BREEDING POPULATION TRENDS OF BRANDT'S AND DOUBLE-CRESTED CORMORANTS, POINT SUR TO POINT MUGU, CALIFORNIA, 1979-2011

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EXECUTIVE SUMMARY

We examined breeding population trends of Brandt's Cormorants (*Phalacrocorax penicillatus*) and Double-crested Cormorants (*P. auritus*) along the south-central California coast from Point Sur to Point Mugu for the 1979-2011 period, based almost entirely on aerial photographic survey data. This study included: 1) conducting aerial photographic surveys in 2010-2011 and determining whole-colony counts of nests, sites and birds from the photographs; 2) determining whole-colony counts from annual, archived, aerial photographs for the 1996-2009 period; and 3) collation of past published and unpublished data since 1979. Data for the entire 1979-2011 period were summarized, and statistical trends were determined for Brandt's Cormorant breeding populations for the 1989-2011 period. Results of this study will assist: (1) the Bureau of Land Management and other coastal partners within the Point Sur to Point Mugu Seabird Protection Network region to implement a seabird colony enhancement program as described within the Torch/Platform Irene Oil Spill Restoration Plan; and (2) larger-scale management and monitoring of seabirds in California.

For Brandt's Cormorants, total numbers of nests for the Point Sur-Point Mugu region varied annually but were higher in 1989 compared to 1979-80, and increased by 4.5% per annum in 1989-2011. Population increase in 1989-2011 mostly occurred south of Piedras Blancas Island (9.9% per annum), with no trend detected for the Point Sur-Piedras Blancas Island subregion. South of Piedras Blancas Island, geographic expansion of breeding colonies began in the mid 1990s and most population size increase occurred in the 2000s. In 1979-2011, the peak annual nest count for the entire region was 7,281 nests (14,562 breeding birds) in 2006. Annual counts were lower during strong El Niño conditions in 1993 and 1998, and during moderate El Niño conditions in 2003. In 2008, breeding populations also were much lower throughout the region (and elsewhere in California) despite La Niña conditions. The largest breeding colonies were Piedras Blancas Island, Morro Rock and Pillar Rock, and Cape San Martin. The largest colony complexes were Partington Ridge North-Buck Creek and Point Buchon-North Pismo Beach Rocks.

For Double-crested Cormorants, total numbers of nests for the Point Sur-Point Mugu region increased from just three nests in 1979-80 to 164 nests in 1989, and increased further to a high count of more than 745 nests in 2009. Most nesting occurred in trees on the mainland. Fairbank Point (in Morro Bay State Park) was the most significant colony, based on its large size (> 400 pairs) and consistent use since at least 1989. The Shell Beach Rocks colony, located on private land, formed by 2000 and grew to about 300 pairs, but was abandoned in 2011 due to hazing and tree removal by homeowners. Two other small colonies in trees have recently formed in Santa Barbara County. Among coastal cliffs, only Rockland Landing North and Morro Rock had annual nesting, but only by small numbers.

In addition to loss of the Double-crested Cormorant colony at Shell Beach Rocks, potential human disturbance, based on patterns of nest abandonments seen in aerial photographs, was noted at three Brandt's Cormorant colonies along the Big Sur Coast: Plaskett Rock, Seastack South of Redwood Gulch, and Ragged Point Lodge Colony. Much interannual variation of breeding locations of Brandt's Cormorant colonies further suggests disturbance factors may be affecting nesting cormorants within the study area, but more study with ground-based surveys is

needed. Potential human disturbance to roosting cormorants by a sea kayaker was noted at Shell Beach Rocks in 2011, but such forms of disturbance may also limit nesting by cormorants and other seabirds.

Roosting Brown Pelicans (*Pelecanus occidentalis*) also were photographed when they occurred within or adjacent to cormorant colonies. The largest roost was at Morro Rock (1,214 birds) on 31 May 2007. Eighteen other sites had at least one count in May-June greater than 100 pelicans, including Shell Beach Rocks, which had previously been identified as among the most important pelican roost sites in central California and subject to high rates of disturbance by sea kayakers.

INTRODUCTION

The south-central California coast from Point Sur (36.3º N; 121.9º W) to Point Mugu (34.1º N; 119.1º W) has several significant seabird colonies and roost sites (Sowls et al. 1980, Carter et al. 1992, 1998). The Torch/Platform Irene Final Restoration Plan and Environmental Assessment selected reduction of human disturbance to seabird breeding colonies and roost sites in this region as a restoration action to compensate for natural resource losses resulting from the 1997 Torch/Platform Irene Oil Spill (Torch/Platform Irene Trustee Council 2007). Focal seabird species of the restoration plan include Brown Pelican (*Pelecanus occidentalis*), Brandt's Cormorant (*Phalacrocorax penicillatus*), Pelagic Cormorant (*P. pelagicus*), Black Oystercatcher (*Haematopus bachmani*), and Western Gull (*Larus occidentalis*). Ground-based surveys of seabird breeding colonies and roost sites will aim to detect human disturbance rates and shape outreach and enforcement efforts to reduce disturbance. Results of aerial photographic surveys in 1979-1995 had indicated human disturbance may have been affecting distribution and population sizes of seabird colonies in parts of this region (Carter et al. 1998). Impacts of human disturbance to breeding and roosting seabirds can include reduced reproductive success, colony abandonment, and increased energy expenditure (e.g., McChesney 1997; Carney and Sydeman 1999; Jaques and Strong 2002; Rojek et al. 2007).

Aerial photographic surveys have been used to estimate breeding population sizes of Brandt's Cormorants, Double-crested Cormorants (*P. auritus*), and Common Murres (*Uria aalge*) throughout coastal California since the mid to late 1970s (e.g., Sowls et al. 1980; Takekawa et al. 1990; Carter et al. 1992, 1995, 1996, 1998, 2000, 2001, 2003; McChesney 1997; McChesney et al. 1998a; 2001; Capitolo et al. 2004, 2006, 2008a, 2010; USFWS, unpubl. data). Carter et al. (1996) indicated that aerial surveys are recommended for monitoring these surface-nesting species because: 1) they provide coverage of extensive portions of breeding ranges; 2) colonies are easily detected from aircraft and readily photographed completely; 3) timing of breeding is fairly synchronized within and between most colonies and occurs at a standard time of the year; and 4) single surveys often can detect a large proportion of active nests for that year and serve as a relative index of annual colony and population size. Within the Point Sur-Point Mugu region, Brandt's and Double-crested Cormorant breeding colonies are widely distributed, but no Common Murre breeding colonies have ever been documented.

For the other focal seabird species of the Torch/Platform Irene Restoration Plan, Brown Pelican and Western Gull breeding colonies also can be surveyed with aerial photographic surveys, but require additional focused effort. The wide range of timing of breeding within Brown Pelican colonies in a survey year and often major differences in timing of breeding between years typically prevents use of single annual counts for monitoring (F. Gress, pers. comm.). Western Gull breeding population sizes can be estimated with a single survey, but because breeding gulls are more widely distributed at lower densities than are cormorants and murres, extra survey effort is needed often to photograph all surface areas of islands where colonies occur (Capitolo et al. 2008b, 2009). Most breeding colonies of Pelagic Cormorants require boat- or land-based surveys for best viewing, though certain colonies can be surveyed well with aerial photographs. Black Oystercatchers are occasionally detected in aerial photographs but they often nest apart from other seabirds and their populations are not surveyed effectively with aerial surveys.

Aerial photographic survey data in California have been used to: 1) monitor population trends over time, including identification of major changes (Carter et al. 1996, 2001; Gibble et al. 2010; Thibault et al. 2010; Capitolo et al., in prep.; McChesney et al., in prep.); 2) assess restoration of Common Murre populations in central California (e.g., McChesney et al. 2007, in prep.); 3) identify population-level concerns and restoration opportunities, including for Common Murres (Takekawa et al. 1990; Carter et al. 1998, 2001; Parker et al. 2007; Thibault et al. 2010) and Brandt's Cormorants (Carter et al. 1998; Capitolo et al. 2008a); and 4) document colonies that would benefit from other special conservation actions, such as for the design of Marine Protected Areas (G.J. McChesney, unpubl. data). Furthermore, Brandt's Cormorants and Common Murres, in particular, are excellent indicator species of annual marine conditions, and for this purpose have been identified by the U.S. Fish and Wildlife Service (USFWS) as focal species for long-term annual monitoring with aerial surveys in Washington, Oregon, and California (M. Naughton and S.K. Nelson, unpubl. data). These colonial, surface-nesting species also are sensitive to human disturbance. Annual colony monitoring has been used by the U.S. Fish and Wildlife Service, as part of the Command and Luckenbach oil spill restoration plans, to detect and monitor potential disturbance impacts on the central California coast, in association with the Seabird Protection Network, which uses education to reduce such disturbances in this region.

However, analyses of aerial photographs have largely been limited to focal colonies and an annual, long-term program to determine annual counts for sample colonies throughout California has not been developed (see Carter et al. 1996). Photographs from many years for large regions of the state have not been analyzed, hindering efforts to understand seabird population trends and potential issues affecting them, including human disturbance. Thus, to assist implementation of a regional Seabird Protection Network in the Point Sur-Point Mugu region, USFWS, University of California (Santa Cruz; UCSC), and Humboldt State University (HSU) brought information on breeding cormorants up to date for the Point Sur-Point Mugu region by:

(1) conducting aerial photographic surveys in 2010 and 2011 in this region and analyzing colony photographs from those surveys;

(2) analyzing uncounted, archived, aerial photographs in this region for the 1996-2009 period; and

(3) collating past published and unpublished counts available for all or certain colonies in this region in 1979-1980, 1989, 1993-1995, 1999-2001, and 2003 (Sowls et al. 1980; Carter et al. 1992, 1996, 1998, unpubl. data; McChesney et al. 2001; Capitolo et al. 2004).

In this report, we summarize trends in the distributions and sizes of breeding populations of Brandt's and Double-crested Cormorants in 1979-2011 in the Point Sur-Point Mugu region. Information on roosting Brown Pelicans also is provided, especially for roost sites within or adjacent to known cormorant colonies, but not all roost sites were surveyed. We also describe direct or potential human disturbance detected from the surveys. The breeding colonies and geographic areas with largest population sizes are highlighted, as are those that potentially have had long-term impacts from natural and/or anthropogenic disturbance.

METHODS

1979-1995 Data

All seabird colonies in the Point Sur-Point Mugu region (Figs. 1, 2) were surveyed with aerial photographs, boat-based counts, and/or mainland-based ground counts in 1979-1980 as part of the California Seabird Colony Catalog (Sowls et al. 1980) and in 1989 as part of an update of the catalog (Carter et al. 1992). No surveys were conducted in 1981-1988. The next surveys of seabird colonies in the region were aerial photographic surveys in 1993-1995 (Carter et al. 1996). Surveys in 1993-1995 did not include the mainland coast south of Pecho Rock because of lack of known prior nesting by Brandt's or Double-crested Cormorants.

