Chick Provisioning

Murre co-attendance and chick provisioning observations were conducted at DSR only. Observations were conducted on 20 June, 22 June, and 1 July following standardized methods (see Parker 2005, McChesney et al. 2006). Sunrise to sunset surveys were attempted, but all three ended before sunset due to poor viewing conditions (fog or excessive heat waves). One survey was paused for several hours mid-day due to fog. Despite weather issues, all three surveys were at least ten-hours long as required by the protocol. Ten to 15 breeding sites with chicks were monitored each day, resulting in a total of 39 site-days. High-powered spotting scopes (65-130X) were used to conduct observations. Adult arrivals, departures, and food deliveries to chicks (including prey type, size, and fate when distinguishable) were recorded at each monitored site to the nearest minute. In addition, the number of birds at each site was recorded every 15 minutes throughout the survey to account for possible missed arrivals or departures. Results from 2013 were compared to the 1999-2012 long-term mean (no data available for 2009).

Nest Surveys

Nest and bird counts of non-murre seabirds were conducted weekly during the breeding season at all colonies in order to assess relative breeding population sizes. Brandt's Cormorant nests and territorial sites were classified into five groups that roughly described nesting stages: site with little or no nesting material, poorly built nest, fairly built nest, well-built nest, and nests with brooded chicks. In addition, large, wandering ("creching") cormorant chicks were counted. See McChesney et al. (2007) for more detailed descriptions of nest categories. Boat surveys were not conducted at any colony in 2013. The land nest count reported was the sum of seasonal peak counts at each subcolony or subarea. Peak counts in 2013 included nests with brooded chicks. Land count totals were compared to 2012 counts.

Brandt's Cormorant Productivity

Breeding phenology and reproductive success (clutch sizes, brood sizes and chicks fledged per pair) of Brandt's Cormorants were monitored at PRH, DSRM, and CHCC. At PRH, Brandt's Cormorants were monitored at Chip Rock (PRH-11A), Face Rock (PRH-11B), and Wishbone Point (PRH-11E-WISH). At DSRM, monitoring was conducted at DSR (DSR-01), Mainland South (DSR-05A), April's Finger (DSR-05-AF), and South of Turtlehead Cliffs (DSR-05C). At

CHCC, monitoring was conducted at CRM-03B. Brandt's Cormorant productivity was not monitored at DBCC in 2013.

Monitored nests were checked every one to seven days from mainland vantage points using binoculars and spotting scopes. Chicks were considered to have fledged if they survived to at least 30 days of age. After that age, chicks typically begin to wander from their nests and become impossible to associate with specific nests without marking (Carter and Hobson 1988, McChesney 1997). Results from 2013 were compared to prior long-term means for DSRM (1997-2007, 2010-2012; n = 14 years), CHCC (1997-2001, 2006-2012; n = 12 years) and PRH (1997-2001, 2006-2012; n = 12 years). Comparisons were made to 2012 if long-term means were not available.

Pelagic Cormorant, Black Oystercatcher, and Western Gull Productivity

Productivity of Western Gulls and Black Oystercatchers was monitored at select nests that were easily visible from mainland vantage points at DSRM and CHCC. Productivity of Pelagic Cormorants was monitored only at DSRM. Nests were checked at least once per week. Chicks were considered to have fledged if they survived at least 30 days. Feathering status was used as a proxy for chick age if precise age was not known (i.e., chicks that were greater than 75% feathered were considered to have fledged). Results were compared to 2012.

Pigeon Guillemot Surveys

To assess relative population size and seasonal attendance patterns, weekly standardized counts were conducted of birds rafting on the water and roosting on land (intertidal and nesting areas) at PRH, DBCC, and DSCC. Surveys were conducted between one-half hour after sunrise and 0830 h. From mid-April to 5 May, when numbers often peak, surveys were conducted twice per week (weather permitting) and about once per week thereafter. Due to the large size of the PRH colony area, weekly counts were conducted from just one location (Lighthouse). While a single survey of the entire PRH colony has been conducted in the past, weather did not permit a full survey in 2013. At DSCC, the entire area from the south side of San Pedro Rock to the south end of the DSRM colony boundary was surveyed. Guillemots were also counted upon arrival (range 0850 – 1401 h) for twice weekly colony surveys at PRS, MPR, and DPR. Guillemot surveys were not conducted at CHCC in 2013 due to road construction that prohibited access to certain survey sites.

RESULTS

Anthropogenic Disturbance

During the 2013 field season, there were 108 aircraft detections within our monitoring zones at PRH, DBCC, DSRM and CHCC combined, including 84 planes (78%) and 24 helicopters (22%). Overall, 41 (38%) of these overflights resulted in disturbance to seabirds (e.g. agitation, displacement or flushing). A total of 26 planes (31% of all planes) and 15 helicopters (63% of all helicopters) caused disturbance. Four helicopters (accounting for 3.7% of all overflights) caused displacement and/or flushing of murres, while planes overflights did not result in anything more than agitation. The most frequently detected aircraft categories were general aviation planes (71.3% of all aircraft detections, and 54% of disturbances) and general aviation helicopters (9.3% of aircraft detections and 19% of disturbances; Figure 7). There were 11 total watercraft detections within 1,500 feet of monitored colonies, including ten recreational fishing boats and one kayak. None of these resulted in observed disturbance (Figure 8).

Three Wildlife Disturbance Reports were completed and submitted to the Seabird Protection Network in 2013 (all from DSR). Reports were submitted for three military helicopters (one event involving two helicopters), and one general aviation helicopter (accounting for two events).

There were two watercraft recorded inside Special Closures, both from DSR. One was a small private recreational fishing boat, and the other a kayak. Neither Special Closure violation resulted in disturbance to seabirds on DSR.

Point Reyes Headlands

At PRH in 2013, eight aircraft overflights (0.021 aircraft/hr; six planes, two helicopters) were recorded but watercraft were not detected (Table 2, Appendices 1, 2). Four aircraft overflights (50%) resulted in disturbance (all agitation) to murres (0.013 disturbances/hr). All four overflights were attributed to a CDFW aircraft contracted by USFWS for annual aerial photographic surveys of seabird colonies.

The 2013 combined detection rate (aircrafts and watercraft) of 0.021 detections/hr was 85% less than the baseline mean, and 62% less than in 2012 (Table 2, Figure 9). Detection rates for planes (0.16 planes/hr) and watercraft (0 watercraft/hr) were less than baseline means, but the rate for helicopters (0.005 helicopters/hr) was 314% greater than the baseline mean. The combined disturbance rate of 0.013 disturbances/hr was 64% less than the baseline mean, but 167% greater than 2012 (Table 2, Figure 10). Disturbance rates for planes (0.013 planes/hr), helicopters (0 helicopters/hr), and watercraft (0 watercraft/hr) were all less than baseline means. It should be noted that despite certain increases in detection and disturbance rates in 2013, detection and disturbance rates at PRH were much less than at other colonies.

Drakes Bay Colony Complex

When considered together, the combined (watercraft and aircraft) detection rate at all DBCC colonies of 0.014 detections/hr was 95% less than the baseline mean. Detection rates for planes

(0 planes/hr), helicopters (0 helicopters/hr), and watercraft (0.014 watercraft/hr) were all less than the baseline means (Figure 11). Disturbance was not observed in 2013 at DBCC (Figure 11).

Point Resistance
At PRS, there were no aircraft or watercraft detections thus, no disturbance (Table 3).

Millers Point Rocks
At MPR, there was one watercraft detection (0.062 watercraft/hr), no aircraft detections, and no anthropogenic disturbances recorded in 2013 (Table 4, Appendix 2).

Double Point Rocks
At DPR, there were no aircraft or watercraft detections in 2013 (Table 5)

Devil's Slide Rock and Mainland
In 2013, 78 plane (0.165 planes/hr), 16 helicopter (0.034 helicopters/hr), and seven watercraft detections (0.015 watercraft/hr) were recorded (Table 6, Appendices 1, 2). The combined (watercraft and aircraft) detection rate of 0.217 detections/hr was 53% less than the baseline mean and 76% less than the 2012 rate (Figure 9, Table 6). Thirty-five percent (33) of all overflights resulted in disturbance to seabirds. Disturbances were caused by 28% of planes (22) and 69% of helicopters (11). Watercraft-related disturbance was not observed at DSR in 2013. The combined disturbance rate of 0.078 disturbances/hr was 50% less than the baseline mean, and 83% less than in 2012. Disturbance rates were less than the baseline means for planes, helicopters and watercraft by 37%, 21% and 100%, respectively (Figure 10, Table 6).

The rate of disturbance events involving displacement and/or flushing of seabirds (0.008 disturbances/hr) was 74% less than the baseline mean and 73% less than in 2012. The four flushing events involved two military helicopters and two general aviation helicopters. The largest numbers of birds affected by one aircraft (two events) was from a general aviation helicopter that flushed 45 murres on a northbound path, and 100 murres minutes later on a southbound path (Table 7).

The annual Half Moon Bay Dream Machines event took place over two days (27-28 April) in 2013. This event includes aircraft displays, airplane rides, and an aircraft fly-in, which can attract dozens or more planes. In some years, aircraft detections and disturbances at DSRM have been relatively severe. In 2013, the event was expanded from one to two days. SPN has been working with event organizers and airport managers to decrease aircraft overflights at DSR. Fog was a factor for both days of the event; fog didn't clear all day on the first day, and cleared around mid-afternoon on the second day. This likely affected overflight activity at DSR, where there were only five aircraft detections (5.3% of total detections in 2013). All five detections were recorded after the fog lifted on the second day. There were 86% fewer aircraft detections around DSR during the 2013 Dream Machines event than in the 2012 event. Three disturbance events (all agitation) were recorded over the course of the two-day event, all by general aviation planes.

To better gauge the level of overflight activity passing near DSR, in 2013, a pilot study was initiated whereby all aircraft (except passenger airliners) observed from DSR vantage points above the standard 1,000 foot detection zone were recorded. In other words, these aircraft were in addition to standardized recording of all aircraft passing within 1,000 vertical ft of DSR. A total of 443 additional aircraft were recorded in this manner, or 0.935 aircraft per observation hour. When these overflights were included in the big picture of aircraft activity at DSR, it was clear that while the majority of aircraft flew outside of the standard detection zone around DSR when transiting along the coast, about 17% flew below 1,000 feet over DSR. However, only 7% of all aircraft detected (inside and outside of the detection zone) caused disturbance at DSR.

Castle-Hurricane Colony Complex

At CHCC, four helicopter overflights (0.014 helicopters/hr) and four watercraft detections (0.014 watercraft/hr) were recorded in 2013 (Table 8, Appendices 1, 2). The combined detection rate of 0.028 detections/hr was 60% less than the baseline mean, and 69% less than the 2012 rate (Figure 9, Table 8). There were no observed disturbance events at CHCC in 2013 (Figure 10).

Non-Anthropogenic Disturbance

Point Reyes Headlands

In 2013, seven flushing events and one displacement event were recorded. Common Ravens were responsible for 50% (n = 4), Brown Pelicans for 25% (n = 2), and Western Gulls for 25% (n = 2). A total of two eggs were observed to be taken from Lighthouse Rock (PRH-03B) (neither within productivity plots) during these events, both by ravens. Both pelican-related events involved pelicans landing nearby murres at Big Roost Rock (PRH-03A), causing murres to flush or displace. The maximum number of murres flushed and/or displaced in a given event was 100, as a result of one pelican. While unclear, some of the 37 eggs that disappeared from PRH productivity plots in 2013 may have been from avian disturbance.

Drakes Bay Colony Complex

Point Resistance

No non-anthropogenic disturbance events were observed at PRS in 2013. However, in mid-July between six and 15 Turkey Vultures (*Cathartes aura*) were observed on Point Resistance Rock (PRS-02), roosting and scavenging on murre adult and chick carcasses. Vultures apparently began attending the rock sometime between surveys on 9 July and 14 July, and were present until at least 25 July. When first discovered, vulture activity was largely observed on the eastern portion of the rock, where nearly all murre attendance had ceased. At this time, murre attendance was still relatively high on the west side, although most birds did not appear to be actively breeding and only a few chicks were evident. Thus, it is unclear if the vultures caused the abandonment of much of the rock's murres or were simply scavenging remains following murre chick fledging.

Millers Point Rocks

There were no non-anthropogenic disturbance events observed at MPR in 2013.

Double Point Rocks
Two flushing and one displacement event were observed at DPR in 2013, all caused by Common Ravens. No eggs or chicks were observed to be lost as a result of these events, though during the displacement event, a raven unsuccessfully attempted to pull a murre off of its egg. The maximum number of murres flushed or displaced in a given disturbance event was 50.

Devil's Slide Rock and Mainland
Four non-anthropogenic disturbance events were observed at DSRM in 2013, all caused by Brown Pelicans. No eggs or chicks were observed to be lost as a result of these events. Unlike 2012, all of these disturbance events involved pelicans taking off from or circling around DSR, rather than direct harassment. The maximum number of murres flushed or displaced in a given pelican disturbance event was 20.

Castle-Hurricane Colony Complex
Two non-anthropogenic disturbance events were recorded in 2013, including one flushing event and one displacement event. The displacement event was caused by a Brown Pelican fly-by and the flushing event by a Peregrine Falcon fly-by. No eggs or chicks were lost as a result of these events.

Common Murre Seasonal Attendance Patterns

Point Reyes Headlands
All well-established nesting areas were active with confirmed breeding in 2013. Dates of peak counts varied, ranging from 25 April to 17 July among subcolonies. In contrast to most years, peak numbers were largely recorded after the first egg lay date (5 May) in productivity plots on Lighthouse Rock (Figure 12-17). Most subcolonies were no longer attended by murres by 1 August; however, Dugout Plot and Ledge Plot were not vacant until 7 August (Figure 12). These attendance patterns were fairly consistent with previous years. In 2011 and 2012, murres attended PRH subcolonies until late July or early August.

Murres attended several infrequently used subcolonies and non-breeding clubs in 2013, including Big Roost Rock (PRH-03A), Aalge Ledge (PRH-03D), Wishbone Point (PRH-11E-WISH), Spine Point (PRH-11E-SPINE) and Area B (PRH-14B). Breeding was confirmed at Wishbone Point (PRH-11E-WISH), but not at the other subcolonies.

Drakes Bay Colony Complex
Point Resistance
Murre attendance at PRS was variable into early June, with a peak count by 4 June (Figure 18). Counts were relatively stable through June, and then decreased by about half by 9 July. Attendance ceased entirely by 25 July. Consistent attendance and observations of fledgling-sized chicks suggested that there was likely successful breeding at PRS, though the presence of multiple Turkey Vultures in mid-July may have caused some unobserved chick loss.

Millers Point Rocks
Common Murre attendance at MPR South Rock (MPR-02) was variable but was some of the most substantial observed in recent years, ranging from 134 to 469 birds between late May and late July (Figure 18). Most attendance was among a large colony of Brandt's Cormorants. The consistent attendance and observations of at least a few chicks suggested that successful breeding was likely. Common Murres were not observed at MPR North Rock (MPR-01), and only one or two murres were observed at a time on Blue Cheese (MPR-04) in 2013.

Double Point Rocks
Attendance at Stormy Stack (DPR-01) was consistent through early July, with a peak count on 18 June (Figure 18). Attendance steadily declined through mid-July, suggesting that there was successful breeding at DPR. Attendance ceased at all plots by 1 August.

Bird Island
Surveys were conducted at Bird Island from 21 April to 10 July 2013. Murres were observed on 12 June only, when a group of about 100 murres landed on Bird Island during the survey, but departed within one hour.

Devil's Slide Rock and Mainland, San Pedro Rock
Devil's Slide Rock
Murres were observed on all count days between 22 April and 3 August 2013, and were completely absent from the rock on 5 August (Figure 19). The greatest counts were recorded during the chick-rearing period (mid to late June, specifically). The maximum count of 1,527 murres was recorded on 21 June, after the average chick hatch date (10 June). This count was 1.8% greater than the 2012 peak count of 1,499 murres, and the greatest count to date. Attendance patterns were relatively consistent from early May to early July through the egg-laying, incubation and early chick periods. This period was followed by a characteristic rapid decline as adults and chicks departed the colony. From photographs obtained during an annual aerial survey on 3 June, 2,001 murres were counted. This count was considerably greater than the standardized land-based counts of 1,248 and 1,345 murres counted on 3 and 5 June, respectively (Figure 19). The greater aerial survey count likely reflects the more complete colony coverage provided by this method. To derive an approximate estimate of the DSR breeding population size, we applied the correction factor of 1.47 calculated for murres at Southeast Farallon Island in 2013 (Warzybok et al. 2013). The correction factor accounts for breeding birds not present as well as non-breeding birds present at the colony at the time of the survey. Applying this correction factor the aerial survey count of 2,001 birds yields an estimate of 2,942 breeding birds, or about 1,471 breeding pairs. This estimate is 46% greater than the estimate of 2,019 breeding birds in 2012 (USFWS, unpubl. data) and is the greatest since DSR was recolonized in 1996 , and is similar to estimates of 2,300-2,923 breeding birds in 1979-1982 prior to colony extirpation (Sowls et al. 1980, Briggs et al. 1983, Carter et al. 2001).

Devil's Slide Mainland
Murre attendance at DSM was among the least since birds began breeding there in 2005. Birds attended South Bunker (DSR-04) and South of Turtlehead Cliffs (DSR-05C) in small numbers from one to 29 birds. Single murres were counted on one day at both Mainland South Roost

(DSR-05A-ROOST) and Turtlehead (DSR-05B). One breeding site was confirmed on South of Turtlehead Cliffs, from which one chick was successfully fledged (Figure 20).

San Pedro Rock
Murres were not observed on San Pedro Rock in 2013.

Castle/Hurricane Colony Complex
Attendance monitoring began on 24 April. However, because of road construction, monitoring of several subcolonies did not begin until 29 May (Figures 21-23) and no surveys were conducted of subcolonies Bench Mark-227X, CRM-03West, CRM-06-A-N, and CRM-06-B-S-N.

Similarities in attendance suggested relatively synchronous breeding at most active CHCC subcolonies, with relatively stable attendance from late April to mid-July. Rapid declines in early to mid-July signified colony departure as chicks fledged (Figure 21-23). Murres were absent from CHCC by 1 August.

Common Murre Productivity

Point Reyes Headlands
A total of 173 sites were monitored between Ledge (n = 97; 56%) and Edge (n = 76; 44%) plots on Lighthouse Rock. In Ledge Plot, 71 sites were breeding, 25 were territorial and one was sporadic. The mean egg lay date for first eggs was 17 May ± 1.4 days (range = 4 May – 17 June; n = 56; Table 9), nine days earlier than the long-term average of 26 May ± 2.5 days. Five replacement eggs were laid in Ledge. Productivity was 0.34 chicks fledged per pair, 36% less than the long-term mean of 0.53 ± 0.08 (Figure 24).

In Edge Plot, 60 sites were breeding and 16 sites were territorial. The mean egg lay date for first eggs was 14 May ± 1.4 days (range = 5 May – 30 June; n = 49; Table 9), 17 days earlier than the long-term mean of 31 May ± 3.1 days. Four replacement eggs were laid. Productivity was 0.53 chicks fledged per pair, 26% greater than the long-term mean of 0.42 ± SE 0.10 (Figure 24).

When Edge and Ledge plots were combined, the mean egg-laying date was 16 May ± 1.0 days, (range = 4 May – 30 June; n = 105; Table 9), eleven days earlier than the long-term mean (27 May ± 2.3 days). Overall productivity was 0.43 chicks fledged per pair, 14% less than the long-term average (0.50 ± 0.09), with fairly poor hatching success (45.7%) and relatively good fledging success (87.5%). The last chick was last observed on 5 August.

Devil's Slide Rock and Mainland
Of 243 sites documented within DSR plots, 234 (96.3%) were breeding, four (1.6%) were territorial, and five (2.1%) were sporadic. At all sites combined, the mean egg-laying date of first eggs was 10 May ± 0.6 days (range = 2 May – 22 May, n = 115; Table 9), which is 16 days earlier than the long-term average (26 May ± 2.0 days). A total of 234 eggs were laid, including two replacement eggs. Overall productivity of 0.95 chicks fledged per pair was 61% greater than the long-term average (0.59 ± 0.06; Figure 24), and the greatest on record. Above average

productivity was influenced by both good hatching and fledging success (88.0% and 96.1%, respectively). The last chick was seen on 25 July.

Only one DSM breeding site was observed at South of Turtlehead Cliffs (DSR-05C). Mean egg-lay date could not be determined for this breeding site. The single breeding site fledged one chick on 7 August.

Castle-Hurricane Colony Complex

Of 111 total monitored sites in the CRM-04 plot in 2013, 96 (86.5%) were breeding, 14 (12.6%) were territorial and one (0.9%) was sporadic (Table 9). Murres had already begun egg-laying when monitoring began. Approximate egg-laying dates for eggs laid prior to the start of monitoring were estimated by back-dating from chick hatch dates. The estimated mean egg-laying date was 24 April ± 0.8 days (range = 8 April – 23 May; n = 93; Table 9), 23 days earlier than the long-term average of 17 May ± 2.1 days. Four replacement eggs were recorded. Overall productivity at CRM-04 was 0.81 chicks per pair, 69% greater than the long-term mean (0.48 ± 0.05 chicks per pair), and the greatest on record (Figure 24). Chicks that fledged remained on the rock for an average of 24 ± 0.6 days (n = 42) after hatching, and the last chick was seen on 2 July.

For the sixth consecutive year, murres were monitored and bred on the east side of CRM-03B. Of 60 sites monitored, 58 (96.7%) were breeding and two (3.3%) were territorial. The mean egg-laying date was 10 May ± 1.8 days (range = 27 April – 21 June; n = 54; Table 9). One replacement clutch was laid. Productivity at CRM-03B was 0.71 in 2013, 78% greater than the long-term average of 0.40 ± 0.13 chicks per pair (1999-2003, 2005, 2008-2012; n = 11 years) for this subcolony.

Common Murre Co-attendance and Chick Provisioning

At DSR, the mean percent of time that pairs with chicks spent in co-attendance was 19.1% ± 0.040 (range = 0.33 – 57.1%; n = 17), which is greater than the long-term (1999-2012) average of 13.2% ± 0.01. There were 196 mate arrivals recorded within three observation periods. On average, mates arrived 0.41 ± 0.03 times per site per hour (range = 0.10 – 0.66; n = 17). Of all mate arrivals seen, 61% were observed with prey, 36.2% had no prey, and 1.0% of arrivals were inconclusive. Of the confirmed prey deliveries, 96.7% were consumed by chicks, 2.5% were undetermined, and 0.83% were stolen by another adult. The mean chick provisioning rate was 0.24 ± 0.02 feedings per hour (range: 0.05 – 0.47; n =17), the same as the long-term mean.

Brandt's Cormorant Nest Surveys and Productivity

Point Reyes Headlands

Nest surveys

Brandt's Cormorant nest surveys were conducted from 25 April to 8 August. Well-built nests were recorded at Boulder (PRH-05B), Greentop (PRH-08B), Cliff Colony East (PRH-09A), Cliff Colony West (PRH-09B), Chip Rock (PRH-11A), Face Rock (PRH-11B), Arch Rock (PRH-11D) and Wishbone Point (PRH-11E-WISH). The first well-built nest was observed on 25

April. The peak single-day count for all subcolonies combined was 224 nests on 19 June. The sum of the seasonal peak counts for each subcolony was 277 nests (Table 10). No boat survey was conducted to supplement land-based surveys in 2013.

Productivity
A total of 129 nests were monitored at three subareas, and 124 were egg-laying sites (Table 11). Monitoring of nests on Chip Rock (PRH-11A) and Face Rock (PRH-11B) began on 22 April and at Wishbone Point (PRH-11E-WISH) on 3 May.

The average clutch initiation date of 4 May ± 0.6 days (range = 22 April to 1 June) for first clutches (Table 11) was 14 days earlier than the long-term mean of 18 May ± 4.3 days. The first chick was observed on 25 May. Overall productivity of 2.38 chicks fledged per pair (subarea range = 2.17 – 2.56) was 38% greater than the long-term average of 1.72 ± 0.2 (Figure 25). Breeding success per nest was 0.92 (subarea range = 0.89 – 1.00), indicating little nest failure.

Drakes Bay Colony Complex
Nest surveys
Brandt's Cormorant nest surveys were conducted from 23 April to 1 August. Peak counts of Brandt's Cormorant nests at each colony are summarized in Table 10. The first well-built nests were observed at both MPR-01 and MPR-02 on 23 April, the first check of the season. The peak count for MPR-01 was five nests on 30 May, and the peak for MPR-02 was 59 nests on 20 June.

The first well-built nests on Stormy Stack (DPR-01) were observed on 2 May. The peak count of 36 nests occurred on 13 June.

Productivity
Productivity data were not collected for Brandt's Cormorants at DBCC this year.

Devil's Slide Rock and Mainland
Nest surveys
Nests and territorial sites were counted at nesting areas on DSR and DSM between 25 April and 7 August. The first well-built nests were observed on 25 April. The peak count on DSR was 31 nests. On the mainland, nesting occurred on South of Turtlehead Cliffs (DSR-05C; peak count of 18 nests), Mainland South Roost (DSR-05A-ROOST; peak count of six nests), Upper Mainland South (DSR-05A-UPPER; peak count of three nests) and April's Finger (DSR-05AF; peak count of one nest). Nesting also occurred at South Bunker (DSR-04; peak count of 36 nests), but an undetermined event before a survey on 17 May resulted in every nest being abandoned. In fact, the nest material from every established nest was gone from the cliff entirely. Some of the cormorants may have relocated their nesting efforts, as an increase in counts from 20 to 36 nests on DSR-01 was observed between 9 May and 17 May, just after the abandonment event.

The peak single day count for all areas combined was 52 nests on 17 July, 29.7% fewer than the 2012 peak count (74 nests). The sum of the seasonal peak counts was 95 nests (Table 10), 12% more than the 2012 seasonal peak count sum of 85 nests.

Productivity

A total of 79 breeding sites were monitored on all of DSRM in 2013. Brandt's Cormorant nests were monitored on DSR (DSR-01), South of Turtlehead Cliffs (DSR-05C), Mainland South Roost (DSR-05A-ROOST), Upper Mainland South (DSR-05A-UPPER) and April's Finger (DSR-05AF) (Table 11). The first egg was observed on DSR-01 on 27 April. For all subareas combined, the mean clutch initiation date of 22 May ± 2.56 days (range = 27 April to 23 June) was ten days later than the long-term mean of 12 May ± 3.0 days. Overall productivity of 1.80 chicks fledged per pair (subarea range = 1.54- 2.50; n = 79) was 10% greater than the long-term average of 1.63 ± 0.2 (Figure 25). Breeding success per nest of 0.78 indicates a moderate amount of nest abandonment. There was one replacement clutch observed in 2013.

Castle-Hurricane Colony Complex

Nest surveys

Brandt's Cormorant nest surveys were conducted from 24 April to 1 August. Subcolonies with confirmed breeding in 2013 were CRM-03B, CRM-06-B-S-S, and CRM-09. Breeding was confirmed at BM227X-02 from annual aerial surveys photographs. The first well-built nests were observed on CRM-03B and CRM-09 on 24 April. At all CRM subcolonies combined, the peak single survey nest count of 201 nests was recorded on both 27 June and 3 July, and the sum of the peak subcolony counts was also 201 nests (Table 10).

Productivity

Brandt's Cormorant productivity was monitored on CRM-03B (Table 11). The mean clutch initiation date of 30 April ± 1.3 was six days earlier than the long-term mean of 6 May ± 4.3 days. The first chick was observed on 15 May. Overall productivity of 2.53 chicks fledged per pair (subcolony range = 0 – 4.00; n = 74) was 58% greater than the long-term average of 1.60 ± 0.2 (Figure 25). Breeding success per nest of 0.93 reflects little nest abandonment.

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

Nest and bird surveys

Peak weekly counts of nests (cormorant, gull, and oystercatcher) or birds (guillemot) from land-based observations are summarized in Tables 10 and 12. Boat counts were not conducted in 2013; therefore nest survey results are compared only to land counts from 2012.

Pelagic Cormorant

Pelagic Cormorant nests were first observed at PRH on 24 April, at DBCC on 23 April, at DSRM on 25 April, and at CHCC on 24 April. The first egg of the year was recorded at DSRM on 9 May. Nest counts at DSRM were 30% greater than in 2012. No comparisons to past years were made for other colonies because boat surveys are needed to provide standardized counts. However, nest counts were relatively high at most colonies.

Western Gull
Compared to 2012, there were fewer nests observed at DSRM (25%) and CHCC (19%) and more nests observed at PRH (12%), DPR (40%) and MPR (63%). The decrease in nests at CHCC was likely due, at least partly, to limited overlook access. No nests were counted at PRS in either year. Because boat surveys are needed for more complete and standardized coverage, comparisons between years should be considered with caution.

Black Oystercatcher
Nest counts for Black Oystercatchers were comparable to 2012. Three total nests were observed at PRH, three at DBCC combined, two at DSR and five at CHCC.

Pigeon Guillemot
At PRH, the peak standardized count from the lighthouse of 140 birds on 3 May (PRH-02, PRH-03 and PRH-04) was 35% greater than in 2012. A land-based survey of the entire headlands was not conducted because it has been determined that boat surveys provide more standardized coverage of PRH. Although surveys of Drakes Bay colonies were not done at standardized times, peak counts were identical to 2012 counts at both PRS and MPR, but 29% less at DPR.

At the Devil's Slide Colony Complex, the peak land-based count of 102 guillemots on 5 June was 50% less than in 2012. Guillemot surveys were not conducted at CHCC in 2013 due to road construction.

Productivity

Productivity results of Pelagic Cormorants, Western Gulls, and Black Oystercatchers are summarized in Table 13. Productivity monitoring was not conducted for these species at PRH or DBCC in 2013, and Pelagic Cormorants were monitored at DSRM only.

Pelagic Cormorant
At DSRM, Pelagic Cormorant productivity was monitored on South Bunker (DSR-04), April's Finger (DSR-05AF), Turtlehead (DSR-05B) and South of Turtlehead Cliffs (DSR-05C). Productivity at DSRM (2.48 chicks fledged per pair) was 39% greater than the long-term mean (2006 – 2012) and 141% greater than in 2012.

Western Gull
Nests were monitored at DSRM and CHCC. Productivity at DSM was 1.00 chicks fledged per pair, compared to 0.33 chicks fledged per pair in 2012. Productivity at CHCC was 0.33 chicks fledged per pair, compared to 0.11 chicks fledged per pair in 2012.

Black Oystercatcher
Two pairs were observed at DSRM, but a nesting attempt was never confirmed. Productivity at CHCC was 0.00 chicks fledged per pair compared to 0.50 chicks fledged per pair in 2012.

DISCUSSION

Anthropogenic Disturbance

Similar to other recent years, aircraft and watercraft detection and disturbance rates were considerably greater at DSRM than other monitored colonies. However, after a season of relatively high detection and disturbance rates in 2012, these rates at DSRM in 2013 were among the lowest recorded to date. In fact, detection and disturbance rates were well below baseline levels, and below most other years, for all categories and colonies except one (helicopter detections at PRH). Disturbance was not recorded at DBCC and CHCC, and watercraft disturbance was not recorded at any colony. Only four flushing events were recorded in 2014, all at DSRM. All flushing events resulted from low helicopter overflights over DSR. Past years' observations have shown that helicopters are more prone to flush seabirds than fixed-winged aircraft.

We continued monitoring aircraft activity during the annual Dream Machines event at Half Moon Bay Airport. In past years, this event has resulted in high levels of aircraft activity and disturbance at DSR. Monitoring efforts are coordinated with outreach efforts to pilots conducted by GFNMS staff. Despite the increase from a one-day to a two-day event, the 2013 Dream Machines event resulted in 85% fewer aircraft overflights than in 2012, with just three disturbance events (all agitation). This year marks the second year in a row in which disturbance rates during this event have been less than average. However, low fog in both 2012 and 2013 may have prevented many pilots from flying into the event. And although there were only three disturbance events, they accounted for more than half of all overflights. Had the weather been less foggy, detection and disturbance rates may have been greater.

Only two watercraft were detected inside state Special Closures at DSR. Thus, either compliance of these Special Closures (established in May 2010) or other factors, such as weather or fishing conditions, are affecting watercraft activity in the area.

Non-Anthropogenic Disturbance

The main difference in 2013 compared to 2012 and certain other recent years was reduced Brown Pelican disturbance. In 2012 and certain other years, disturbances by pelicans have resulted in large-scale Common Murre egg and chick loss where it has occurred. The few pelican disturbances observed in 2013 resulted in no egg or chick loss. Pelican disturbance at the Yaquina Head murre colony in Oregon was also reduced in 2013 (Suryan et al. 2013). Most disturbances were caused by Common Ravens at PRH, where resident ravens often harass murres in attempts to steal eggs or chicks. Raven disturbance in 2013 did not appear to be abnormal, although relatively low murre productivity at PRH monitored plots may have been a result of this disturbance, at least in part.

Attendance and Reproductive Success

At DSR, murre attendance continued the long-term trend of colony growth. This was evident both in increases in densities and distribution on the rock. Increases were especially reflected in the aerial photographic count of 2,001 murres and resulting corrected estimate of 2,942 breeding birds, 46% greater than in 2012. Both this and the peak land-based count of 1,527 murres were the greatest recorded since DSR was recolonized in 1996. Colony expansion was evident on the perimeters of the colony, particularly on the east and north sides where breeding activity had been sparse in previous years. Although comparisons to photographs of DSR from 1979 to 1982 suggest the colony was still somewhat larger then than now, the population estimate for 2013 is similar to those pre-extirpation years. This is a very significant and exciting milestone for the Devil's Slide restoration project. Former natural colony expansion to the adjacent Devil's Slide mainland has largely stopped, and few birds attend or breed there any longer.

In addition to increased attendance at DSR, murre productivity at DSR (0.95 chicks/pair) was the greatest productivity recorded to date at any of our monitored colonies. Similarly, murre productivity at the standardized CRM-04 study plot (0.81 chicks/pair) was the greatest ever recorded for that colony, and productivity at adjacent CRM-03B (0.71 chicks/pair) was also unusually great for that subcolony. These productivity values continued a trend started in 2010 and point to abundant local prey resources and minimal impact from disturbance or other factors on breeding success. On the contrary, overall productivity at PRH study plots was less than average (0.43 chicks/pair), especially at Ledge Plot (0.34 chicks/pair) which traditionally experienced greater reproductive success than nearby Edge Plot. While dismal productivity at PRH in 2012 was largely due to large-scale pelican disturbance, the cause(s) in 2013 are unclear. Avian (e.g., pelican or raven) disturbance and predation are typically greater at PRH than other study colonies, but unusual levels of disturbance and predation were not observed in 2013.

Brandt's Cormorants showed signs of recovery from major population declines and persistent low productivity that began in 2008. Nest counts were greater than in 2012 at nearly all colony complexes, although aerial photographic analyses are needed to confirm this and provide better counts. Productivity was above average at all monitored colonies, and values at PRH and CHCC were among the greatest recorded to date. This success follows a year of poor productivity in Brandt's Cormorants at all three colony complexes, as well as Southeast Farallon Island in 2012 (Warzybok et al. 2012). Peak single-day nest counts occurred later than in 2012 at every colony complex. Similar to our monitored colonies, Brandt's Cormorants at Southeast Farallon Island had increased numbers of breeding pairs and above average productivity in 2013 (Warzybok et al. 2013).