1996-2011 Data

Aerial Surveys

In 2010-2011, we aimed to photograph completely all breeding colonies of Brandt's Cormorants and all coastal and estuarine breeding colonies of Double-crested Cormorants, from Point Sur to Point Mugu and at the northern Channel Islands (i.e., San Miguel, Santa Rosa, Santa Cruz, and Anacapa islands). Locations where colonies have occurred in the past were surveyed and most other areas of the outer coast and island shorelines were inspected for new nesting areas. However, because Double-crested Cormorant colonies often form in groves of trees on the mainland, our search effort is less systematic for their mainland colonies compared to Brandt's Cormorant colonies. Cormorants and Brown Pelicans roosting within or adjacent to cormorant breeding colonies also were photographed, but roosting areas were not always photographed completely. From Point Sur to Point Conception, colonies were surveyed once per year in early to mid June. South of Point Conception, surveys were conducted in April, May, and June, because of wide variation of timing of breeding in this geographic area for Brandt's Cormorants and because of known later timing of breeding for Double-crested Cormorants (McChesney et al. 1998a; Capitolo et al. 2008a). We aimed to photograph all Brandt's Cormorant colonies in late May and all Double-crested Cormorant colonies in mid June, with certain sample Brandt's Cormorant colonies also photographed in April and June.

In 1996-2009, coastal survey coverage from Point Sur to Point Mugu was similar to 2010-2011 coverage, with the following exceptions: 1) in 1996, surveys were not conducted south of Pecho Rock; 2) in 1996-2000, the Double-crested Cormorant colony at Fairbank Point was not surveyed; 3) in 1999-2001, surveys from Cambria to the Mexico border also included all seabird roosts during May (McChesney et al. 2001); 4) in 2004, Morro Rock and Fairbank Point were not surveyed due to fog; and 5) in 2004, surveys were not conducted south of Point Conception.

Photograph Counting and Population Sizes

Whole-colony counts of nests, territorial sites, and birds were determined for all cormorant colonies surveyed from Point Sur to Point Mugu. Although surveys of the northern Channel Islands also were conducted in 2010-2011, no funds have been obtained for photograph counting of those colonies. Counts were determined from selected best images of each colony.

Nests, sites, and birds were manually marked and automatically tallied for each image using image analysis software. Totals for each image were summed to determine total counts for each subcolony, and subcolony counts were summed to determine whole-colony counts. Subcolonies are distinct geographic areas within colonies, most of which had been previously defined (Carter et al. 1992, 1996; McChesney et al. 1998a). New colonies and subcolonies identified during photograph counting for this report were mapped and presented in Appendix 1.

In this report, we treated whole-colony counts of nests as the peak annual number of egg-laying sites, with estimated numbers of breeding birds equal to the nest counts multiplied by 2. Other estimates may be calculated with use of correction factors (e.g., Carter et al. 1992). Nests were categorized by their stage of development following a standardized protocol used since 1997 (McChesney et al. 1998a,b, 1999). Cormorant nest totals reported here are sums of: well-built nests (X), poorly-built nests (P), nests with chicks (C), abandoned nests (A), and empty nests (E). Total numbers of sites include territorial sites (Z), abandoned sites (AZ), and undetermined sites (S). Undetermined sites (S) were rarely recorded. Counts of territorial sites indicate the potential for possible egg-laying at additional nests after the survey was conducted. Most poorly-built nests also probably did not have eggs laid in them yet, but had a relatively high likelihood of eggs being laid in the near term. Roosting cormorants were identified by: 1) location away from other breeding birds, often in non-breeding habitat (e.g. intertidal areas); 2) lack of observed breeding behaviors and nesting material; and 3) often denser groups of birds compared to birds attending nest sites. Most roosting cormorants likely were Brandt's Cormorants, but we categorized them as Unidentified because some Double-crested and Pelagic Cormorants also were likely present but not consistently distinguishable away from nest sites. Roosting Brown Pelicans were aged as adult or immature.

Statistical Analyses

For the 1989-2011 period, we performed linear Poisson regression analyses to determine percent per annum changes in total numbers of Brandt's Cormorant nests for: 1) the entire Point Sur-Point Mugu region; 2) the northern part of the region (the Big Sur Coast) from Point Sur through Piedras Blancas Island; 3) the southern part of the region, south of Piedras Blancas Island; and 4) 10 colonies, colony complexes, or other coastal subregions. Colony complexes were defined based on proximity of colonies and possible nearby shifting of colony locations between years. Nest totals for all colonies within a complex or subregion were summed for analyses. For regions without nesting early in the period, only the most recent zero count was used in regressions. All standard errors were corrected for overdispersion. We also produced LOESS (locally weighted scatter-plot smoothing) plots to show general population trends for each complex or region. Plots were fitted with a LOESS smooth curve (α=0.75) and pointwise 95% confidence intervals. All analyses were performed using the software "R" (version 2.10.0, R Development Core Team, Vienna, Austria). The 1979-1980 period was excluded from linear regressions mainly because of the large time period (1981-1988) without data prior to 1989. Analyses were not performed for Double-crested Cormorants at this time, as missing data may require certain adjustments and necessitate analysis for time periods different than used for Brandt's Cormorants.

Figure 1. Locations of breeding colonies of Brandt's and Double-crested Cormorants, Point Sur to Point Piedras Blancas, California, 1979-2011.

Figure 2. Locations of breeding colonies of Brandt's and Double-crested Cormorants, from south of Point Piedras Blancas to Point Mugu, California, 1979-2011.

RESULTS

Brandt's Cormorant

Population Trends

In 1979-2011, Brandt's Cormorants were documented at 49 different breeding colonies between Point Sur and Point Mugu. The number of active breeding colonies varied annually and was highest in 2011 (N = 30; Tables 1, 2). Through 1995, Brandt's Cormorants had been documented breeding at just 32 different colonies (Carter et al. 1998), indicating substantial variation in colony distributions over time. In the 1979-2011 period, only one colony, Piedras Blancas Island, had nesting every year, though some others were active in most years (e.g., Cape San Martin, Pecho Rock, Morro Rock and Pillar Rock); others were only occasionally active.

Total numbers of nests varied annually from a low of just 284 nests (568 breeding birds) in 1993 during strong El Niño conditions to a high of 7,281 nests (14,562 breeding birds) in 2006. Low numbers also occurred during moderate El Niño conditions in 2003, and also in 2008 despite La Niña conditions. Four colonies (Piedras Blancas Island, Morro Rock and Pillar Rock, Lion Rock, and Diablo Canyon Nuclear Power Plant South) had counts > 1000 nests in one or more years.

Over the 1989-2011 period, total numbers of nests increased by 4.5% per annum ($P < 0.05$) for the entire Point Sur-Point Mugu region (Fig. 3; Table 3). South of Piedras Blancas Island, 9.9% per annum increase occurred ($P < 0.001$), whereas no trend was detected to the north from Point Sur to Piedras Blancas Island. Population increase in the southern part of the study area also was evident in comparison to 1979 data; the region south of Piedras Blancas Island accounted for just 10% of nests in 1979 and 64% in 2011. Most increase south of Piedras Blancas Island occurred in 2005-2011 (Fig. 3). Among colony complexes, the northernmost, Point Sur-Torre Canyon Rocks, experienced decline (-7.3% per annum; $P < 0.05$), but all other colony complexes from Point Sur to Piedras Blancas Island showed no trend. South of Piedras Blancas Island, significant increase occurred at all colony complexes (Table 3).

Despite a lack of linear trends at most colony complexes in the northern part of the study area, examinations of non-linear trends still offer insights into abundance patterns. In general, most colonies from Point Sur to Piedras Blancas Island declined between 1989 and the mid 1990s, then increased through the mid 2000s, then were stable or declined by 2011. In contrast, three of four colony complexes south of Piedras Blancas Island continued to increase through 2011 (Figs. 4-10).

Population increase south of Piedras Blancas Island was most evident in formation and growth of the colony at Morro Rock and Pillar Rock, as well as increased nesting in the Diablo Canyon area (i.e., the Point Buchon-North Pismo Beach Rocks colony complex; Tables 1-3). Farther south, nesting along the Vandenberg Air Force Base coast was first noted in 1995 at Point Arguello and nearby Rocky Point (Carter et al. 1996). South of Point Conception, two colonies have formed on artificial habitat. At Sandpiper Pier Foundation (within the Class B airspace of Santa Barbara Airport), nesting was first noted in 1997 on the remains of an abandoned oil pier (McChesney et al. 1998a); cormorants now nest on platforms constructed in late 2005 to provide breeding and roosting habitat for seabirds following demolition of the pier remains (Capitolo et al. 2008a). At Port Hueneme Harbor (within Naval Base Ventura County), nesting was first noted in 2007 on a seawall at the entrance to the harbor (Capitolo et al. 2008a).

Disturbance

Potential human-caused disturbance to breeding Brandt's Cormorants was noted at three colonies north of Piedras Blancas Island. In 2006, all nests and sites were abandoned at Plaskett Rock and Seastack South of Redwood Gulch (Table 5; Fig. 11). Plaskett Rock had previously had annual nesting since 1994. After 2006, small numbers nested at Plaskett Rock in 2007 but none in 2008-2011. At Seastack South of Redwood Gulch in 2006, eggs were visible in many of the nests, suggesting a recent disturbance event caused sudden abandonment by all breeding birds. Nesting did not occur there in 2007-2011, though previous nesting at this colony had been sporadic. Disturbance also was suspected at Ragged Point Lodge Colony in 2010, where just two Brandt's Cormorant nests were still active during the aerial survey. Some abandoned nests also were noted in 2011 at Ragged Point Lodge Colony, but some may have been Pelagic Cormorant nests that were completed and unattended. In each of these cases, large numbers of active nests remained at other nearby colonies, suggesting nest abandonments were not a result of poor breeding conditions. Potential disturbance to roosting cormorants was documented with an image of a kayaker in close proximity to a roost rock at Shell Beach Rocks in 2011 (Fig. 12).

Other instances of substantial numbers or proportions of abandoned nests and sites (Table 5) did not as clearly suggest recent human-caused disturbance, and may have been related instead to poor prey conditions. In 2008, when reduced numbers of nests were seen throughout the region, abandonments had occurred at Morro Rock and Point Buchon during different breeding stages. At Morro Rock, abandoned nests were distributed throughout nesting areas while about 200 nests were still attended by incubating adults. At Point Buchon, abandonment apparently occurred before any egg-laying, based on nesting material that appeared flattened and without guano accumulation. At Redwood Gulch Rock and 3 Rocks in 2005, despite much abandonment, several remaining nests had medium-sized chicks, suggesting early breeding with variable success. Although these patterns of abandonments were likely related to prey conditions, human disturbances cannot be excluded as a possible cause of abandonments. For example, birds incubating at Morro Rock could possibly have re-laid following an earlier more widespread abandonment of the colony.