Although a lack of boat surveys precluded more complete colony surveys, land-based Pelagic Cormorant nest counts in 2013 were greater than 2012 counts at all colony complexes. Pelagic Cormorant productivity was only recorded at DSRM in 2013, and was the greatest recorded at DSRM since monitoring began there in 2006 and was much greater than in 2012. Western Gulls also showed higher productivity in 2013.

Murre Time Budgets and Ocean Conditions

At DSR in 2013, very high co-attendance rates of Common Murre breeding pair members, and above average chick provisioning rates, strongly suggest the availability of local prey. This is consistent with high chick production for Common Murres and several other species including Brandt's Cormorants, Pelagic Cormorants, and Western Gulls. Adult murres likely were able to find plentiful prey close to the colony, allowing them to spend a substantial amount of time at the colony and still able to provision chicks adequately. This is consistent with other local observations, including the nearby Farallon Islands (Warzybok et al. 2013).

Recommendations for Future Management, Monitoring and Research

- Outreach and education efforts targeting aircraft and watercraft user groups must be continued and adapted to changing conditions. Broadening efforts to include the military may reduce disturbances from military aircraft.

- A new tunnel through Montara Mountain near Pacifica was completed in March of 2013, re-routing Highway 1 away from the dangerous Devil's Slide. Plans to convert the former highway to a public trail for pedestrians and bikers were underway throughout the 2013 seabird field season. This change in use could have dramatic effects on breeding birds on DSM, as breeding colonies will be close to pedestrian vantage points. If not planned properly, human disturbance could increase dramatically in this area with potential harmful impacts to these important seabird colonies. Continued coordination with San Mateo County Parks, the California Coastal Commission, and others will be important to ensure that trail plans include measures to protect breeding seabirds. Once opened, an increased emphasis on pedestrian disturbance to nesting seabirds may be needed for Devil's Slide field monitoring.

- Annual aerial surveys of central and northern California Common Murre, Brandt's Cormorant and Double-crested Cormorant colonies continued in 2013 in cooperation with California Department of Fish and Wildlife and U.C. Santa Cruz. However, no sustained funding is currently available to count nests and birds from the photographs. Analysis of aerial survey photographs has provided the baseline for assessing population trends of these species since the early 1980s and must be continued to properly track murre recovery efforts as well as murre and cormorant population changes caused by natural and anthropogenic sources. Additionally, as murre numbers have increased, land-based counts have become more difficult and even less accurate. This enhances the importance of counting of these aerial photographs for accurate tracking of central California seabird numbers.

- As the numbers and densities of murres on monitored breeding colonies increases, it will be crucial to continually evaluate productivity monitoring methods (especially at DSR and PRH), This will include adjustments to plot boundaries and dropping of difficult to view sites. Eventually data will likely rely more heavily on behavioral observations, as it becomes harder to confirm eggs and chicks within the crowded colony.

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Table 1. Monitoring effort of study colonies or colony complexes, April 2013 to August 2013.

Colony/Colony Complex	Start date	End date	Number of observation days	Total hours
Point Reyes	22-Apr-13	09-Aug-13	88	374.15
Point Resistance	23-Apr-13	06-Aug-13	15	15.34
Millers Point Rocks	23-Apr-13	06-Aug-13	15	16.10
Double Point Rocks	2-May-13	01-Aug-13	12	38.62
San Pedro Rock	22-Apr-13	07-Aug-13	27	15.68
Devil's Slide Rock & Mainland	22-Apr-13	20-Aug-13	103	458.28
Castle-Hurricane Colony Complex	22-Apr-13	27-Aug-13	73	288.60

Table 2. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Point Reyes, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	6	0.016	4	0	0	0.013	0.000	0.040 (± 0.009)	0.020 (± 0.017)	-60.02%	-32.31%
Helicopter	2	0.005	0	0	0	0.000	0.000	0.001 (± 0.001)	0.001 (± 0.001)	313.6%	-100%
Watercraft	0	0.000	0	0	0	0.000	0.000	0.097 (± 0.030)	0.015 (± 0.002)	-100%	-100%
Total	8	0.021	4	0	0	0.013	0.000	0.138 (± 0.022)	0.037 (± 0.019)	-84.50%	-64.21%

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

Table 3. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Point Resistance, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	0	0.000	0	0	0	0.000	0.000	0.018 (± 0.018)	0.0	-100%	-
Helicopter	0	0.000	0	0	0	0.000	0.000	0.0	0.0	-	-
Watercraft	0	0.000	0	0	0	0.000	0.000	0.018 (± 0.018)	0.018 (± 0.018)	-100%	-100%
Total	0	0.000	0	0	0	0.010	0.000	0.036 (± 0.036)	0.018 (± 0.018)	-100%	-100%

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

Table 4. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Millers Point Rocks, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	0	0.000	0	0	0	0.000	0.000	0.044 (± 0.044)	0.0	-100%	-
Helicopter	0	0.000	0	0	0	0.000	0.000	0.022 (± 0.022)	0.022 (± 0.022)	-100%	-100%
Watercraft	1	0.062	0	0	0	0.000	0.000	0.185 (± 0.015)	0.054 (± 0.031)	-66.43%	-100%
Total	1	0.062	0	0	0	0.010	0.000	0.252 (± 0.082)	0.076 (± 0.009)	-75.33%	-100%

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

Table 5. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Double Point Rocks, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	0	0.000	0	0	0	0.000	0.000	0.009 (± 0.009)	0.009 (± 0.009)	-100%	-100%
Helicopter	0	0.000	0	0	0	0.000	0.000	0.047 (± 0.030)	0.028 (± 0.011)	-100%	-100%
Watercraft	0	0.000	0	0	0	0.000	0.000	0.289 (± 0.057)	0.082 (± 0.005)	-100%	-100%
Total	0	0.000	0	0	0	0.010	0.000	0.345 (± 0.036)	0.118 (± 0.003)	-100%	-100%

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

Table 6. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Devil's Slide Rock & Mainland, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	78	0.165	22	0	0	0.046	0.000	0.311 (± 0.081)	0.073 (± 0.023)	- 47.01%	- 37.05%
Helicopter	16	0.034	11	0	4	0.032	0.008	0.076 (± 0.004)	0.040 (± 0.015)	- 55.48%	- 20.72%
Watercraft	7	0.015	0	0	0	0.000	0.000	0.071 (± 0.008)	0.030 (± .005)	- 78.91%	- 100%
Total	101	0.213	33	0	4	0.078	0.008	0.459 (± 0.077)	0.154 (± 0.033)	- 53.59%	- 49.46%

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

Table 7. Number of disturbance events and mean numbers (range) of Common Murres (COMU), Brandt's Cormorants (BRCO), Pelagic Cormorants (PECO), Brown Pelicans (BRPE), Western or Unknown Gulls (WEGU/UNGU), Black Oystercatchers (BLOY), and Pigeon Guillemots (PIGU) flushed or displaced at Devil's Slide Rock & Mainland, 2013.

		COMU Disturbance		BRCO Disturbance		PECO Disturbance		BRPE Disturbance		WEGU/UNGU Disturbance		BLOY Disturbance		PIGU Disturbance	
Source	Mean Number Seabirds Flushed/ Displaced	Number Events	Mean Number birds	Number Events	Mean Number birds	Number Events	Mean Number birds	Number Events	Mean Number birds	Number Events	Mean Number birds	Number Events	Mean Number birds	Number Events	Mean Number birds
Plane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicopter	61 (30-100)	4	61 (30-100)	0	0	0	0	0	0	0	0	0	0	0	0
Watercraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	61	4	61	0	0	0	0	0	0	0	0	0	0	0	0

Table 8. Total detected watercraft and aircraft, and resulting disturbances to all seabirds (Common Murres, Brandt's Cormorants, and Brown Pelicans) at Castle-Hurricane Colony Complex, 2013. Detection and disturbance rates reported as numbers per observation hour.

			Number of Disturbance Events			Number of Disturbance Events/hr		Baseline mean ± SE		% Difference	
Source	Total Detections	Number Detections/hr	A	D	F	Total/hr[1]	Flush or Displace/ hr	Number Detections/hr	Number Disturbances/hr	Number Detections/hr	Number Disturbances/hr
Plane	0	0.000	0	0	0	0.000	0.000	0.064 (±0.013)	0.003 (±0.003)	-100%	-100%
Helicopter	4	0.014	0	0	0	0.000	0.000	0.003 (± 0.003)	0.002 (±0.002)	365.63%	-100%
Watercraft	4	0.014	0	0	0	0.000	0.000	0.002 (± 0.002)	0.000	585.97%	-100%
Total	8	0.028	0	0	0	0.000	0.000	0.069 (±0.014)	0.006 (±0.006)	-59.80%	-100%

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

Table 9. Common Murre breeding phenology and reproductive success at Point Reyes (2 plots and combined), Devil's Slide Rock & Mainland (DSR, 3 plots; DSM; and combined), and Castle Rocks & Mainland (2 plots), 2013. Means (range; n) are reported.

Colony/Plot	Number of Sites Monitored	Number of Egg Laying Sites	Mean Lay Date[1]	Number of Eggs Laid	Mean Hatch Date	Hatching Success[2]	Mean Fledge Date	Fledging Success[3]	Chicks Fledged per Pair
Point Reyes (PRH)									
PRH-Ledge	97	71	14 May (5/5-6/30; 49)	76	16 June (6/7-6/22; 27)	38.2% (76)	10 July (6/30-7/19; 30)	82.8% (29)	0.34 (71)
PRH-Edge	76	60	17 May (5/4-6/17; 56)	64	16 June (6/6-7/14; 23)	54.7% (64)	12 July (6/30-8/5; 23)	91.4% (35)	0.53 (60)
PRH-(combined)	173	131	16 May (5/4-6/30; 105)	140	16 June (6/6-7/14; 50)	45.7% (140)	11 July (6/30-8/5; 53)	87.5% (64)	0.43 (131)
Devil's Slide Rock and Mainland (DSRM)									
DSR-A	145	122	10 May (5/2-5/19; 55)	142	11 June (6/4-7/10; 92)	85.2% (142)	8 July (6/27-7/25;113)	96.7% (121)	0.96 (122)
DSR-B	85	74	9 May (5/3-5/22; 60)	80	10 June (6/1-6/19; 70)	91.3% (80)	6 July (6/22-7/15; 70)	98.6% (73)	0.97 (74)
DSR-C	13	13	No Data	13	13 June (6/12-6/14; 2)	92.3% (13)	13 July (6/29-7/24; 5)	75.0% (12)	0.69 (13)
DSR (combined)	243	232	10 May (5/2-5/22;115)	235	10 June (6/1-7/10; 164)	87.7% (235)	7 July (6/22-7/25;188)	96.1% (206)	0.95 (209)
DSM	1	1	No Data	1	15 July (1)	100% (1)	7 August (1)	100% (1)	1.00 (1)
Castle Rocks and Mainland (CRM)									
CRM-04	111	96	24 April (4/8-5/23; 93)	100	27 May (5/10-6/25; 88)	88.0% (100)	19 June (6/6-7/2; 81)	92.0% (88)	0.81 (96)
CRM-03B	60	58	10 May (4/27-6/21; 54)	59	7 June (5/30-6/30; 43)	72.9% (59)	29 June (6/21-7/16; 42)	97.7% (43)	0.71 (58)

Table 9 (con't).

[1] Calculated using first eggs only; i.e., does not include replacement clutches.

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

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

Table 10. Peak counts of nests for Brandt's Cormorants (BRCO), Pelagic Cormorant (PECO), obtained during land, boat, and combined land/boat counts (total), 2013. ND = No Data.

Species	Colony	Land[1]	Boat	Total Count[2]
Brandt's Cormorant	Point Reyes	277	ND	277
	Point Resistance	0	ND	0
	Miller's Point Rocks	64	ND	64
	Double Point Rocks	36	ND	36
	Bird Island (Point Bonita)	0	ND	0
	Devil's Slide Rock & Mainland	95	ND	95
	San Pedro Rock	0	ND	0
	Bench Mark-227X	ND	ND	-
	Castle Rocks & Mainland	201	ND	201
	Hurricane Point Rocks	0	ND	0
Pelagic Cormorant	Point Reyes	45	ND	45
	Point Resistance	14	ND	14
	Miller's Point Rocks	19	ND	19
	Double Point Rocks	4	ND	4
	Devil's Slide Rock & Mainland	60	ND	60
	San Pedro Rock	0	ND	0
	Bench Mark-227X	ND	ND	-
	Castle Rocks & Mainland	28	ND	28
	Hurricane Point Rocks	11	ND	11

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

Table 11. Brandt's Cormorant breeding phenology and reproductive success at Point Reyes, Devil's Slide Rock & Mainland, and Castle Rocks & Mainland, 2013. Reported are means (range; n).

Colony/Subcolony	Number of Breeding Sites	Clutch Initiation Date[1]	Clutch Size[1]	Breeding Success[2]	Number of Chicks Fledged/Pair[2]	Breeding Success/ Nest[3]
Point Reyes						
East Chip Rock (PRH-11A)	9	22 Apr (4/11-5/8; 9)	3.7 (3-4; 9)	67.6% (34)	2.56 (1-3; 23)	1.00 (9)
East Face Rock (PRH-11B)	80	22 Apr (4/22-6/1; 76)	3.8 (1-5; 68)	57.2% (264)	2.17 (1-4; 176)	0.89 (71)
Wishbone Pt. (PRH-11E)	35	1 May (5/1-5/26; 34)	3.7 (3-4; 29)	62.2% (111)	2.25 (1-4; 81)	0.97 (35)
Total - Point Reyes	124	22 Apr (4/27-6/5; 119)	3.7 (1-5; 106)	59.4% (409)	2.38 (1-4; 300)	0.92 (114)
Devil's Slide Rock and Mainland						
Devil's Slide Rock (DSR-01)	57	12 May (4/27-6/8; 37)	2.9 (2-4; 47)	63.8% (138)	1.54 (0-3; 88)	0.70 (57)
South of Turtlehead Cliffs (DSR-05C)	18	9 June (4/27-6/19; 18)	3.1 (2-5; 18)	80.4% (56)	2.50 (1-3; 45)	1.00 (18)
Mainland South (DSR-05A)	3	-	3.0 (3-3; 3)	77.8% (9)	2.33 (1-3; 7)	1.00 (3)
April's Finger (DSR-05-AF)	1	23 June (1)	2.0 (2-2; 1)	100% (2)	2.00 (2-2; 2)	1.00 (1)
Total – Devil's Slide	79	22 May (4/27-6/23; 79)	2.7 (1-5; 69)	69.3% (205)	1.80 (0-3; 142)	0.78 (142)
Castle Rocks & Mainland						
CRM-09	74	30 April (4/16-6/29; 70)	3.2 (1-4; 74)	79.2% (236)	2.53 (0-4; 74)	0.93 (74)

[1] Includes first clutches only. [2] Includes replacement clutches. See text for details

[3] Breeding success per nest is defined as the proportion of egg-laying nests that fledged at least one chick [3]

Table 12. Peak counts of nests (Black Oystercatcher and Western Gull) and of birds (Pigeon Guillemot), from land, boat, and combined land/boat counts (Total), in 2013. ND = No Data.

Species	Colony	Land[1]	Boat[2]	Total Count[3]
Black Oystercatcher	Point Reyes	3	ND	3
	Point Resistance	0	ND	0
	Miller's Point Rocks	2	ND	2
	Double Point Rocks	1	ND	1
	Devil's Slide Rock & Mainland	2	ND	2
	Bench Mark-227X	ND	ND	-
	Castle Rocks & Mainland	3	ND	3
	Hurricane Point Rocks	2	ND	2
Western Gull	Point Reyes	136	ND	136
	Point Resistance	0	ND	0
	Miller's Point Rocks	13	ND	13
	Double Point Rocks	7	ND	7
	San Pedro Rock	2	ND	2
	Devil's Slide Rock & Mainland	7	ND	7
	Gray Whale Cove South	ND	ND	-
	Bench Mark-227X	ND	ND	-
	Castle Rocks & Mainland	5	ND	5
	Hurricane Point Rocks	8	ND	8
Pigeon Guillemot	Point Reyes	140[4]	ND	-
	Point Resistance	28	ND	28
	Miller's Point Rocks	42	ND	42
	Double Point Rocks	36	ND	36
	Devil's Slide Colony Complex	102	ND	102
	Castle-Hurricane Colony Complex[5]	ND	ND	-

[1] Sum of peak seasonal counts at each subcolony.
[2] In several cases, Black Oystercatcher and Western Gull nests were counted only if they could not be seen from mainland vantage points.
[3] Black Oystercatcher and Western Gull nests that may have been counted on both surveys were included only once towards the total count.
[4] Single-day survey of entire Point Reyes colony not completed in 2013. PIGU survey high count of Lighthouse survey areas (PRH-02, PRH-03, and PRH-04) totaled 140.
[5] Pigeon guillemot surveys were not completed due to road construction and inaccessibility to overlooks

Table 13. Productivity of Pelagic Cormorants, Black Oystercatchers, and Western Gulls at Devil's Slide Rock and Mainland, and Castle Rocks & Mainland, 2013. Means (range; n) or (n) are reported. A dash (-) indicates no data.

	Pelagic Cormorant				Black Oystercatcher				Western Gull			
	Number of Breeding Sites	Number of Chicks Fledged	Number of Chicks Fledged/ Pair (Productivity)	Breeding Success/ Nest[1]	Number of Breeding Sites	Number of Chicks Fledged	Number of Chicks Fledged/ Pair (Productivity)	Breeding Success/ Nest[1]	Number of Breeding Sites	Number of Chicks Fledged	Number of Chicks Fledged/ Pair (Productivity)	Breeding Success/ Nest[1]
Devil's Slide Rock and Mainland	33	82	2.48 (0-5;33)	0.91 (30)	-	-	-	-	4	4	1.00 (0-2;4)	0.50 (2)
Castle Rocks and Mainland	-	-	-	-	4	0	0.0 (0-0;4)	0.0 (4)	6	2	0.33 (0-1;6)	0.33 (6)

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

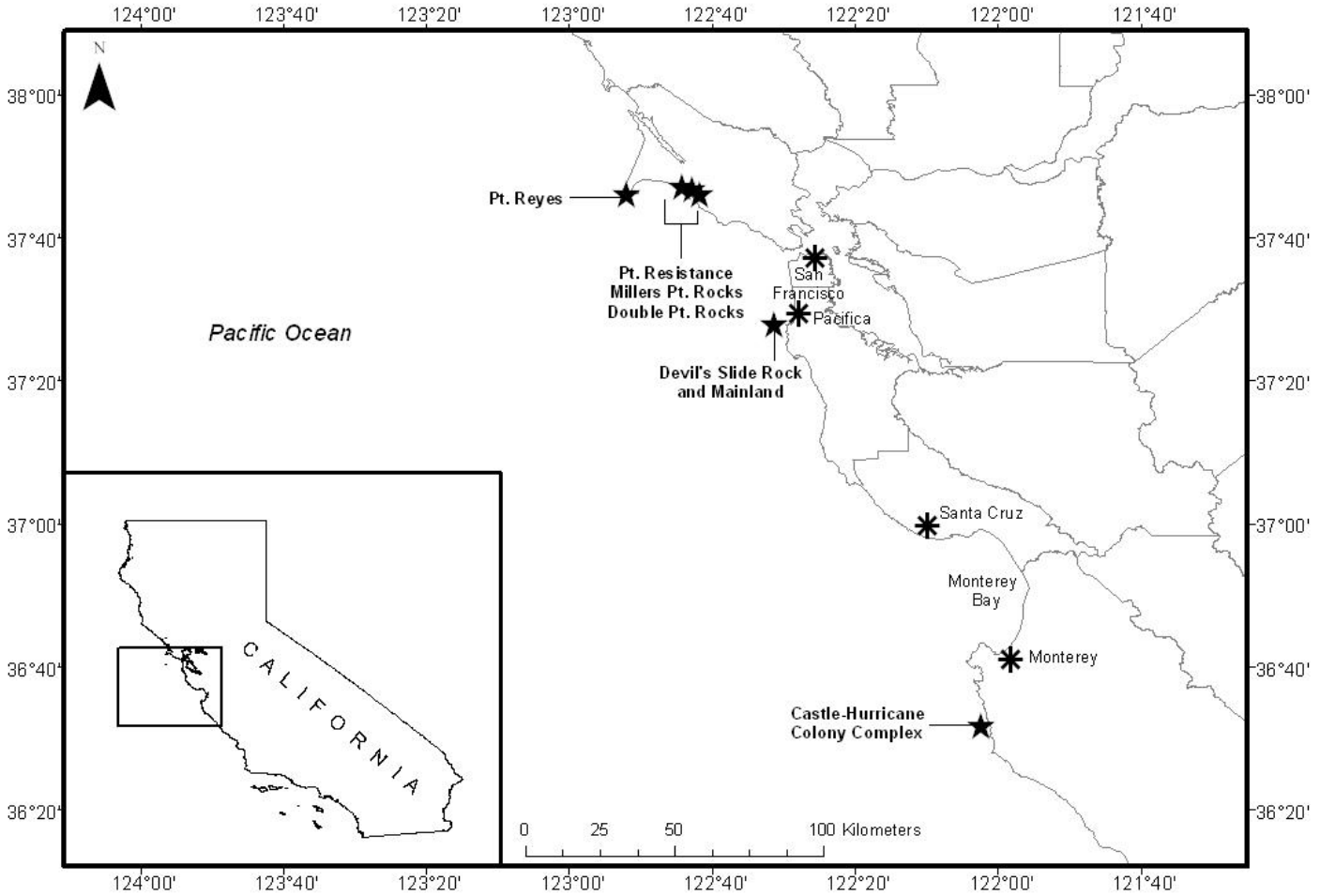

Figure 1. Study area, with locations of study colonies or colony complexes along the Central California coast where seabird disturbance, attendance and breeding biology are monitored.

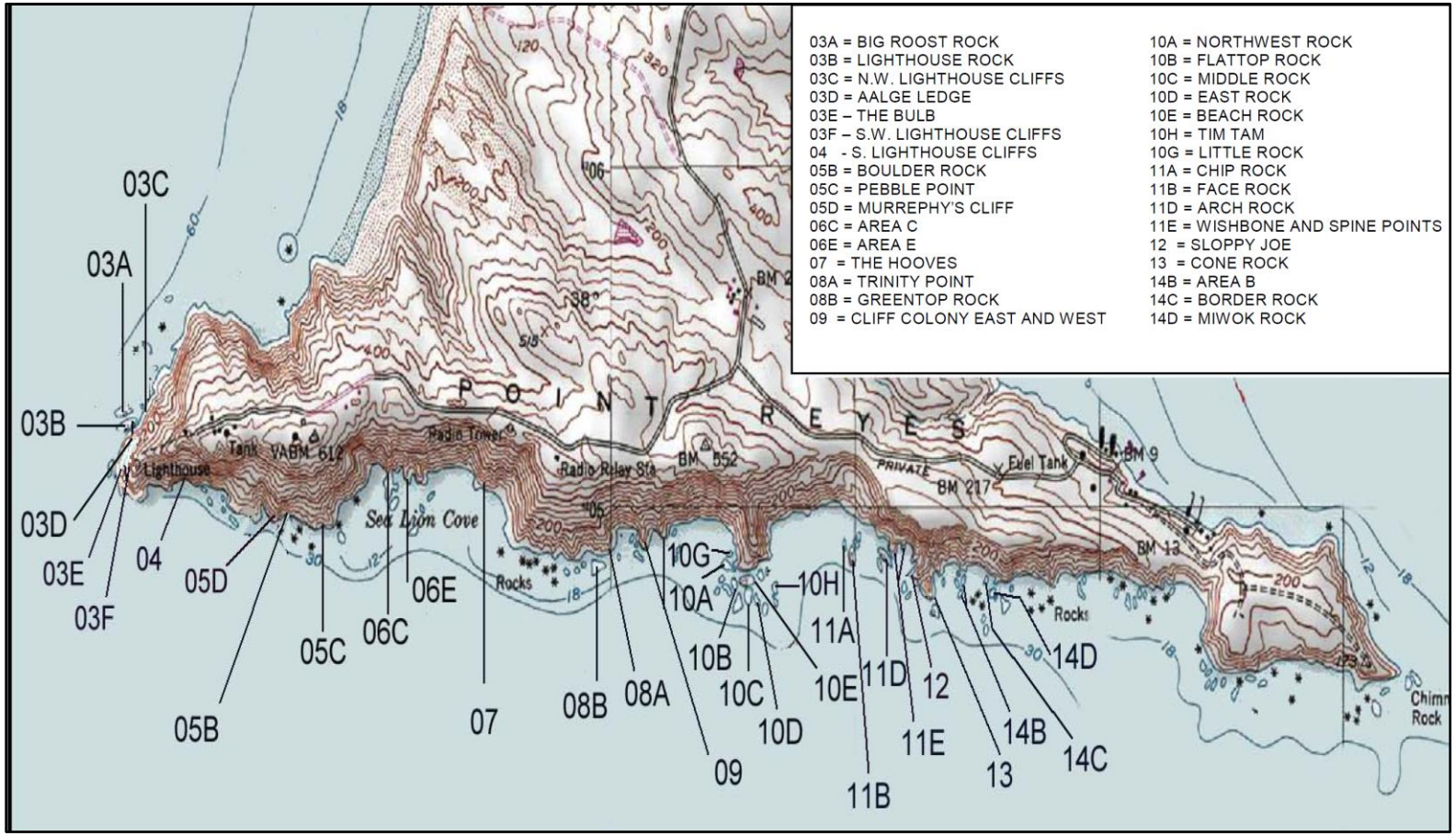

Figure 2. Point Reyes, including subcolonies 03A through 14D.

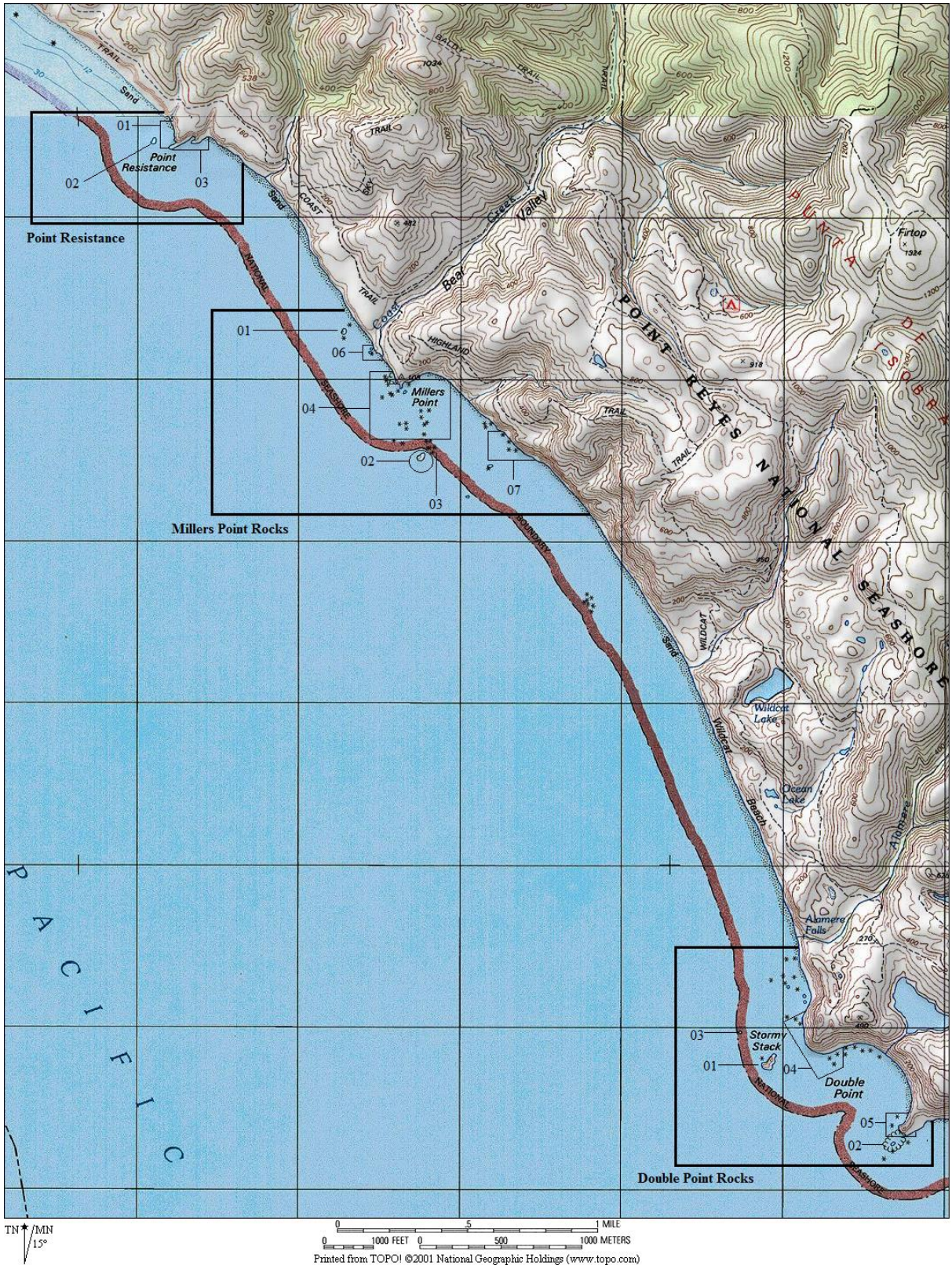

Figure 3. Drakes Bay Colony Complex, including Point Resistance, Millers Point Rocks and Double Point Rocks colonies and subcolonies.

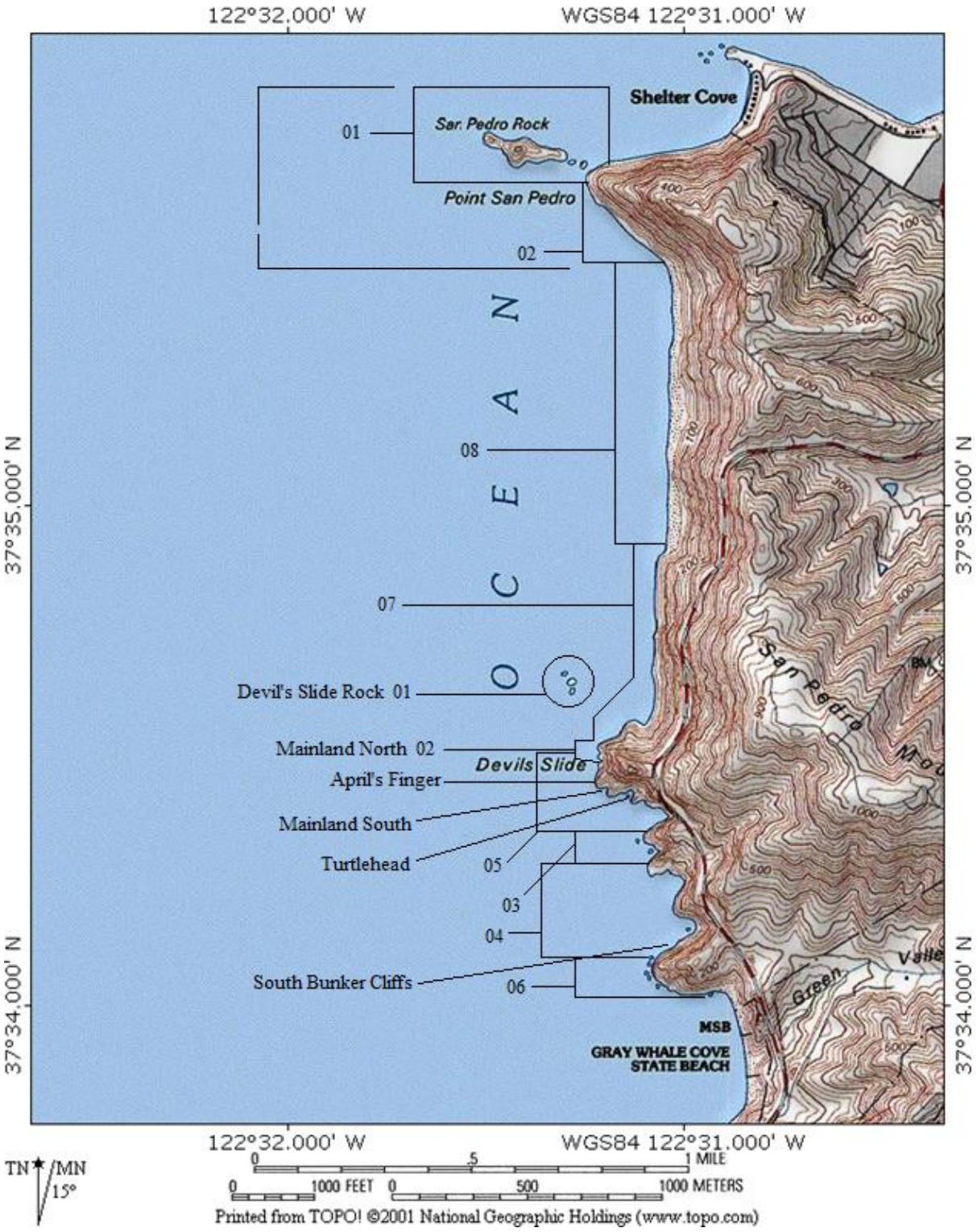

Figure 4. Devil's Slide Colony Complex, including San Pedro Rock and Devil's Slide Rock & Mainland colonies and subcolonies.

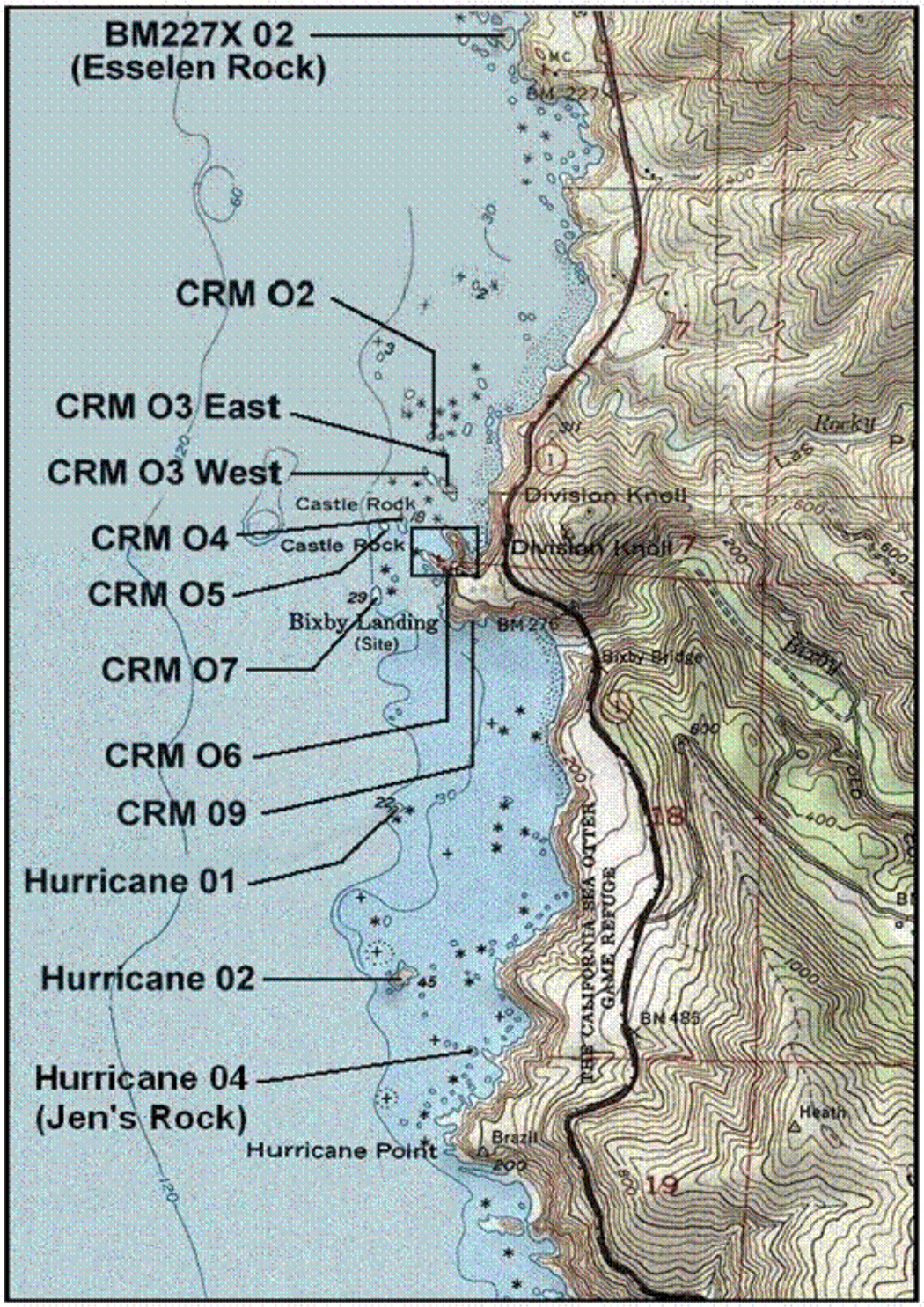

Figure 5. Castle-Hurricane Colony Complex, including Bench Mark-227X (BM227X), Castle Rocks and Mainland (CRM), and Hurricane Point Rocks (Hurricane) colonies and subcolonies.