Double-crested Cormorant

Population Trends

In 1979-1980 between Point Sur and Point Mugu, only three Double-crested Cormorant nests were documented at one colony, Partington Ridge North (Sowls et al. 1980). By 1989, the population for the region had increased to 164 nests at six colonies (Carter et al. 1992). Most of the increase by 1989 was due to formation of the large colony in *Eucalyptus* trees at Fairbank Point in Morro Bay State Park (138 nests). Small numbers also were noted at Morro Rock (10 nests) and Rockland Landing North (11 nests), both of which have had regular nesting since 1989. In contrast, nesting at Partington Ridge North, Anderson Canyon Rocks, and Cape San

Martin (1-2 nests each) detected with boat surveys in 1989 was not detected subsequently with aerial surveys. In 1993-1995, nesting was detected only at Morro Rock, but Fairbank Point was not surveyed (Carter et al. 1996).

In 1996-2011, not all colonies were surveyed in every year, but breeding population increase was evident by 2000. By 2000, the Fairbank Point colony had more than doubled in size since 1989 and a new colony in trees on private properties had formed on the mainland at Shell Beach Rocks. Fairbank Point reached nearly 500 nests in 2005 and 2011, and Shell Beach Rocks exceeded 300 nests in 2009. The total breeding population for the region exceeded 700 nests in 2005, 2006, and 2009 (Table 4).

Only two colonies annually occurred on mainland cliffs on the outer coast. At Rockland Landing North, Double-crested Cormorants nested on steep cliffs, above Brandt's Cormorant nesting areas that were closer to the sea surface. Unfortunately, Double-crested Cormorant nests were not always photographed because they were often inconspicuous. Numbers at Morro Rock declined substantially after 1996 (perhaps reflecting movement of birds to Fairbank Point), but were consistent from 1997 to 2011 (18-65 nests).

At least two other tree colonies formed by the early 2000s in coastal Santa Barbara County. The colony at Andree Clark Bird Refuge in Santa Barbara had been active at least since 2001 (P. Gaede, pers. comm.), but we only became aware of it recently and first surveyed it in 2011. Another small colony was first documented in 2008 at Goleta Slough by local birders in Santa Barbara. We currently do not attempt to survey this colony because of its proximity to Santa Barbara Airport and difficulty receiving permission from Air Traffic Control to circle the area. An internet search revealed a count of 13 nests in 2011 by M. Holmgren.

Disturbance

In 2011, the Shell Beach Rocks colony was completely abandoned following specific actions by homeowners that included several years of tree removals, tree-trimming during the breeding season in 2010, and hazing actions in 2011. The colony was first noted in 2000, when 77 nests were counted in Monterey Cypress (*Cupressus macrocarpa*) trees adjacent to homes on private property (McChesney et al. 2001). The colony was not present in 1989 (Carter et al. 1992), but it is not known what year nesting first occurred because the coastal area near Shell Beach Rocks was not thoroughly inspected in all years between 1993 and 2000 during aerial surveys. The colony grew steadily and peaked at more than 300 nests in 2009 (Table 4). In 2010, the colony had mostly shifted to trees about 1 km to the south of the original colony location, following removal of trees in recent years, including several between the 2009 and 2010 breeding seasons based on comparison of aerial photographs. Only 5% of nests (14 nests, including 10 abandoned) occurred at the original location (Subcolony 09) in 2010, compared to 95% (254 nests, including one abandoned) at the new, southern location (Subcolony 10). Trees at the southern location also were on private property overhanging homes. News reports indicated that a depredation permit was issued by USFWS to allow homeowners to trim trees and remove nests once chicks had fledged (i.e., were capable of flight) due to concerns of impacts of cormorant guano on nearby homes and property, as well as on human health. In 2011, no active nests were seen in photographs, though birds carrying nesting material had been noted in May

(D. Robinette, pers. comm.). Hazing methods were employed by homeowners prior to egg laying in 2011 to deter cormorant nesting. Hazing continued in 2012 (S. Krenn, pers. comm.).

Other Species

Roosting Brown Pelicans were counted at 33 different cormorant colonies, and 15 cormorant colonies had at least one count > 100 roosting pelicans (Table 6). Highest counts were at Morro Rock in 2007 (1214 birds; 52% immature) and 2005 (718 birds; 87% immature). From surveys in 1999-2001 that included all seabird roosts south of Cambria (McChesney et al. 2001; H.R. Carter, unpubl. data), pelicans also were counted at many other roost sites away from cormorant colonies. Four roost sites had counts > 100 birds during the breeding season survey in May, all in Ventura County: Rincon Island, Ventura Harbor Breakwater, Santa Clara River Mouth, and Mugu Lagoon.

Five Common Murres were present in an intertidal area at Shell Beach Rocks (Subcolony 06) on 31 May 2007. This is the first known record of murres on land between Point Sur and Point Conception, but it likely does not reflect prospecting behavior because the murres were not in potential breeding habitat. Murres normally only land on shore at breeding colonies, but will sometimes come ashore when in poor condition, especially when oiled.

DISCUSSION

In 1979-2011, breeding populations of both Brandt’s Cormorants and Double-crested Cormorants increased substantially in the Point Sur-Point Mugu region. Brandt’s Cormorant breeding population size peaked at > 7,000 nests in 2006, with an overall population increase of 4.5% per annum in 1989-2011. This increase resulted mainly from 9.9% per annum increase south of Piedras Blancas Island, where new colonies were established in the mid 1990s and most increase occurred in the 2000s. Double-crested Cormorant breeding population size increased from just three nests at one colony in 1979 to > 700 nests in several recent years and up to six colonies.

Breeding population increase for both species may reflect changes in prey availability in the California Current Upwelling System, reduced levels of anthropogenic disturbance to nesting and roosting birds over time, and reduced levels of organochlorine and other pollutants over time, all potentially resulting in increased breeding propensity, reproductive success, survival, and possibly immigration. Relatively high prey availability in the region in recent years was suggested by continued high Brandt’s Cormorant nest totals in 2009, when to the north in the Gulf of the Farallones a major die off and widespread colony abandonments occurred due to food shortages (Gibble et al. 2010; Eigner et al. 2010). Similarly, Double-crested Cormorant nest totals remained high through 2010, in contrast to large declines in San Francisco Bay and the Gulf of the Farallones after 2007 (Elliott et al. 2010; Warzybok and Bradley 2011). Establishment of protected areas and certain regulations of aircraft and vessel operations (e.g., within Monterey Bay National Marine Sanctuary, Diablo Canyon Security Area, and various State Marine Reserves) have likely resulted in reduced disturbance in recent decades, at least at certain colonies. Double-crested Cormorant populations elsewhere on the Pacific coast of North

America also have experienced large population increases since the 1970s due to reductions of impacts from human disturbance and chemical pollutants (e.g., DDT contamination), use of artificial breeding habitats, and possible immigration (Carter et al. 1995; Adkins et al. 2010).

For Brandt's Cormorants, the most significant individual breeding colonies were Cape San Martin, Piedras Blancas Island, and Morro Rock and Pillar Rock. At Cape San Martin and Piedras Blancas Island, hundreds of pairs nested annually throughout the 1979-2011 period, with Piedras Blancas Island exceeding 1000 nests in several years. The Morro Rock and Pillar Rock colony was established at least by 1989, began to increase substantially in 2003, and ultimately became the largest colony in the region each year in 2009-2011. These three colonies all occurred on large islands or headlands, but other important breeding areas included colony complexes where colony shifting from year to year occurred regularly. The Point Buchon-North Pismo Beach Rocks colony complex (including colonies near Diablo Canyon Nuclear Power Plant) hosted several hundred nesting pairs by 1989 and grew to more than 3,000 pairs in 2006 and 2007. Along the Big Sur Coast, nest numbers at the Partington Ridge North-Buck Creek colony complex have fluctuated, but were highest (> 600 nests) at the beginning (1979) and end (2011) of the study period. In 2006, when nest totals for the entire region peaked, these three colonies and two colony complexes accounted for 92% of all nests counted.

For Double-crested Cormorants, Fairbank Point and Shell Beach Rocks were the most significant colonies, accounting for 90% of counted nests when peak numbers for the region occurred in 2009. With such a large percentage of nest totals occurring in trees planted and/or non-native to the region, it is possible recent numbers of nests along the south-central coast exceed historical numbers prior to about 1850 (when California began a rapid human population increase and many impacts to coastal habitats began). Abandonment of the colony at Shell Beach Rocks due to tree removal and cormorant hazing may have resulted in movements of some birds to the Fairbank Point colony. Recent nesting also has been observed in *Eucalyptus* trees at San Simeon in 2011 (D. Robinette, pers. comm.) and 2012 (P. Capitolo, unpubl. data). In 2012, the Andree Clark Bird Refuge colony in Santa Barbara was similarly abandoned following tree pruning, and birds apparently relocated to *Eucalyptus* trees about 5 km to the east within 100 m of the south side of Highway 101 (P. Capitolo, unpubl. data).

Potential disturbance of Brandt's Cormorant breeding colonies along the Big Sur Coast was suggested by: 1) patterns of nest abandonments seen in aerial photographs at three colonies; 2) long-term abandonment of certain colony sites, such as Plaskett Rock; and 3) much interannual variation of locations of breeding colonies. However, more study with ground-based surveys is needed to document sources and patterns of potential anthropogenic and natural disturbance (Carter et al. 1998). In contrast, Brandt's Cormorants apparently can habituate to certain types and levels of human activity perceived as non-threatening. At Port Hueneme Harbor, cormorants nesting on an elevated seawall are exposed to frequent U.S. Navy vessel traffic and occasionally to people on the dock about 15 feet below. Cormorants do not flush from nests even during activities such as power-washing of the dock (M. Ruane, pers. comm.).

For Brown Pelicans, large numbers of roosting birds at Morro Rock further reflect the importance of protecting nesting and roosting areas near Morro Bay from disturbance. Large numbers of roosting pelicans also have been documented on jetties and spits near Morro Rock.

Additionally, North Pismo Beach Rocks and Shell Beach Rocks were previously identified as among the most important pelican roost sites in central California (Jaques et al. 2008). In 1999-2000, Jaques and Strong (2002) recorded a high rate of disturbance by kayakers to pelicans roosting at Shell Beach Rocks. South of Point Conception, high rates of human disturbance also have been recorded at the Santa Clara River Mouth (Jaques et al. 1996; Jaques and Strong 2002; Capitolo et al. 2003). With recent federal delisting and loss of protections for roosting areas, a plan for monitoring pelican roost sites throughout California has been proposed (USFWS 2009), but remains to be implemented.