Figure 6. Aerial photograph of Devil's Slide Rock, 3 June 2013, showing the distribution of the Common Murre and Brandt's Cormorant breeding colony and boundaries of murre productivity plots.

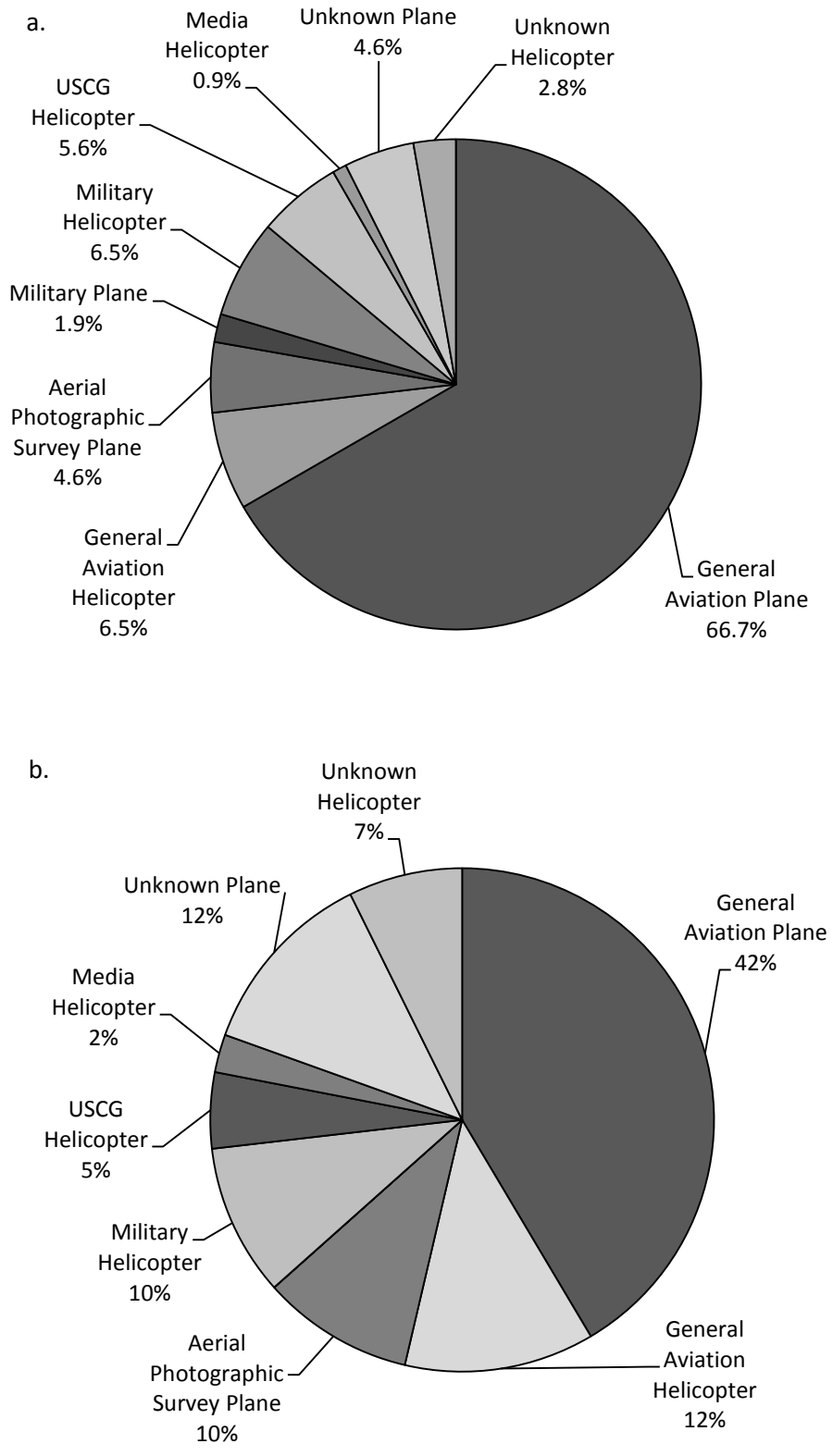

Figure 7. a) Aircraft detections (n = 108) and b) aircraft disturbances (n = 41) at Point Reyes, Drakes Bay, Devil's Slide Rock and Mainland and Castle-Hurricane Colony Complex combined, in 2013, categorized by type.

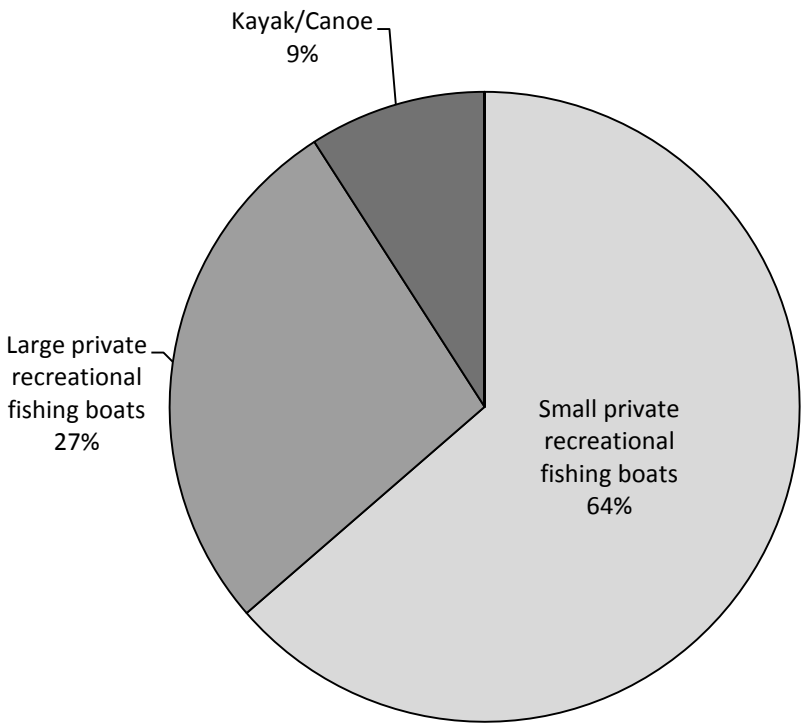

Figure 8. Watercraft detections (n = 11) in 2013 at Point Reyes Headlands, Drakes Bay, Devil's Slide Rock and Mainland, and Castle-Hurricane Colony Complex combined, categorized by type. Watercraft disturbance events were not observed in 2013.

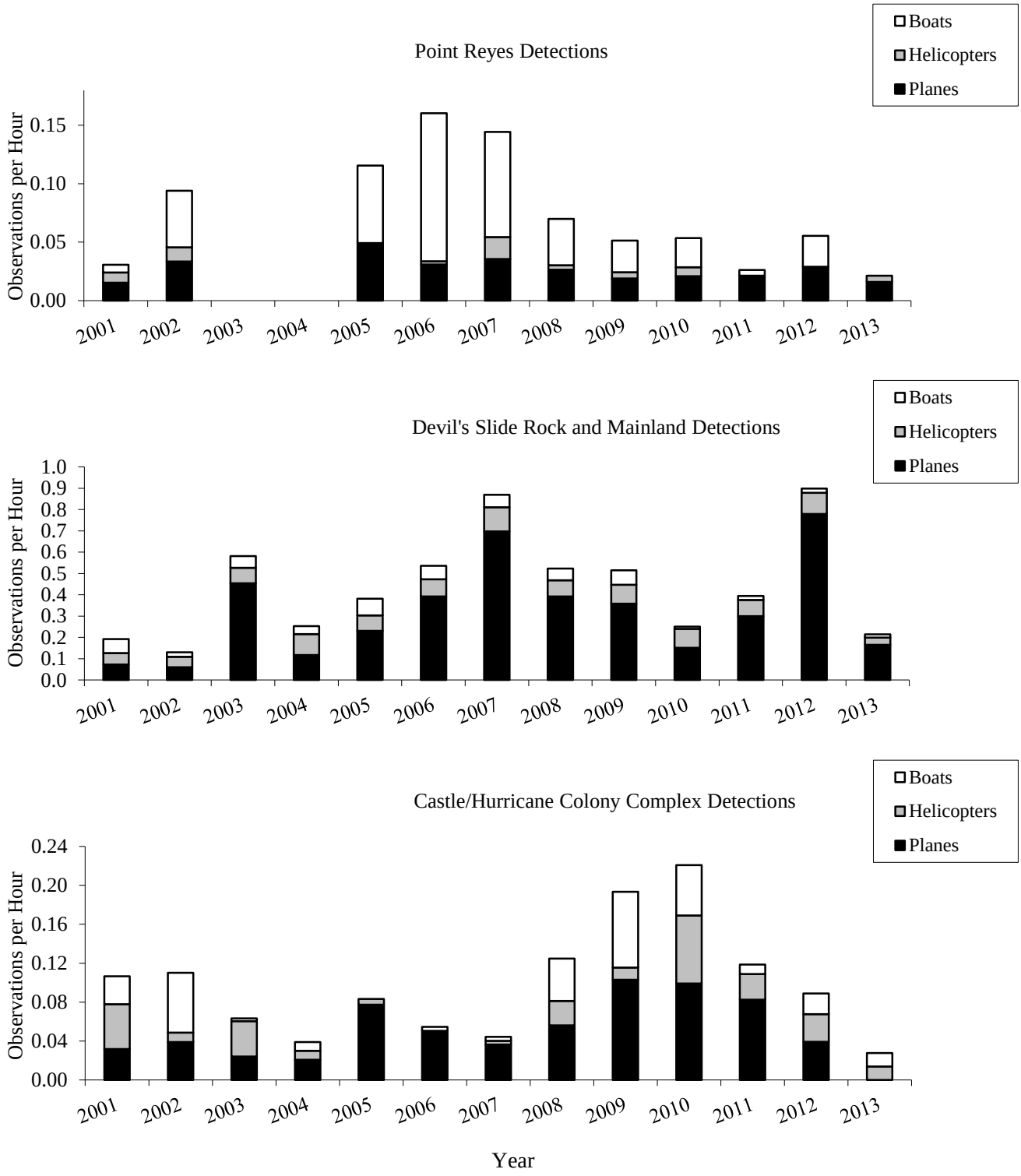

Figure 9. Detection rates (number of detections per observation hour) of boats, helicopters and planes at Point Reyes, Devil's Slide Rock and Mainland, and Castle-Hurricane Colony Complex, 2001 to 2013.

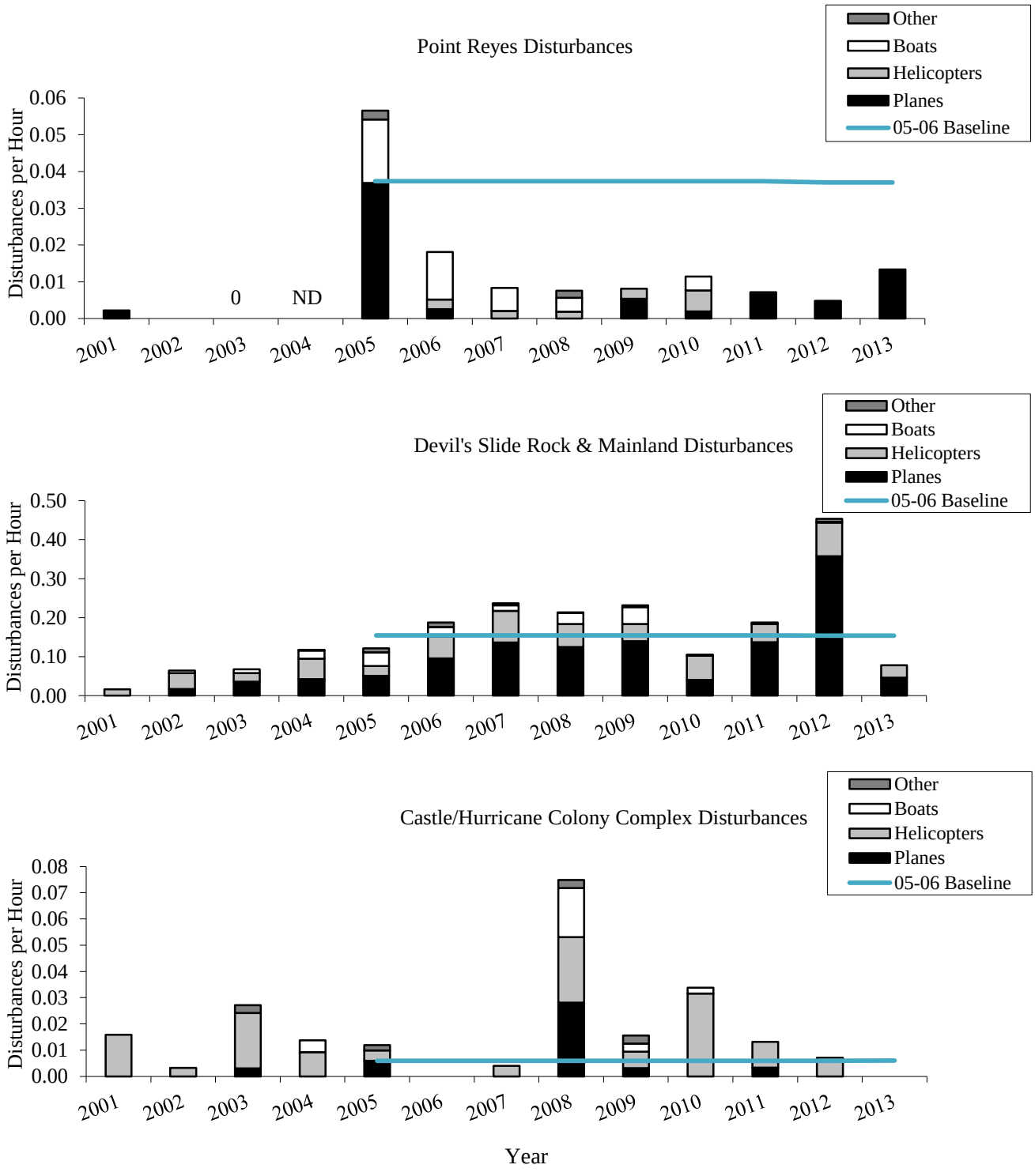

Figure 10. Disturbance rates (number of seabird disturbances per observation hour) from boats, helicopters, planes, and other anthropogenic sources at Point Reyes, Devil's Slide Rock and Mainland and Castle-Hurricane Colony Complex from 2001 to 2013. The horizontal line indicates the baseline mean disturbance rate from 2005 to 2006.