CONCLUSION

Breeding population trends of Brandt's and Double-crested Cormorants in 1979-2011 in the Point Sur-Point Mugu region underscored the importance of the Torch/Platform Irene Trustee Council's selection of the restoration action to reduce human disturbance to seabird breeding colonies and roost sites in this region (Torch/Platform Irene Trustee Council 2007) by showing that the region hosts substantial populations of both species and that human disturbance is likely occurring.

But given continued high breeding population sizes for Brandt's Cormorants in recent years through 2011, potential human disturbance in the region that may cause nest abandonments and/or colony shifting is at the same time likely not having a significant net impact on the species' overall regional or range-wide population sizes. For Double-crested Cormorants, however, breeding population size in the region is apparently limited by availability of suitable breeding habitat.

For best determination of long-term cormorant population trends throughout California, it is critical that aerial photographic surveys continue on an annual basis. Aerial photographic surveys provide near-peak population sizes that can be used as indices of annual breeding populations. In the Gulf of the Farallones, where seasonal ground-monitoring of breeding colonies also has occurred, the single, annual aerial photographic survey typically has captured more than 90% of Brandt's Cormorant nests initiated (USFWS, unpubl. data). Annual surveys are needed given variability over time in oceanographic conditions and prey availability that may affect annual variation in percentages of breeding-age birds that attempt to breed. Finally, similar assessments of breeding population trends in other coastal California regions, including the northern Channel Islands, are needed for better understanding of cormorant population dynamics throughout the California Current Upwelling System.

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Table 1. Total numbers of Brandt's Cormorant nests at coastal breeding colonies, Point Sur-Point Mugu, in 1979-1980, 1989, and 1993-1999. CCN = California Colony Number; ND = No Data. Alternating bold and regular font indicates colony complexes.

Colony Name	CCN	1979[1]	1980[1]	1989[2]	1993	1994	1995	1996	1997	1998	1999
Cooper Point and Islands	MO-360-03	36	ND	17	0	0	0	0	0	0	0
Pfeiffer Point	MO-360-04	3	ND	0	0	0	0	0	0	0	0
Grimes Point	MO-360-06	8	ND	89	0	146	153	15	106	0	44
Lafler Rock and Mainland	MO-360-07	6	ND	107	0	19	1	0	0	90	0
Torre Canyon Rocks	MO-360-08	0	ND	0	0	0	0	0	0	0	0
Partington Ridge North	MO-360-10	455	ND	78	0	4	135	180	166	0	136
McWay Rocks	MO-360-11	10	ND	48	0	0	0	0	0	0	4
Partington Ridge South	MO-360-12	0	ND	7	0	0	4	0	0	0	0
Anderson Canyon Rocks	MO-360-13	0	ND	146	0	221	38	0	208	0	0
Burns Creek Rocks	MO-360-14	174	ND	147	0	17	191	93	46	24	28
Buck Creek	MO-360-15	0	ND	0	0	0	0	0	0	0	0
Dolan Rock	MO-360-16	0	ND	0	0	0	0	0	0	0	0
Bench Mark 223	MO-360-17	0	ND	0	0	0	0	0	0	0	0
Square Black Rock	MO-360-18	0	0	0	0	0	0	2	0	0	0
Gamboa Point	MO-360-19	0	ND	0	0	0	0	0	0	0	0
Lopez Rock	MO-360-21	0	0	52	0	46	32	0	0	19	19
Rockland Landing North	MO-360-23	8	ND	3	0	0	0	0	0	0	54
Larus Rock	MO-354-03	0	ND	0	0	0	0	0	0	0	0
Gorda Area	MO-354-05	0	ND	0	0	0	0	0	0	0	0
Plaskett Rock	MO-354-07	0	0	386	0	47	63	61	136	73	136
Cape San Martin	MO-354-08	614	340	341	0	388	387	283	279	83	110
Unnamed Rock	MO-354-09	0	ND	125	0	0	5	0	0	0	0
Redwood Gulch Rock	MO-354-12	239	ND	169	0	126	19	25	207	44	105
Seastack S of Redwood Gulch	MO-354-13	0	ND	0	0	ND	42	0	0	34	0
Unmapped Island	MO-354-14	28	ND	14	0	33	10	29	15	0	25

Table 1 (Continued).

Colony Name	CCN	1979[1]	1980[1]	1989[2]	1993	1994	1995	1996	1997	1998	1999
Crystal Point	MO-354-17	0	ND	0	0	0	0	0	0	0	0
Ragged Point Lodge Colony	SL-354-01	0	ND	0	0	0	0	0	0	0	0
3 Rocks	SL-354-03	0	ND	0	0	106	14	93	123	0	73
La Cruz Rock	SL-354-04	0	0	308	0	0	48	0	0	86	0
Piedras Blancas Island	SL-352-01	680	600	1194	267	971	1005	815	1237	263	576
Two Rks S of Piedras Blancas	SL-352-03	0	ND	0	0	0	0	0	0	0	0
Morro Rock and Pillar Rock	SL-352-07	0	ND	63	0	92	ND	74	172	121	101
Point Buchon	SL-350-02	0	7	0	0	0	0	0	0	223	0
Unnamed Rocks	SL-350-03	0	0	0	0	0	0	0	0	0	0
Pup Rock & Adj. Mainland	SL-350-04	0	0	595	0	559	598	242	99	31	388
Lion Rock	SL-350-05	0	0	126	0	281	644	590	1354	104	603
Diablo Rock & Adj. Mainland	SL-350-06	180	106	7	0	0	17	341	0	0	133
Diablo Canyon NPPS	SL-350-07	8	50	0	0	0	0	0	0	0	33
Pecho Rock	SL-350-09	70	74	146	17	65	89	75	111	28	68
Shell Beach Rocks	SL-350-13	0	0	0	ND	ND	ND	ND	ND	0	0
North Pismo Beach Rocks	SL-350-14	0	ND	0	ND	ND	ND	ND	ND	0	0
Point Sal	SB-344-03	0	0	0	ND	ND	ND	ND	ND	0	0
Lion Rock at Point Sal	SB-344-04	0	0	0	ND	ND	ND	ND	ND	0	0
Destroyer Rock	SB-342-03	0	ND	0	ND	ND	ND	ND	ND	0	0
Point Arguello	SB-342-04	0	0	0	ND	ND	15	ND	2	0	25
Rocky Point (SB)	SB-342-05	0	ND	0	ND	ND	6	ND	32	7	0
Point Conception	SB-342-06	0	ND	0	ND	ND	ND	ND	ND	0	0
Sandpiper Pier Foundation	SB-342-07	0	ND	0	ND	ND	ND	ND	37	5	7
Port Hueneme Harbor	VE-340-08	0	ND	0	ND	ND	ND	0	0	0	0
Total		**2519**		**4168**	**284**	**3121**	**3516**	**2918**	**4330**	**1170**	**2624**

[1]Source: Sowls et al. (1980); [2]Source: Carter et al. (1992).

Table 2. Total numbers of Brandt's Cormorant nests at coastal breeding colonies, Point Sur-Point Mugu, in 2000-2011. CCN = California Colony Number; ND = No Data. Alternating bold and regular font indicates colony complexes.

Colony Name	CCN	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cooper Point and Islands	MO-360-03	4	0	0	19	29	0	0	0	0	26	0	11
Pfeiffer Point	MO-360-04	0	0	0	0	0	0	0	0	0	0	0	0
Grimes Point	MO-360-06	78	104	37	15	35	8	0	0	0	0	0	15
Lafler Rock and Mainland	MO-360-07	0	150	129	24	109	0	7	0	0	30	0	3
Torre Canyon Rocks	MO-360-08	0	0	0	0	0	0	0	0	0	0	0	0
Partington Ridge North	MO-360-10	84	91	0	138	350	0	223	342	8	0	190	320
McWay Rocks	MO-360-11	3	0	0	0	0	330	0	0	134	104	0	166
Partington Ridge South	MO-360-12	0	0	0	0	0	0	0	0	7	0	0	0
Anderson Canyon Rocks	MO-360-13	75	0	332	0	74	80	166	134	0	0	0	120
Burns Creek Rocks	MO-360-14	72	201	0	0	212	0	39	0	0	311	24	0
Buck Creek	MO-360-15	0	0	0	0	0	0	0	0	28	0	0	0
Dolan Rock	MO-360-16	1	0	0	0	0	0	0	35	49	0	0	0
Bench Mark 223	MO-360-17	0	0	0	0	0	0	46	41	0	20	0	0
Square Black Rock	MO-360-18	0	0	0	0	0	34	0	0	0	0	0	0
Gamboa Point	MO-360-19	0	0	0	28	37	7	0	0	0	0	0	0
Lopez Rock	MO-360-21	28	6	25	0	40	5	0	0	0	0	0	13
Rockland Landing North	MO-360-23	57	35	59	57	19	61	44	52	42	26	12	40
Larus Rock	MO-354-03	0	0	0	0	0	0	0	0	27	0	0	0
Gorda Area	MO-354-05	0	0	0	0	0	0	0	0	0	9	0	0
Plaskett Rock	MO-354-07	234	188	220	13	170	61	15	95	0	0	0	0
Cape San Martin	MO-354-08	54	130	294	148	366	457	339	117	55	135	209	480
Unnamed Rock	MO-354-09	0	30	0	0	0	0	0	0	0	0	0	0
Redwood Gulch Rock	MO-354-12	78	92	161	0	133	29	0	94	0	66	56	122
Seastack S of Redwood Gulch	MO-354-13	0	0	0	67	0	0	43	0	0	0	0	0
Unmapped Island	MO-354-14	21	31	37	11	44	0	3	17	0	0	19	0
Crystal Point	MO-354-17	0	0	0	0	0	0	0	112	0	47	0	107

Table 2 (Continued).