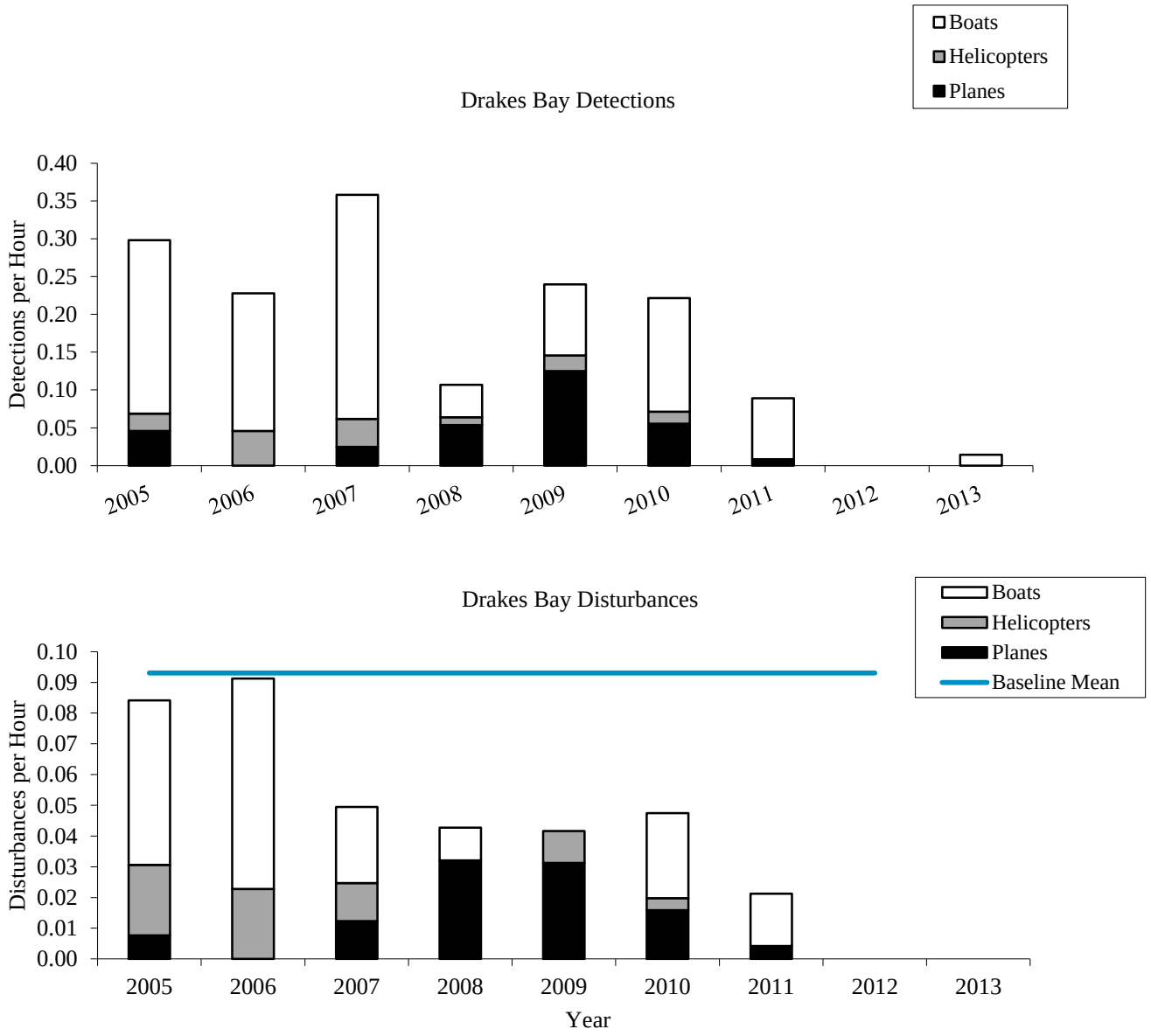

Figure 11. Detection and disturbance rates of boats, helicopters, and planes at Drakes Bay Colony Complex from 2005 to 2013. The horizontal line indicates the baseline mean disturbance rate from 2005 to 2006.

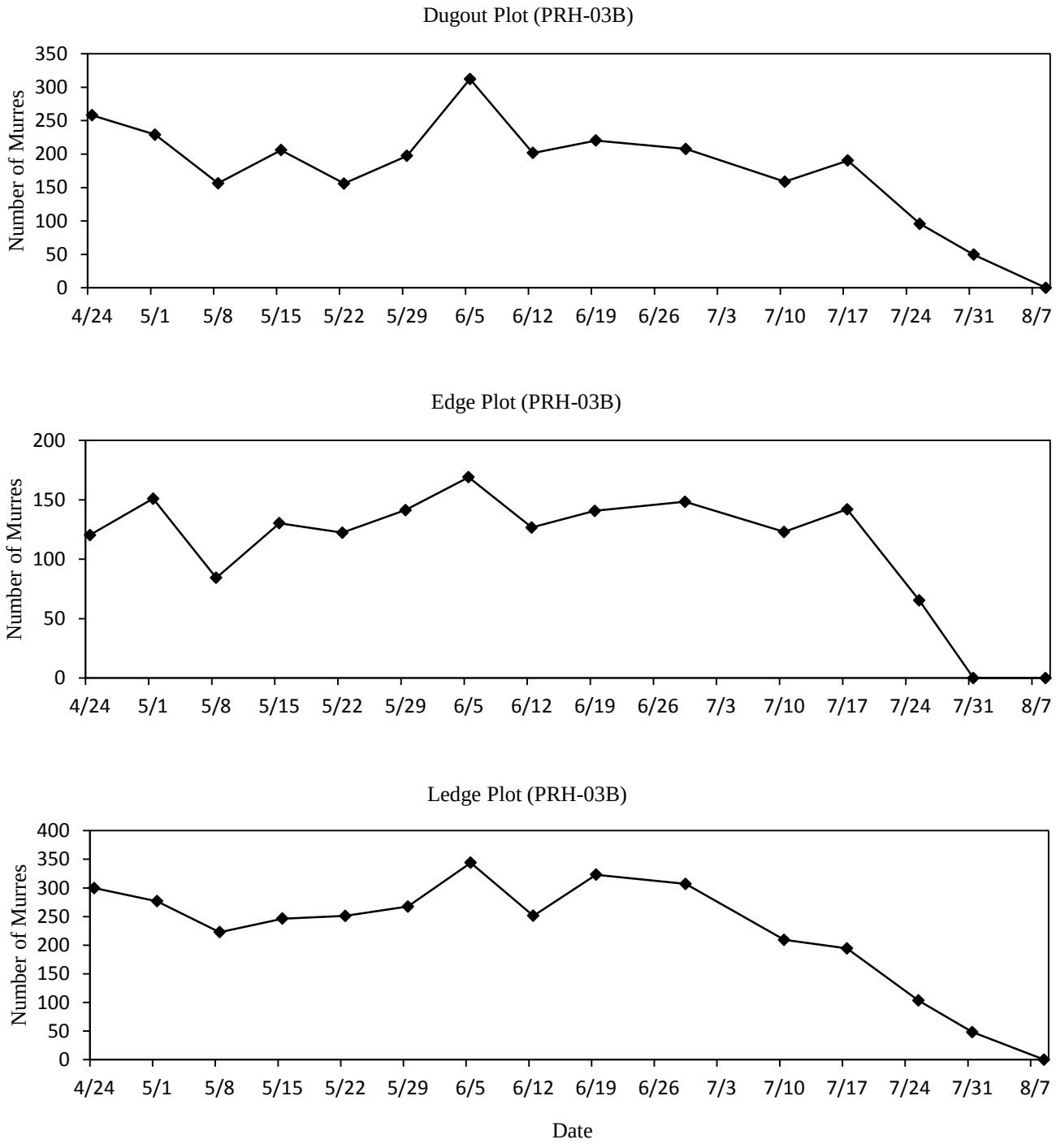

Figure 12. Seasonal attendance of Common Murres at Dugout, Edge and Ledge plots, Point Reyes Headlands, 22 April to 7 August 2013.

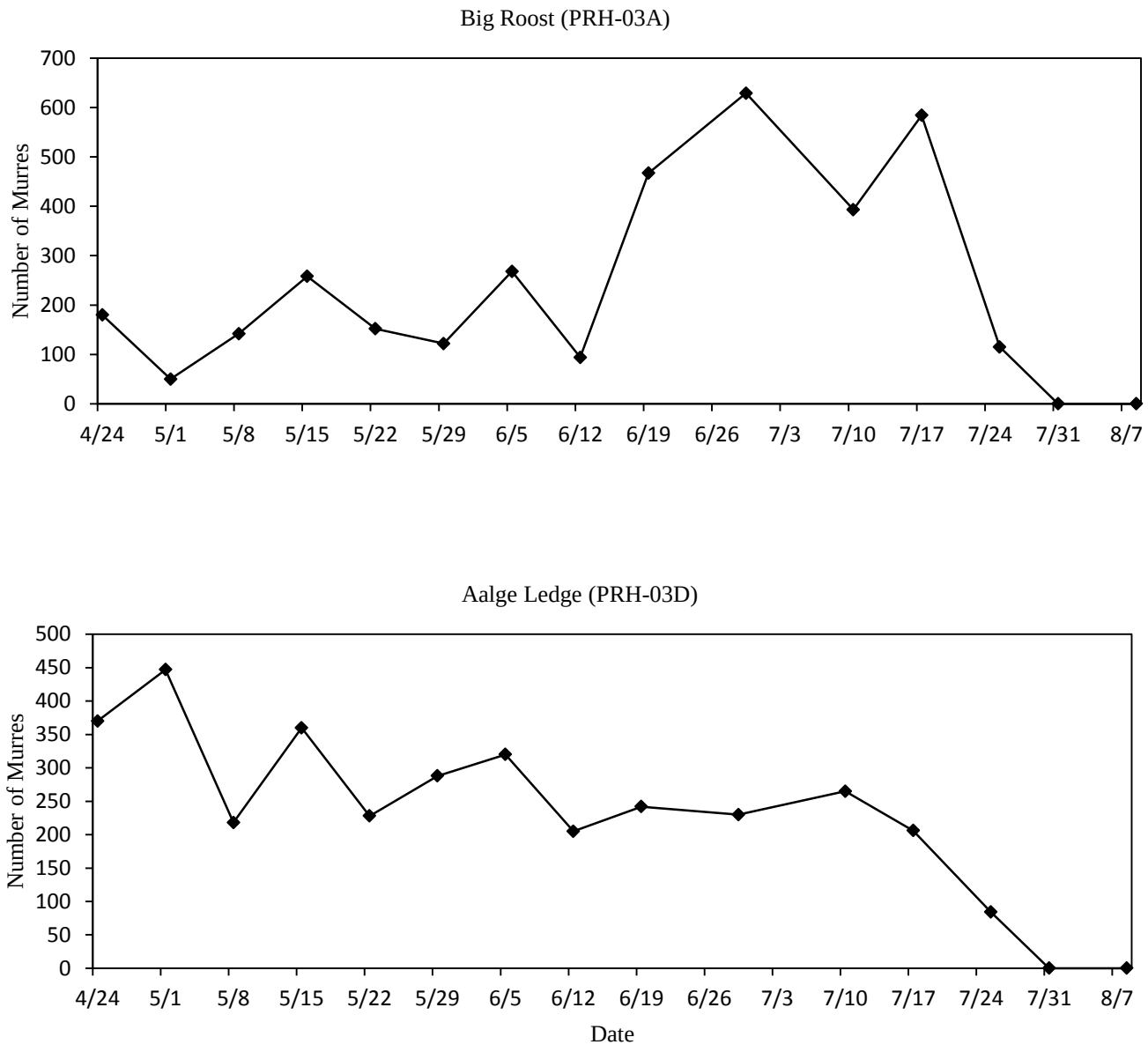

Figure 13. Seasonal attendance of Common Murres at Big Roost Rock and Aalge Ledge, Point Reyes Headlands, 22 April to 7 August 2013.

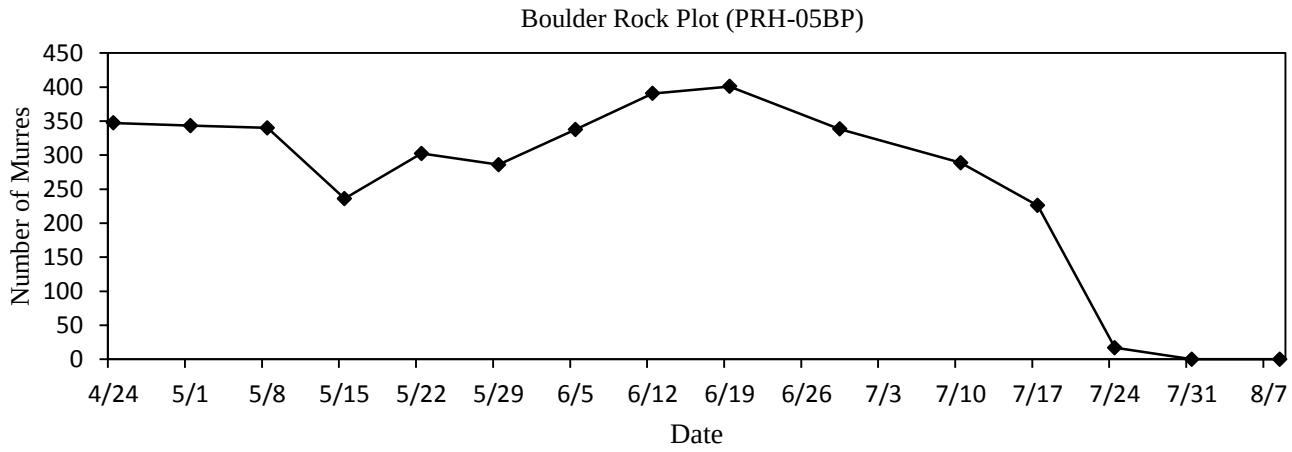

Figure 14. Seasonal attendance of Common Murres at Boulder Rock plot, Point Reyes Headlands, 22 April to 7 August 2013.

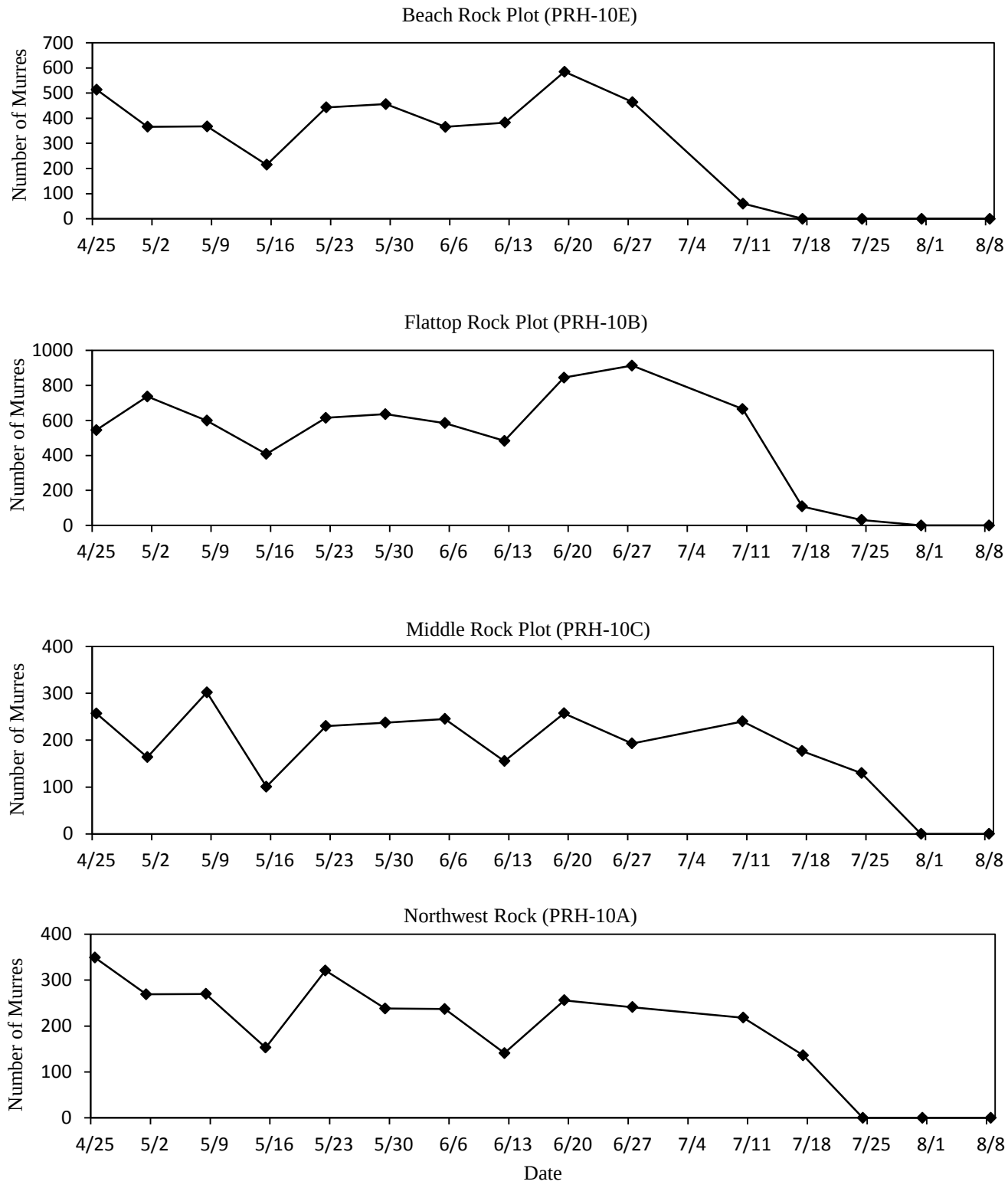

Figure 15. Seasonal attendance of Common Murres (Beach, Flattop, Middle, and Northwest rocks), Point Reyes Headlands, 22 April to 7 August 2013.