Colony Name	CCN	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Ragged Point Lodge Colony	SL-354-01	0	0	0	68	66	57	210	52	0	47	14	7
3 Rocks	SL-354-03	81	46	59	65	188	22	31	119	0	53	62	162
La Cruz Rock	SL-354-04	0	8	0	0	0	101	0	0	0	4	0	0
Piedras Blancas Island	SL-352-01	641	625	991	612	1041	872	1589	810	88	913	501	953
Two Rocks S of Piedras Blancas	SL-352-03	0	6	136	0	0	0	48	0	0	0	0	0
Morro Rock and Pillar Rock	SL-352-07	84	131	171	438	ND	654	1069	909	259	1155	1516	1501
Point Buchon	SL-350-02	0	0	72	86	285	363	0	0	0	797	52	0
Unnamed Rocks	SL-350-03	0	0	0	143	119	0	86	482	0	0	137	819
Pup Rock and Adj. Mainland	SL-350-04	387	4	531	0	595	836	183	5	0	210	0	83
Lion Rock	SL-350-05	212	267	240	60	141	1000	260	759	0	53	0	186
Diablo Rock & Adj. Mainland	SL-350-06	192	73	0	0	0	861	0	12	160	0	0	638
Diablo Canyon NPPS	SL-350-07	0	86	0	0	979	80	2550	2101	0	309	890	247
Pecho Rock	SL-350-09	95	67	66	0	231	127	163	306	70	182	57	268
Shell Beach Rocks	SL-350-13	0	24	0	0	0	0	0	24	20	69	25	60
North Pismo Beach Rocks	SL-350-14	0	0	0	0	0	0	0	45	0	281	0	215
Point Sal	SB-344-03	0	0	0	0	0	0	0	0	0	0	0	5
Lion Rock at Point Sal	SB-344-04	0	0	0	0	1	0	0	4	0	102	0	0
Destroyer Rock	SB-342-03	0	0	0	0	0	0	0	0	0	0	0	8
Point Arguello	SB-342-04	2	23	38	35	27	52	81	70	95	100	109	159
Rocky Point (SB)	SB-342-05	16	0	0[1]	0	27	5	4	30	0	0	4[1]	25[1]
Point Conception	SB-342-06	0	0	0	ND	0	ND	0	0	16	10	17	12
Sandpiper Pier Foundation	SB-342-07	17	24	49	68	ND	96	82	95	117	148	136	125
Port Hueneme Harbor	VE-340-08	0	0	0	0	0	0	0	8	27	40	45	45
Total		**2516**	**2442**	**3647**	**2095**	**5318**	**6198**	**7281**	**6870**	**1202**	**5247**	**4075**	**6915**

[1]D. Robinette and J. Howar, unpubl. data.

Table 3. Trends in sums of whole-colony counts of Brandt's Cormorant nests for colony complexes and regional totals (bold italics) from Point Sur to Point Mugu, California, in 1989-2011, using Poisson Regressions. Bold indicates P < 0.05.

		Slope of ln(*N*)				**$H_0 = 0$**	**Percent per annum = e^{β} - 100%**		
				95% CI				**95% CI**	
Colony Complex/Region	**N**	**Estimate**	**SE**	**Lower**	**Upper**	**p-value**	**Estimate (%)**	**Lower (%)**	**Upper (%)**
Point Sur-Point Mugu	20	0.044	0.018	0.009	0.080	**0.026**	4.5%	0.9%	8.3%
Point Sur-Torre Canyon Rocks	20	-0.076	0.035	-0.146	-0.009	**0.042**	-7.3%	-13.6%	-0.9%
Partington Ridge N-Buck Creek	20	0.030	0.020	-0.009	0.071	0.152	3.1%	-0.9%	7.3%
Dolan Rock-Rockland Landing North	20	0.048	0.025	0.001	0.097	0.067	4.9%	0.1%	10.2%
Larus Rock-Unnamed Rock	20	-0.028	0.020	-0.068	0.012	0.182	-2.8%	-6.6%	1.2%
Redwood Gulch Rock-La Cruz Rock	20	0.002	0.021	-0.040	0.044	0.932	0.2%	-3.9%	4.5%
Piedras Blancas Island	20	-0.004	0.017	-0.039	0.030	0.805	-0.4%	-3.8%	3.1%
Point Sur-Piedras Blancas Island	20	-0.004	0.017	-0.037	0.029	0.824	-0.4%	-3.6%	3.0%
Morro Rock and Pillar Rock	18	0.200	0.025	0.153	0.252	**0.000**	22.1%	16.5%	28.7%
Point Buchon-N Pismo Beach Rocks	20	0.061	0.025	0.013	0.112	**0.026**	6.3%	1.3%	11.9%
Point Sal-Point Conception	18	0.218	0.021	0.178	0.260	**0.000**	24.3%	19.5%	29.7%
South of Point Conception	14	0.181	0.022	0.139	0.226	**0.000**	19.9%	15.0%	25.3%
South of Piedras Blancas Island	20	0.094	0.022	0.052	0.138	**0.000**	9.9%	5.4%	14.8%

Table 4. Total numbers of Double-crested Cormorant nests at coastal breeding colonies from Point Sur to Point Mugu, 1996-2011. ND = No Data; ID = Incomplete data. Dash (-) = prior nesting not known.

Colony	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rockland Landing North	ND	ND	ND	0[1]	10	0[1]	ND	9	ND	13	ND	14	8	23	10	12
Morro Rock	138	27	65	44	37	37	28	41	ND	30	38	26	18	22	27	33
Fairbank Point	ND	ND	ND	ND	ND	421	402	406	ND	496	468	384	293	389	304	478
Shell Beach Rocks	-	-	-	-	77	48	91	130	168	183	227	244	258	311	268	0
Goleta Slough	-	-	-	-	-	-	-	-	-	-	-	-	ND	ND	ND	13
Andree Clark Bird Refuge	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	88
Total	**ID**	**ID**	**ID**	**ID**	**ID**	**506**	**521**	**586**	**ID**	**722**	**733**	**668**	**577**	**745**	**609**	**624**

[1] Small numbers (~ < 5) may have been present, but not identified due to inadequate photo quality.

Table 5. Brandt's Cormorant (BRCO) and Double-crested Cormorant (DCCO) breeding colonies with > 10% of nests plus sites abandoned, 1996-2011.

Colony Name	CCN	USFWSCN	Date	Species	Nests	Sites	% Abandoned
Lopez Rock	MO-360-21	454-020	06-Jun-05	BRCO	5	0	100.0
Plaskett Rock	MO-354-07	477-002	30-May-06	BRCO	15	50	100.0
Redwood Gulch Rock	MO-354-12	477-005	01-Jun-05	BRCO	29	18	42.6
Seastack S of Redwood Gulch	MO-354-13	477-018	30-May-06	BRCO	43	29	100.0
Unmapped Island	MO-354-14	477-019	30-May-06	BRCO	3	11	14.3
Ragged Point Lodge Colony	SL-354-01	477-022	03-Jun-10	BRCO	14	29	95.3
Ragged Point Lodge Colony	SL-354-01	477-022	06-Jun-11	BRCO	7	9	56.3
3 Rocks	SL-354-03	477-023	01-Jun-05	BRCO	22	4	23.1
Morro Rock and Pillar Rock	SL-352-07	477-026	10-Jun-08	DCCO	18	0	38.9
Morro Rock and Pillar Rock	SL-352-07	477-026	10-Jun-08	BRCO	259	78	24.9
Morro Rock and Pillar Rock	SL-352-07	477-026	16-Jun-10	DCCO	27	1	10.7
Point Buchon	SL-350-02	477-009	10-Jun-08	BRCO	0	30	100.0

Table 6. Counts of roosting Brown Pelicans > 100 birds at cormorant colonies from Point Sur to Point Conception, California, 1996-2011.

Colony Name	CCN	USFWSCN	Date	Total	Adult	Immature	Unknown Age
Morro Rock and Pillar Rock	SL-352-07	477-026	31-May-07	**1214**	571	629	14
Morro Rock and Pillar Rock	SL-352-07	477-026	01-Jun-05	**718**	93	625	0
Pup Rock and Adjacent Mainland	SL-350-04	477-028	01-Jun-05	**443**	41	267	135
Morro Rock and Pillar Rock	SL-352-07	477-026	30-May-06	**419**	52	18	349
Shell Beach Rocks	SL-350-13	477-035	08-Jun-09	**355**	309	46	0
Unnamed Rocks	SL-350-03	477-010	31-May-07	**282**	70	212	0
Piedras Blancas Island	SL-352-01	477-007	31-May-07	**281**	178	103	0
Lion Rock	SL-350-05	477-011	31-May-07	**274**	129	129	16
Point Buchon	SL-350-02	477-009	01-Jun-05	**261**	51	210	0
Pup Rock and Adjacent Mainland	SL-350-04	477-028	31-May-07	**236**	59	126	51
Point Sal	SB-344-03	501-018	08-Jun-09	**201**	164	37	0
North Pismo Beach Rocks	SL-350-14	477-036	10-Jun-08	**159**	95	64	0
Lion Rock at Point Sal	SB-344-04	501-008	08-Jun-09	**158**	133	25	0
Pecho Rock	SL-350-09	477-032	01-Jun-05	**149**	27	122	0
Sandpiper Pier Foundation	SB-342-07		20-May-99	**133**	130	3	0
Lion Rock at Point Sal	SB-344-04	501-008	24-May-01	**129**	101	28	0
Rocky Point (SB)	SB-342-05	501-012	10-Jun-08	**125**	65	60	0
Cape San Martin	MO-354-08	477-003	31-May-07	**121**	96	25	0
Shell Beach Rocks	SL-350-13	477-035	24-May-01	**119**	90	29	0
Plaskett Rock	MO-354-07	477-002	06-Jun-05	**110**	25	85	0
Lion Rock at Point Sal	SB-344-04	501-008	31-May-07	**106**	19	87	0
Shell Beach Rocks	SL-350-13	477-035	20-May-99	**103**	101	2	0

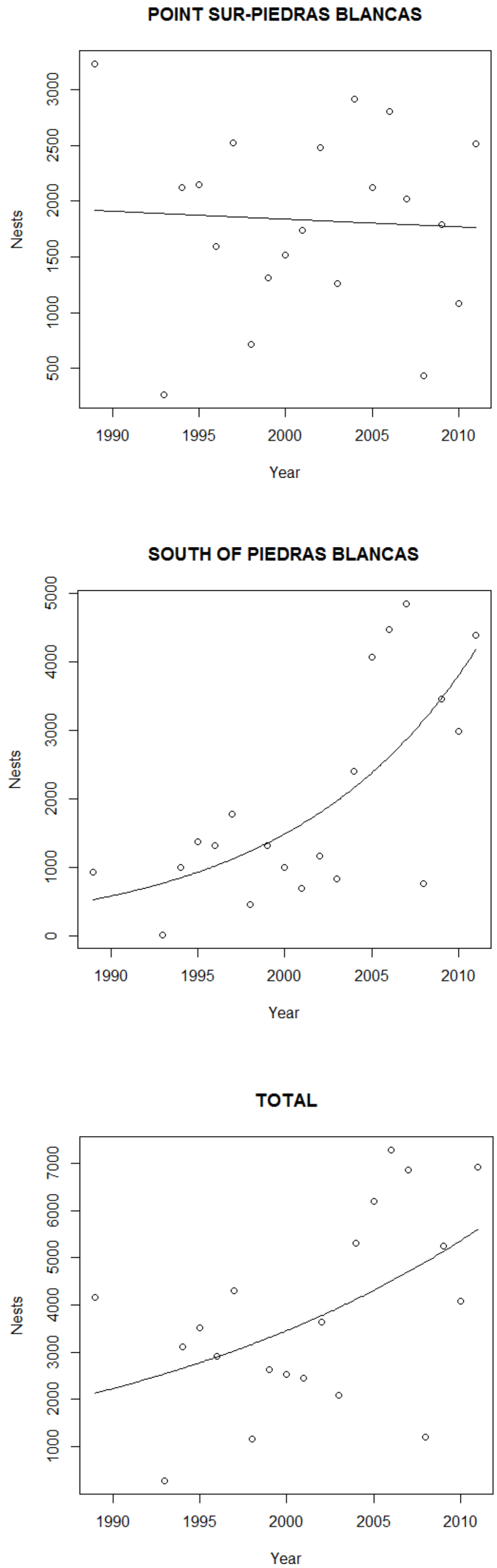
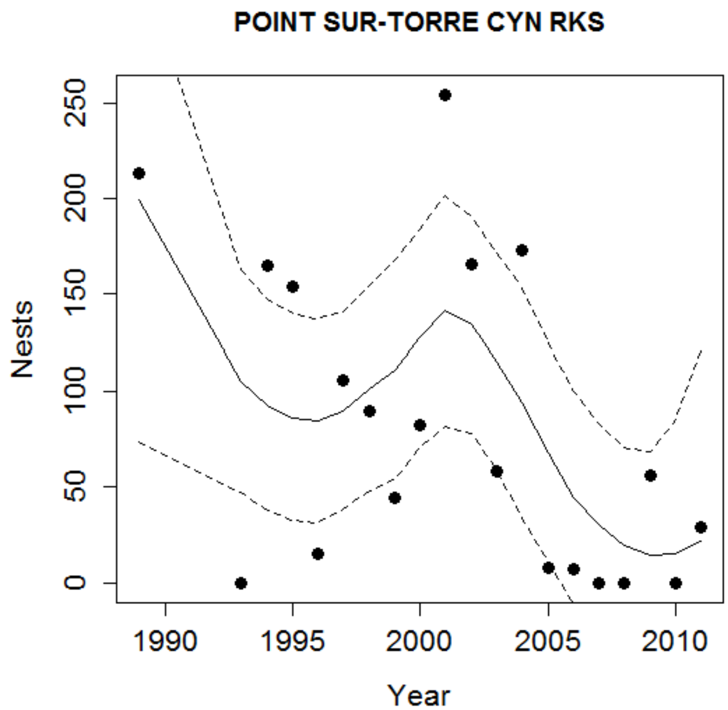


Figure 3. Trends in numbers of Brandt's Cormorant nests, Point Sur-Point Mugu, California, 1989-2011, using Poisson Regression. Trends are shown for northern and southern subregions and for the entire region (Total).



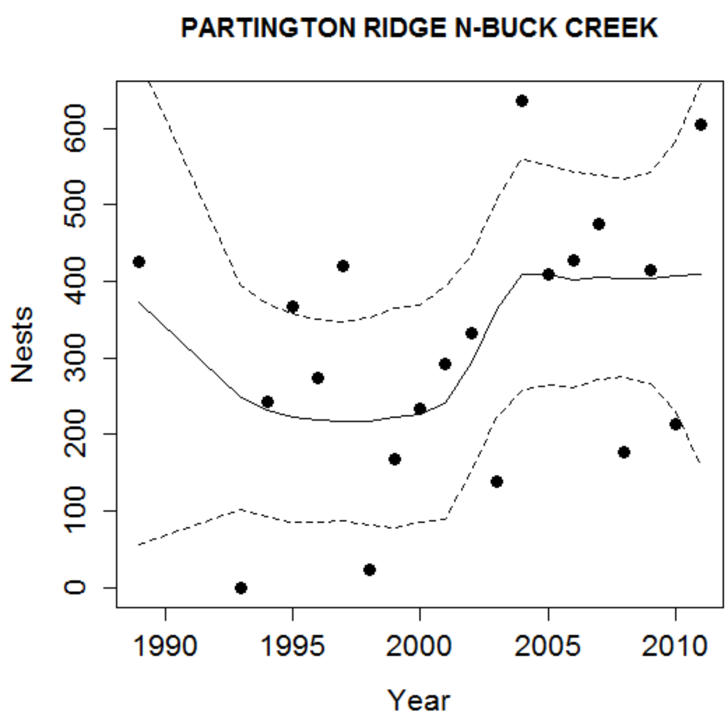


Figure 4. Non-linear trends in numbers of Brandt's Cormorant nests for the Point Sur to Torre Canyon Rocks and Partington Ridge North to Buck Creek colony complexes, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.

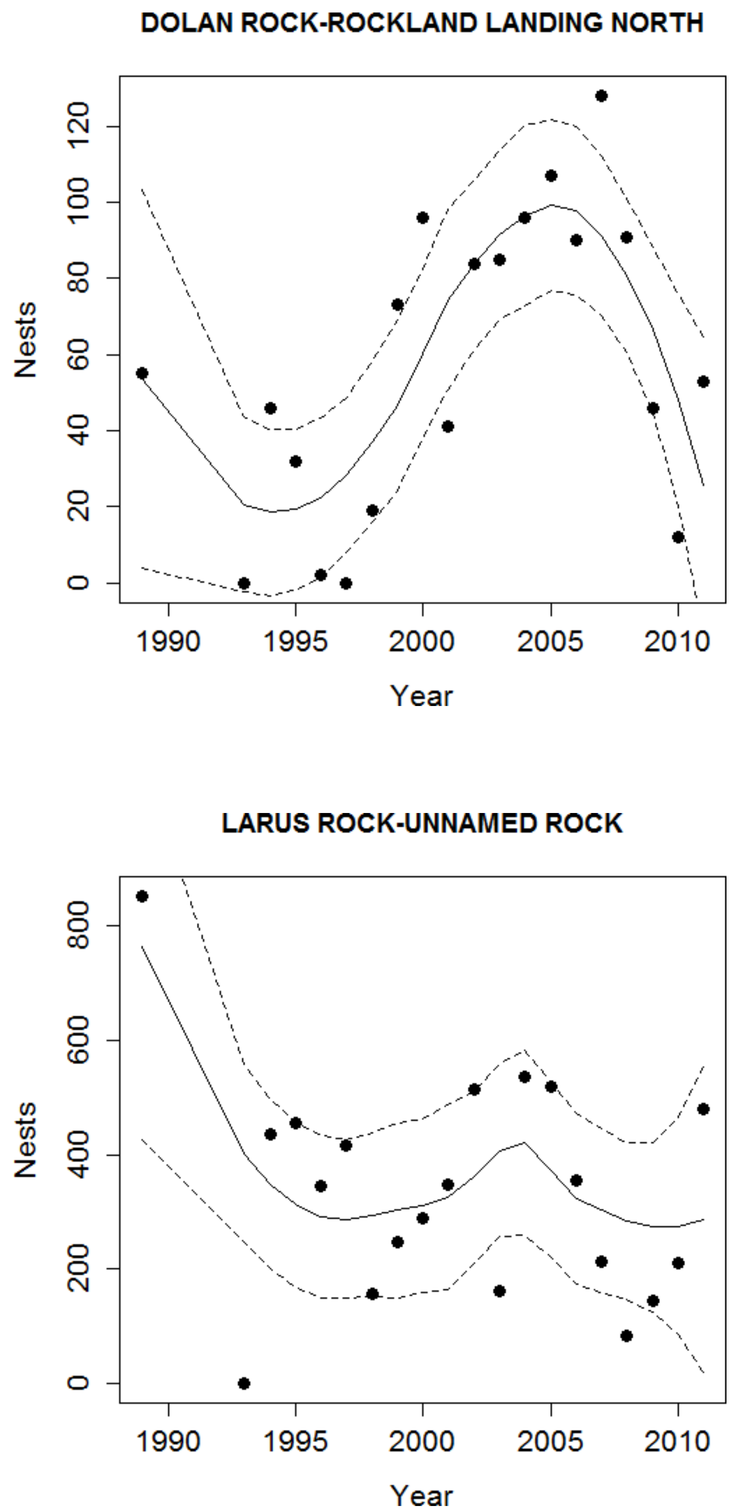


Figure 5. Non-linear trends in numbers of Brandt's Cormorant nests for the Dolan Rock to Rockland Landing North and Larus Rock to Unnamed Rock colony complexes, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.