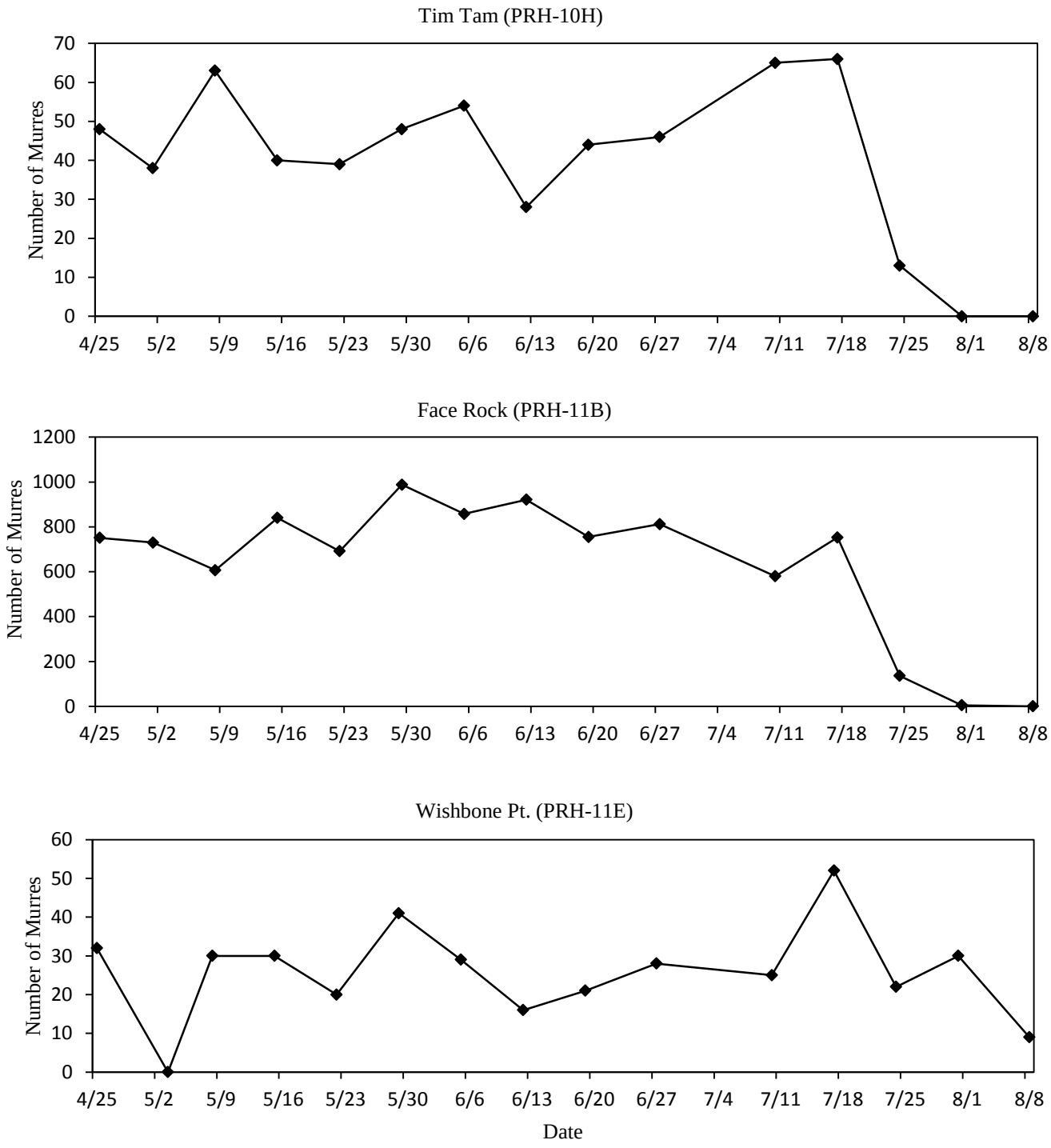

Figure 16. Seasonal attendance of Common Murres at Tim Tam, Face Rock and Wishbone Point, Point Reyes Headlands, 22 April to 7 August 2013.

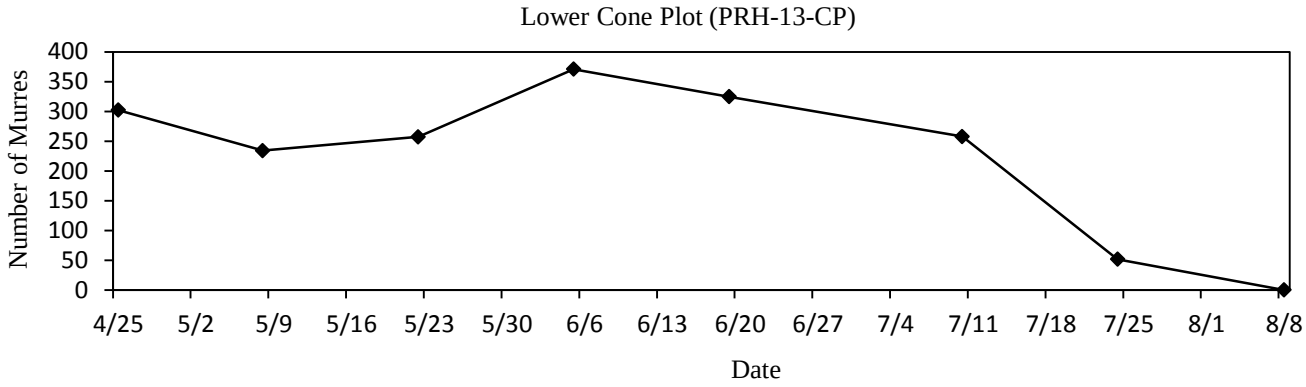

Figure 17. Seasonal attendance of Common Murres at Lower Cone Plot, Point Reyes Headlands, 22 April to 7 August 2013.

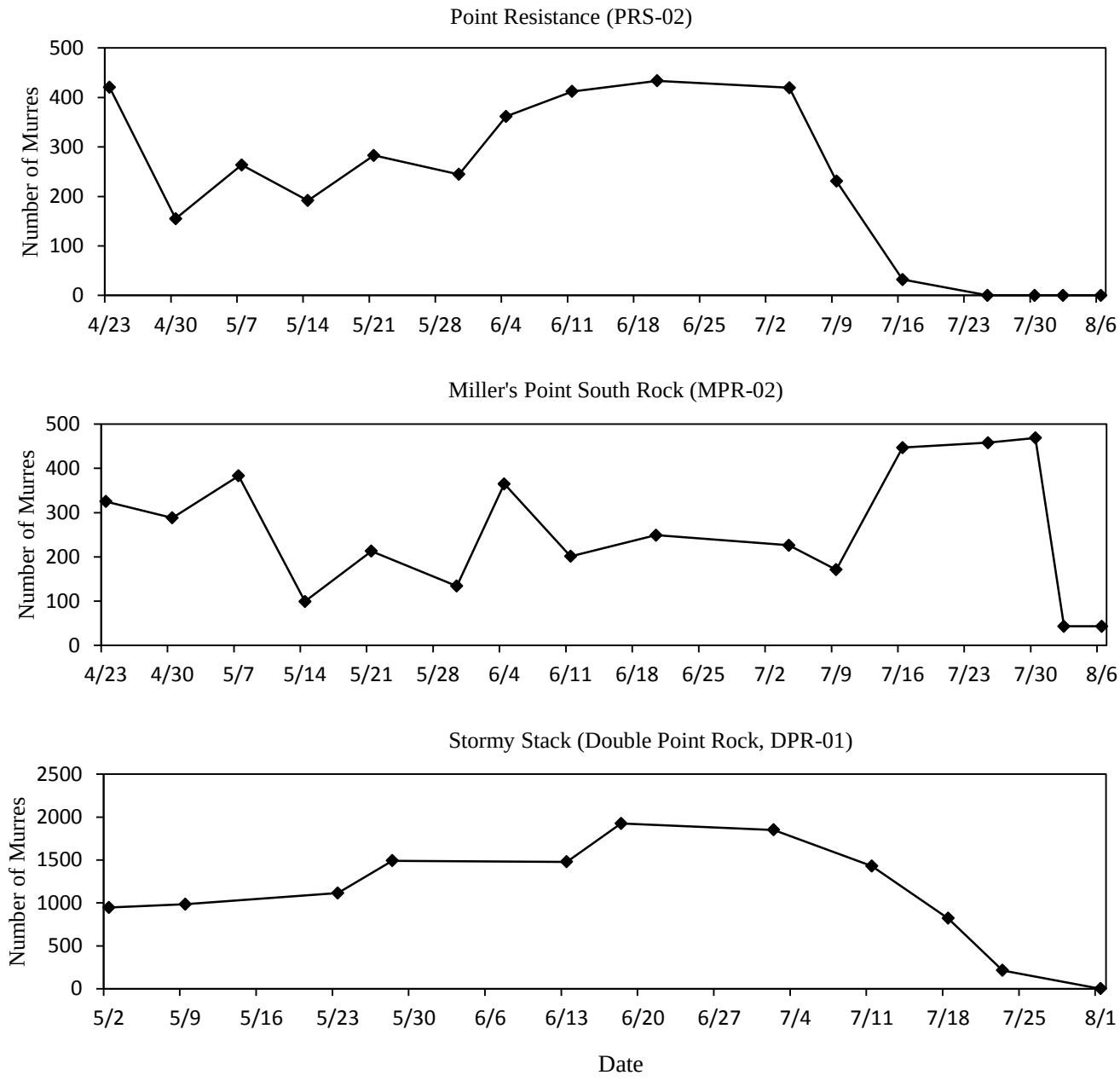

Figure 18. Seasonal attendance of Common Murres at Point Resistance, Millers Point South Rock, and Stormy Stack (Double Point Rocks), 23 April to 6 August 2013.

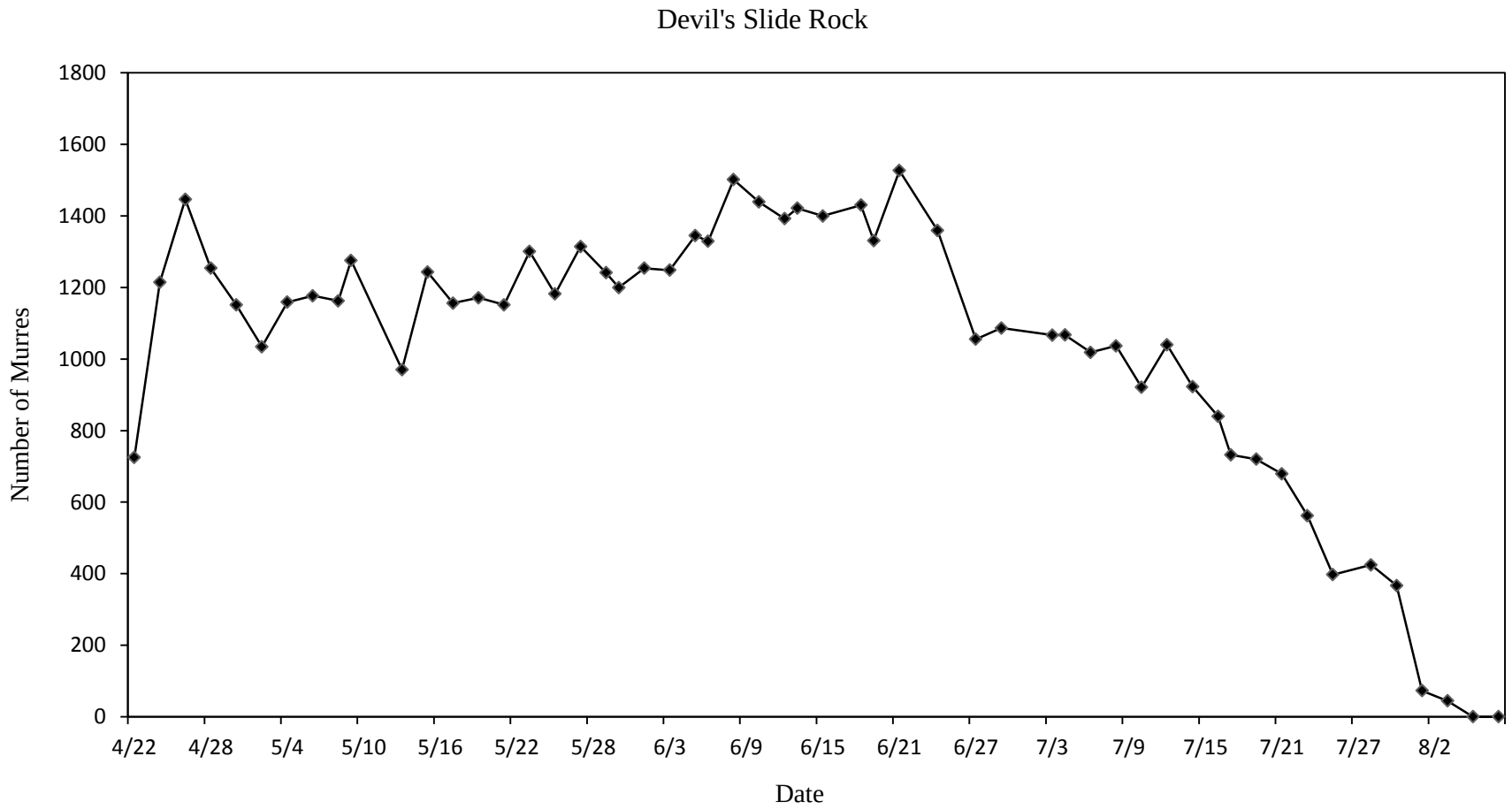

Figure 19. Seasonal attendance of Common Murres at Devil's Slide Rock, 22 April 2013 to 7 August 2013.

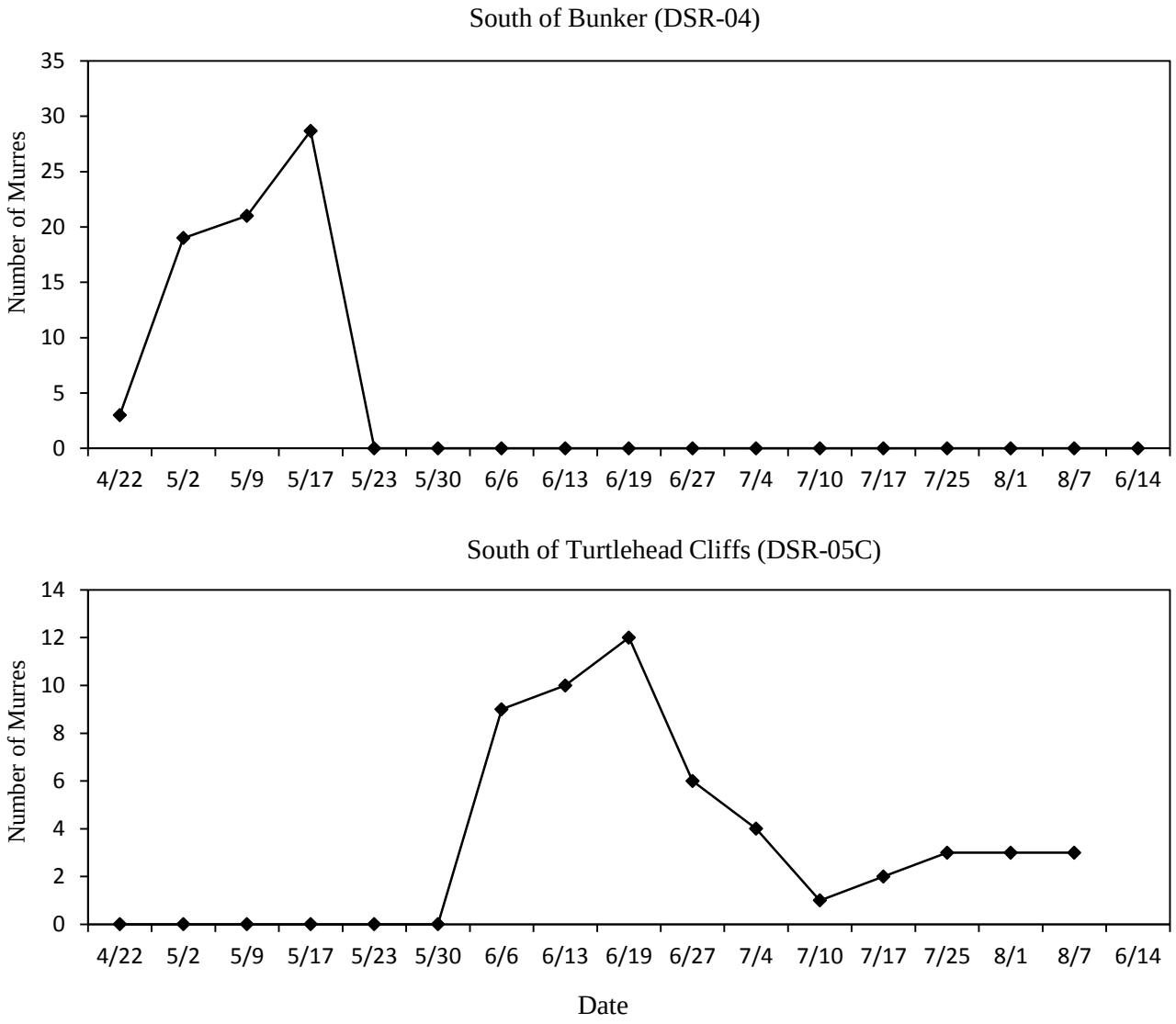

Figure 20. Seasonal attendance of Common Murres at South Bunker (DSR-04), and South of Turtlehead Cliffs (DSR-05C), Devil's Slide Rock and Mainland, 22 April to 14 June.

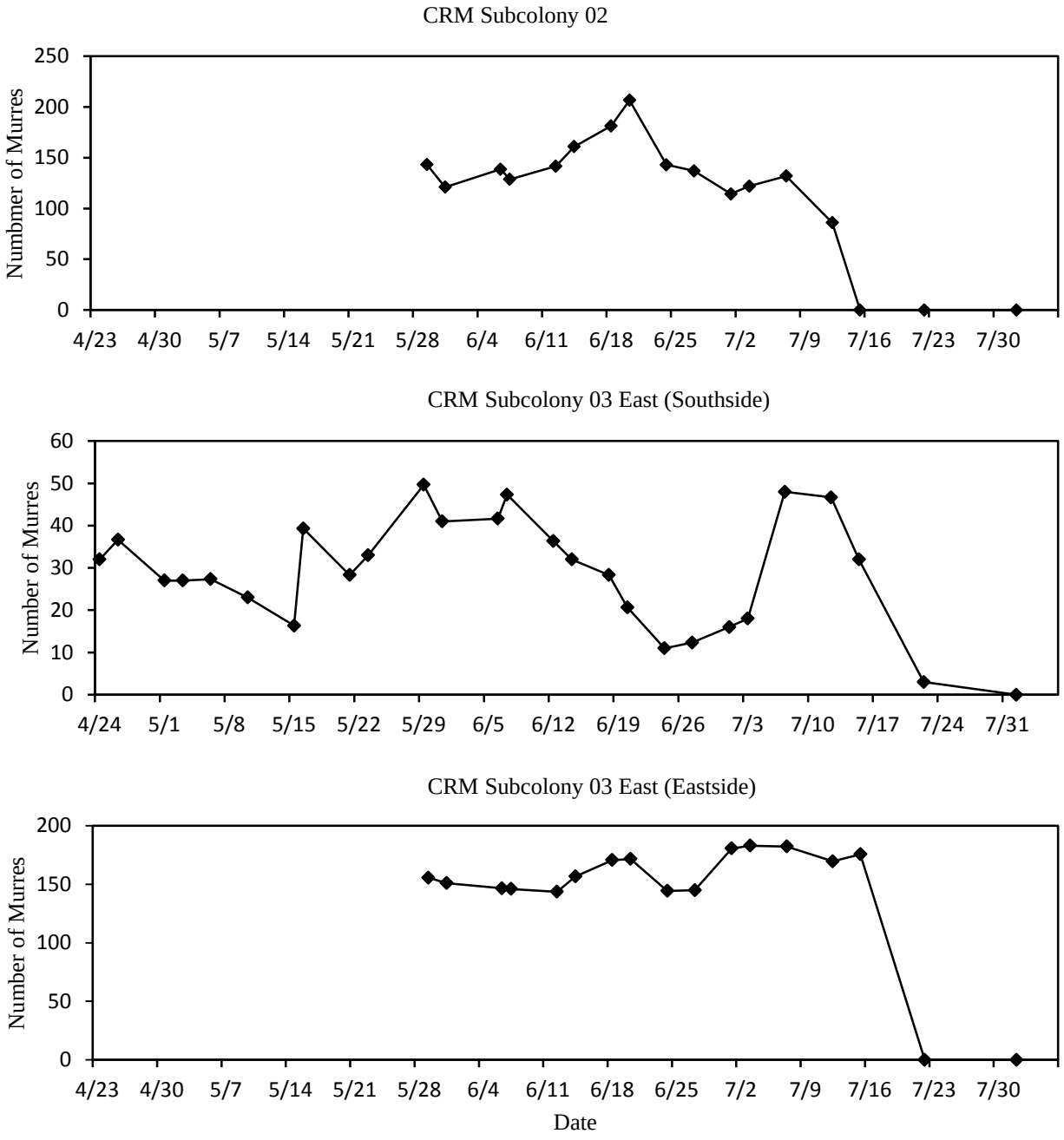

Figure 21. Seasonal attendance of Common Murres at subcolonies 02, 03 East (Southside) and 03 East (Eastside), Castle-Hurricane Colony Complex, 23 April to 31 July 2013.