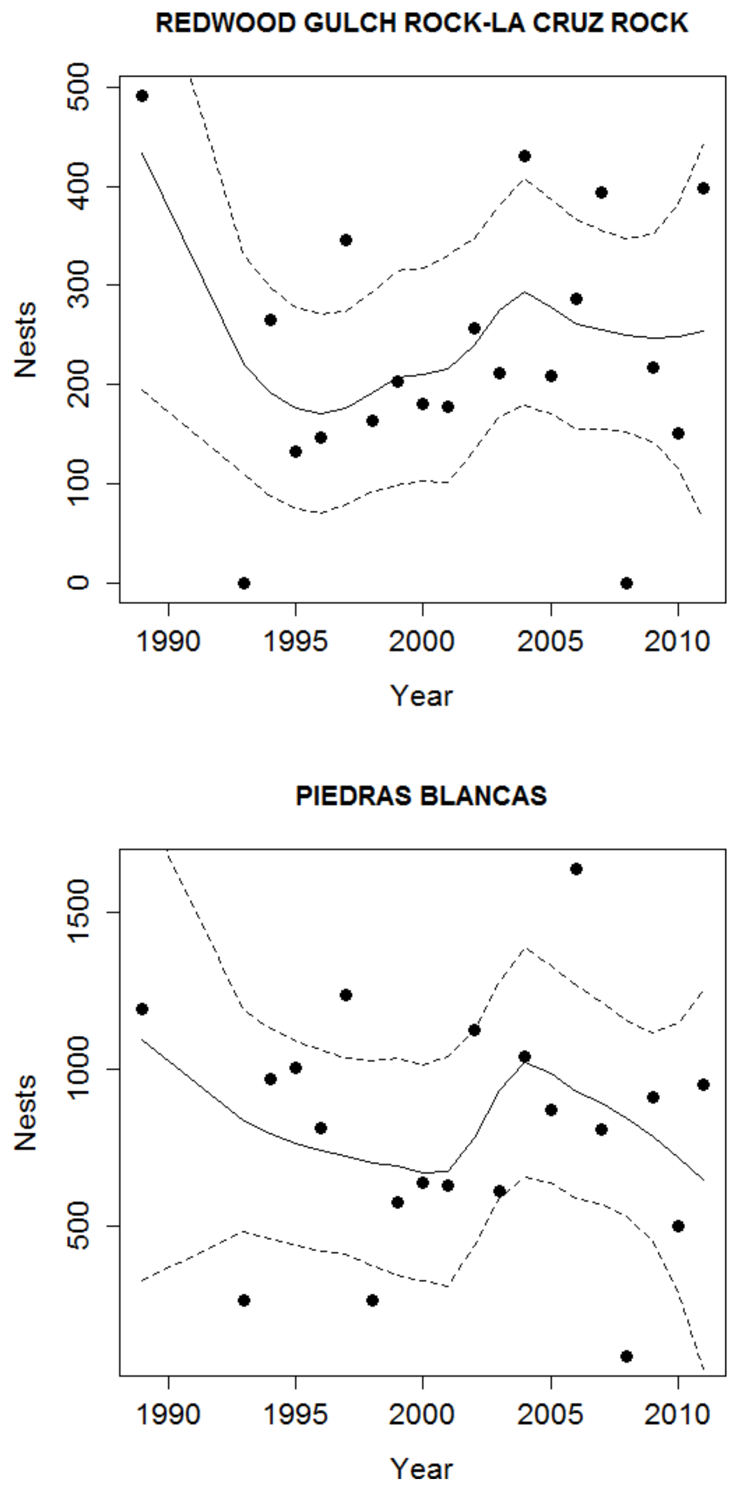
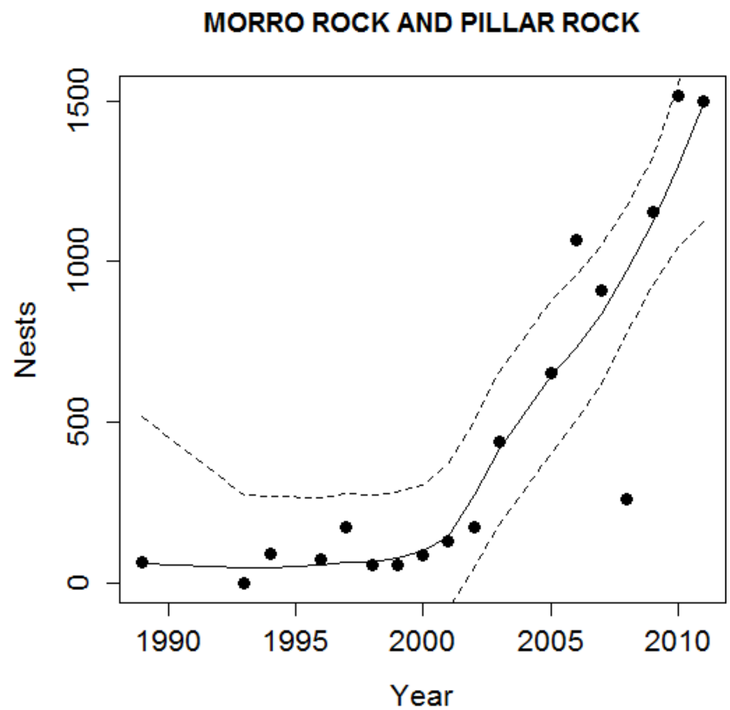


Figure 6. Non-linear trends in numbers of Brandt's Cormorant nests for the Redwood Gulch Rock to La Cruz Rock and Piedras Blancas colony complexes, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.



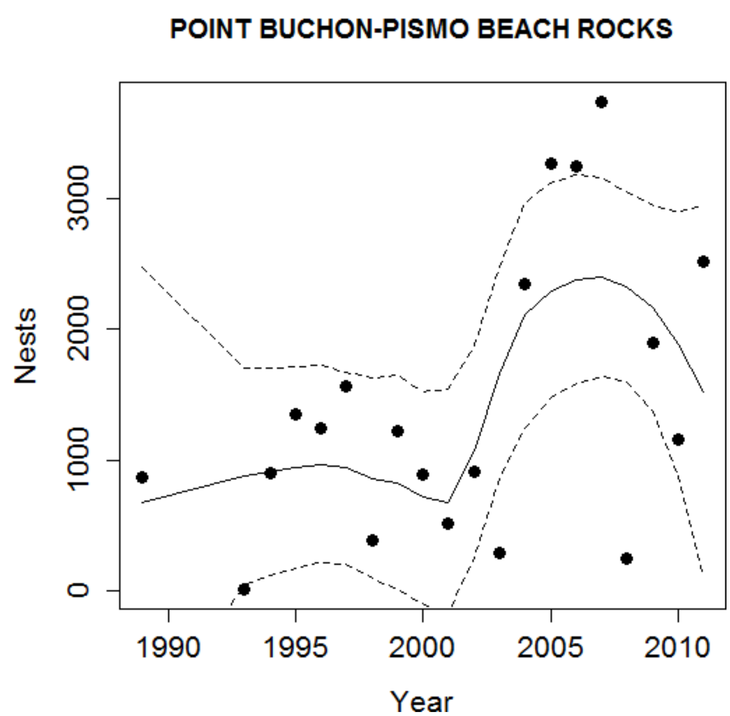


Figure 7. Non-linear trends in numbers of Brandt's Cormorant nests for Morro Rock and Pillar Rock and the Point Buchon to North Pismo Beach Rocks colony complex, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.

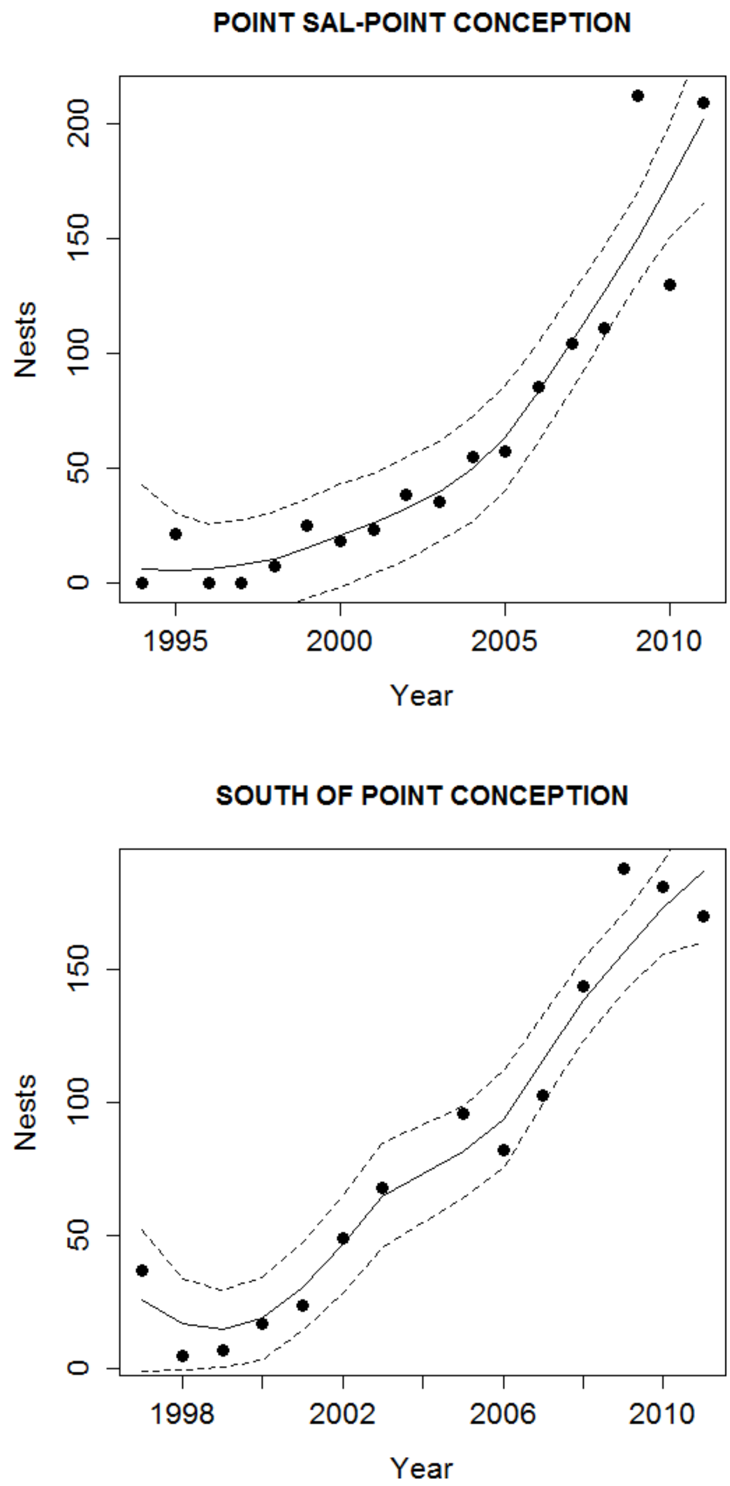


Figure 8. Non-linear trends in numbers of Brandt's Cormorant nests for the Point Sal to Point Conception and South of Point Conception colony complexes, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.