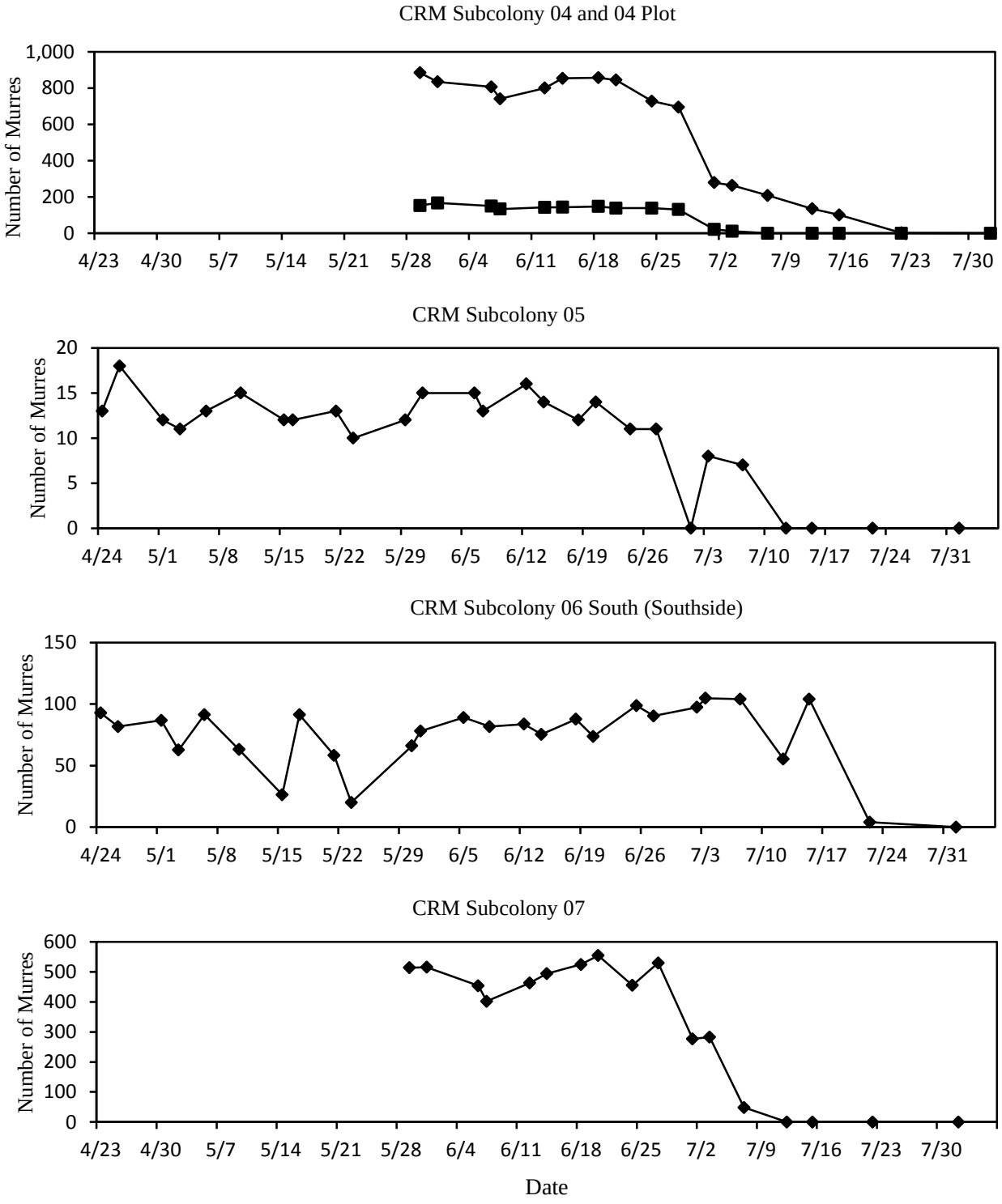

Figure 22. Seasonal attendance of Common Murres at subcolonies 04 and 04 Plot, 05, 06, and 07 Castle-Hurricane Colony Complex, 23 April to 31 July 2013.

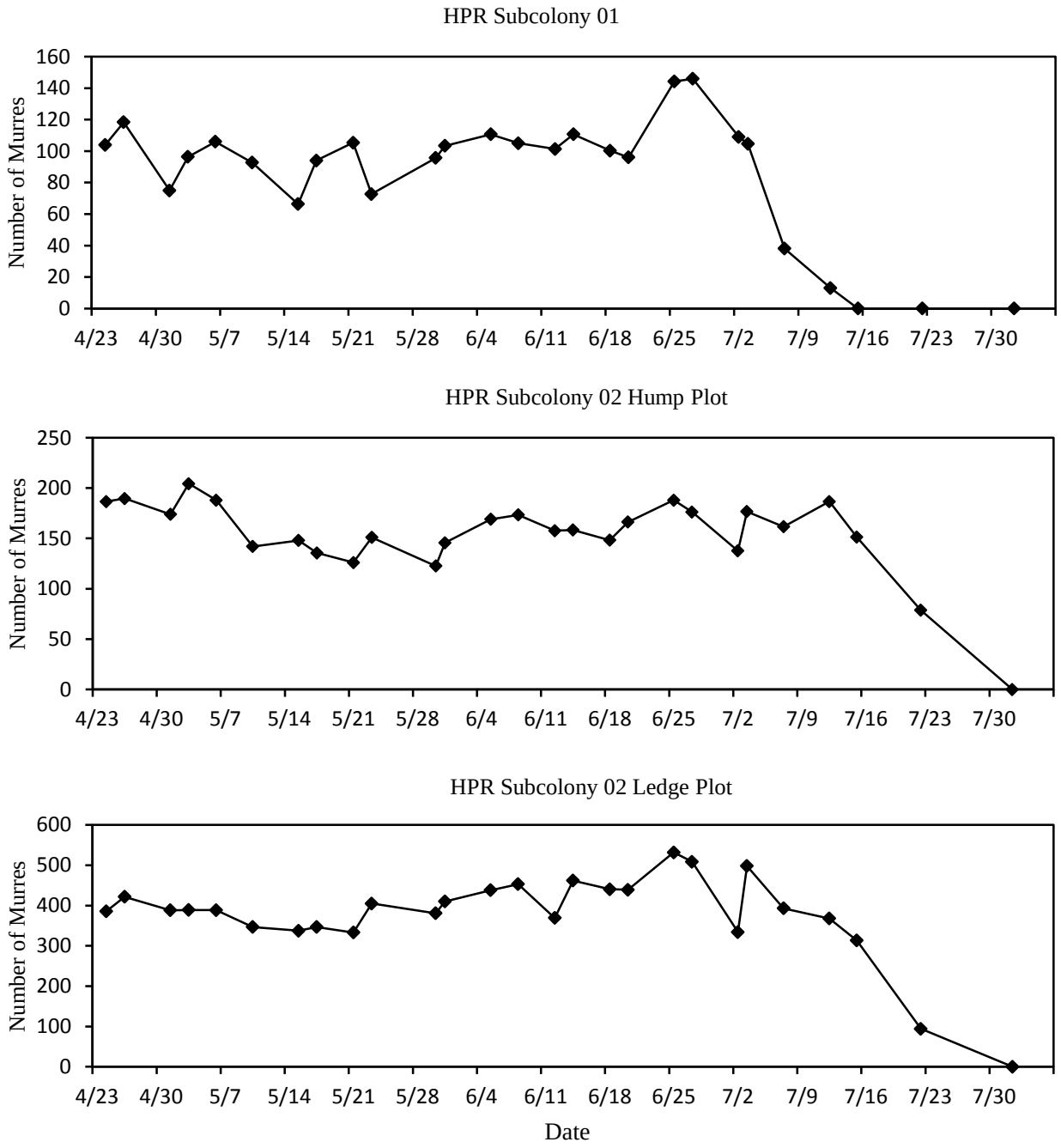

Figure 23. Seasonal attendance of Common Murres at Hurricane Point Rocks subcolonies 01, 02 Hump Plot and 02 Ledge Plot, Castle-Hurricane Colony Complex, 23 April to 31 July 2013.

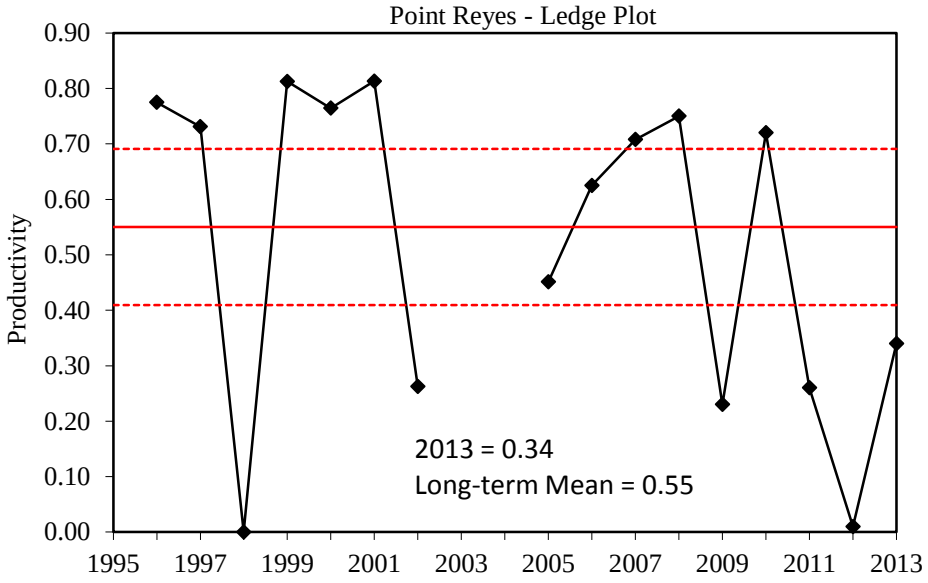

Figure 24. Productivity (chicks fledged per pair) of Common Murres at Point Reyes (Ledge and Edge plots), Devil's Slide Rock, and Castle Rock 04 plot, 1996-2013. The solid horizontal line indicates the long-term weighted mean and the dashed lines represent the 95% confidence interval.

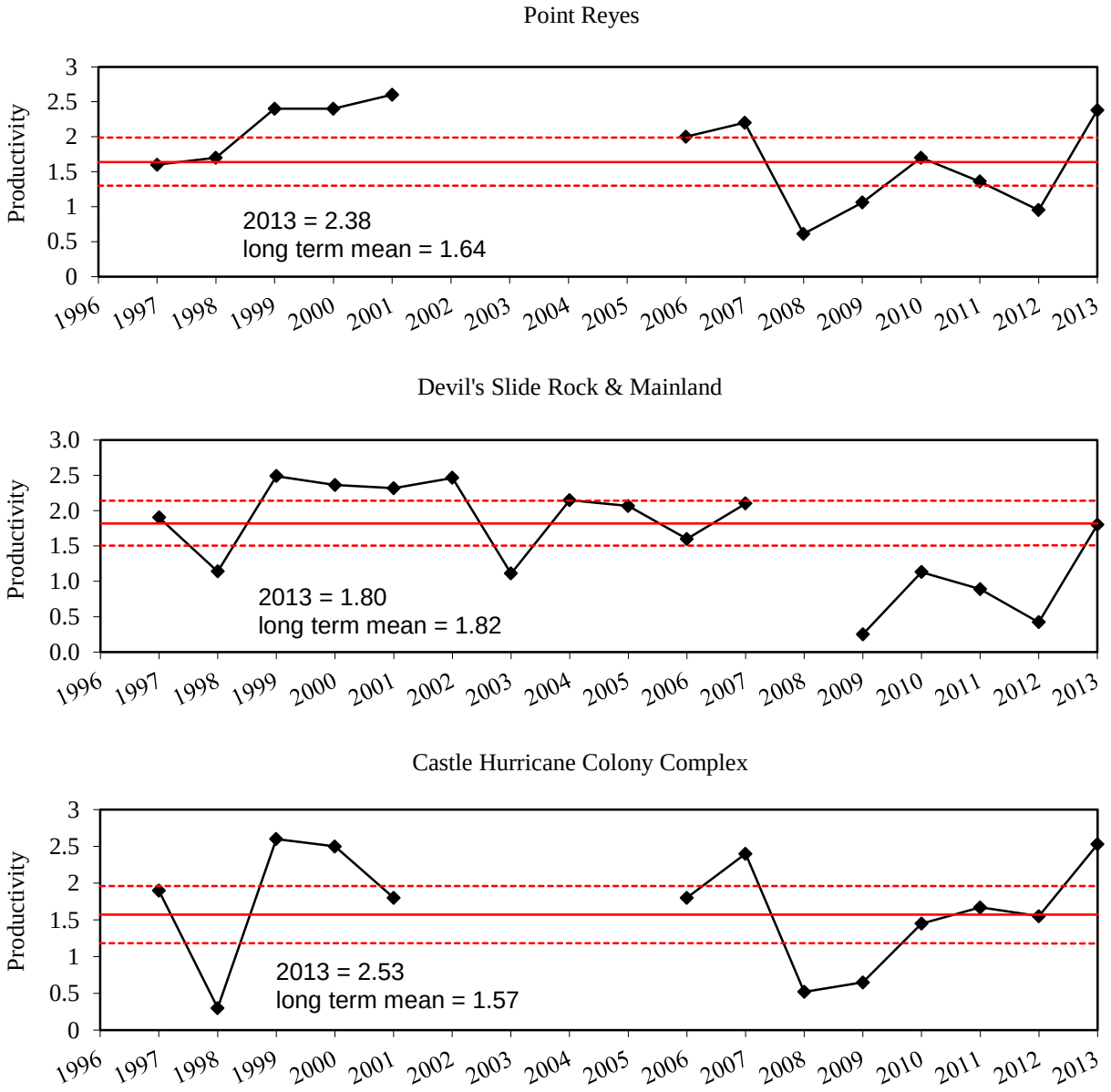

Figure 25. Productivity (chicks fledged per pair) of Brandt's Cormorants at Point Reyes, Devil's Slide Rock & Mainland, and Castle-Hurricane Colony Complex, 1996-2013. The solid horizontal line indicates the long-term weighted mean and the dashed lines represent the 95% confidence interval.

Appendix 1. Number of aircraft overflights detected categorized by type and resulting disturbance events recorded at Point Reyes, Devil's Slide Rock and Mainland, and Castle-Hurricane Colony Complex in 2013.

Aircraft Type	Total Detections		Number of Agitation Events		Number of Displacement Events		Number of Flushing Events		Total Disturbance Events	
	Plane	Helicopter	Plane	Helicopter	Plane	Helicopter	Plane	Helicopter	Plane	Helicopter
Point Reyes										
Aerial Photographic Survey Plane	5	0	4	0	0	0	0	0	4	0
USCG	0	4	0	0	0	0	0	0	0	0
General Aviation	1	0	0	0	0	0	0	0	0	0
Devil's Slide Rock and Mainland										
Media	0	1	0	1	0	0	0	0	0	1
USCG	0	3	0	2	0	0	0	0	0	2
Military	2	4	0	2	0	0	0	2	0	4
General Aviation	71	5	17	5	0	0	0	0	17	5
Unknown	5	3	5	1	0	0	0	2	5	3
Castle-Hurricane Colony Complex										
USCG	0	1	0	0	0	0	0	0	0	0
Military	0	1	0	0	0	0	0	0	0	0
General Aviation	0	2	0	0	0	0	0	0	0	0

Appendix 2. Number of watercraft detected categorized by type and resulting disturbance events recorded at Point Reyes, Millers Point Rocks, Devil's Slide Rock and Mainland, and Castle-Hurricane Colony Complex, 2013. Watercraft disturbances were not observed in 2014.

Watercraft Type	Total Detections
Point Reyes	0
Millers Point Rocks	
Recreational (<25') Small Private	1
Devil's Slide Rock and Mainland	
Recreational (<25') Small Private	3
Recreational (>25') Large Private	2
Kayak/Canoe	1
Charter	1
Castle-Hurricane Colony Complex	
Recreational (<25') Small Private	4