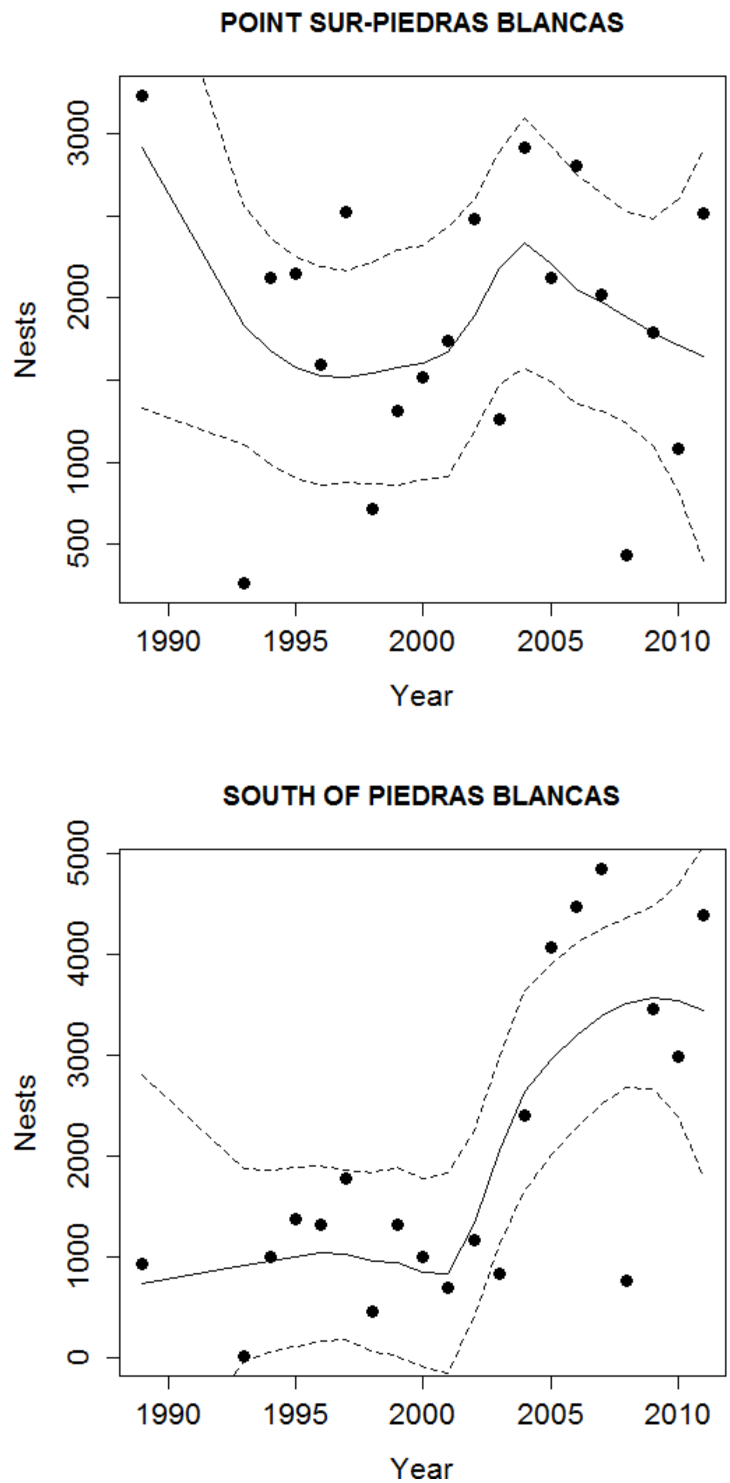


Figure 9. A figure of Non-linear trends in numbers of Brandt's Cormorant nests for the Point Sur to Piedras Blancas and South of Piedras Blancas subregions, 1989-2011. Shown are LOESS smooth curveand 95% confidence intervals. Also see Tables 1-3.

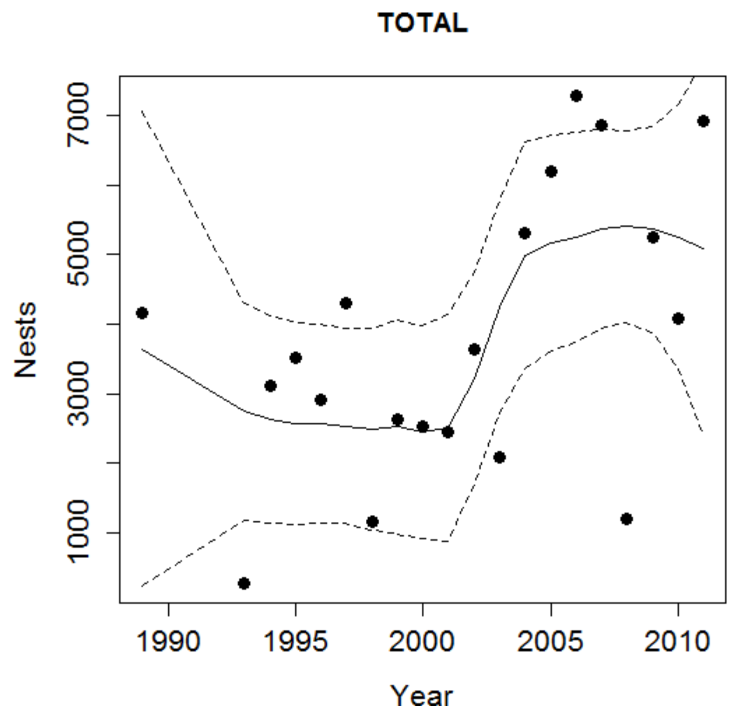


Figure 10. Non-linear trends in numbers of Brandt's Cormorant nests from Point Sur to Point Mugu, California, 1989-2011. Shown are LOESS smooth curve and 95% confidence intervals. Also see Tables 1-3.

Figure 11. Abandoned Brandt's Cormorant nests at Seastack South of Redwood Gulch, Subcolony 03, 30 May 2006.

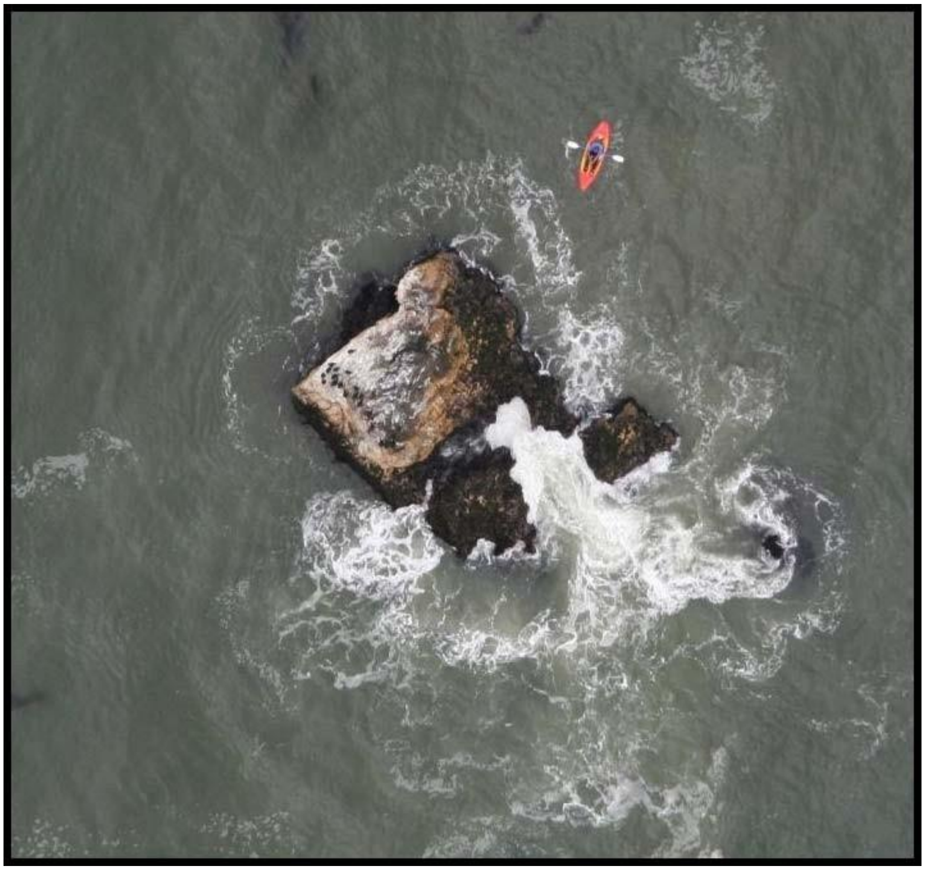
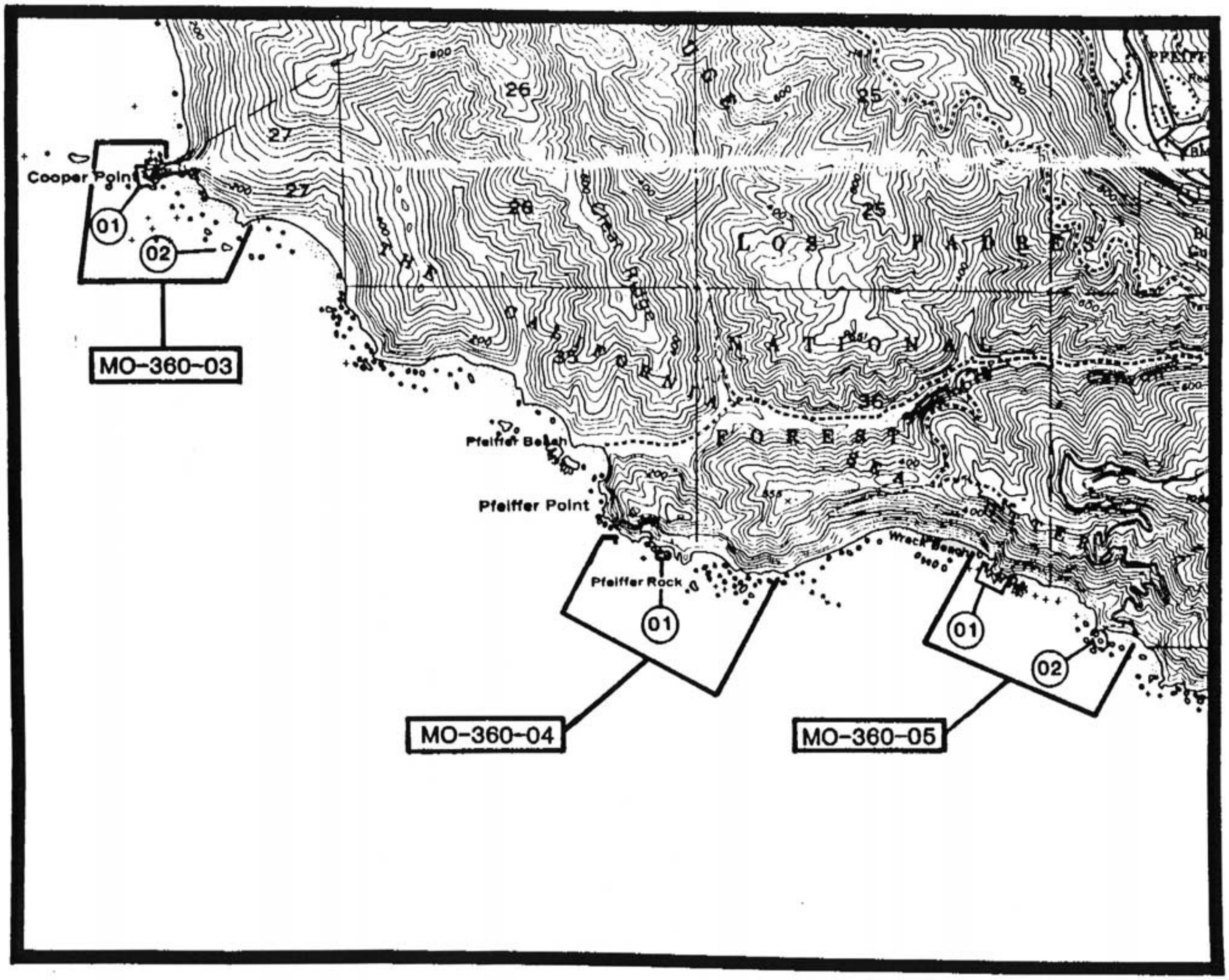


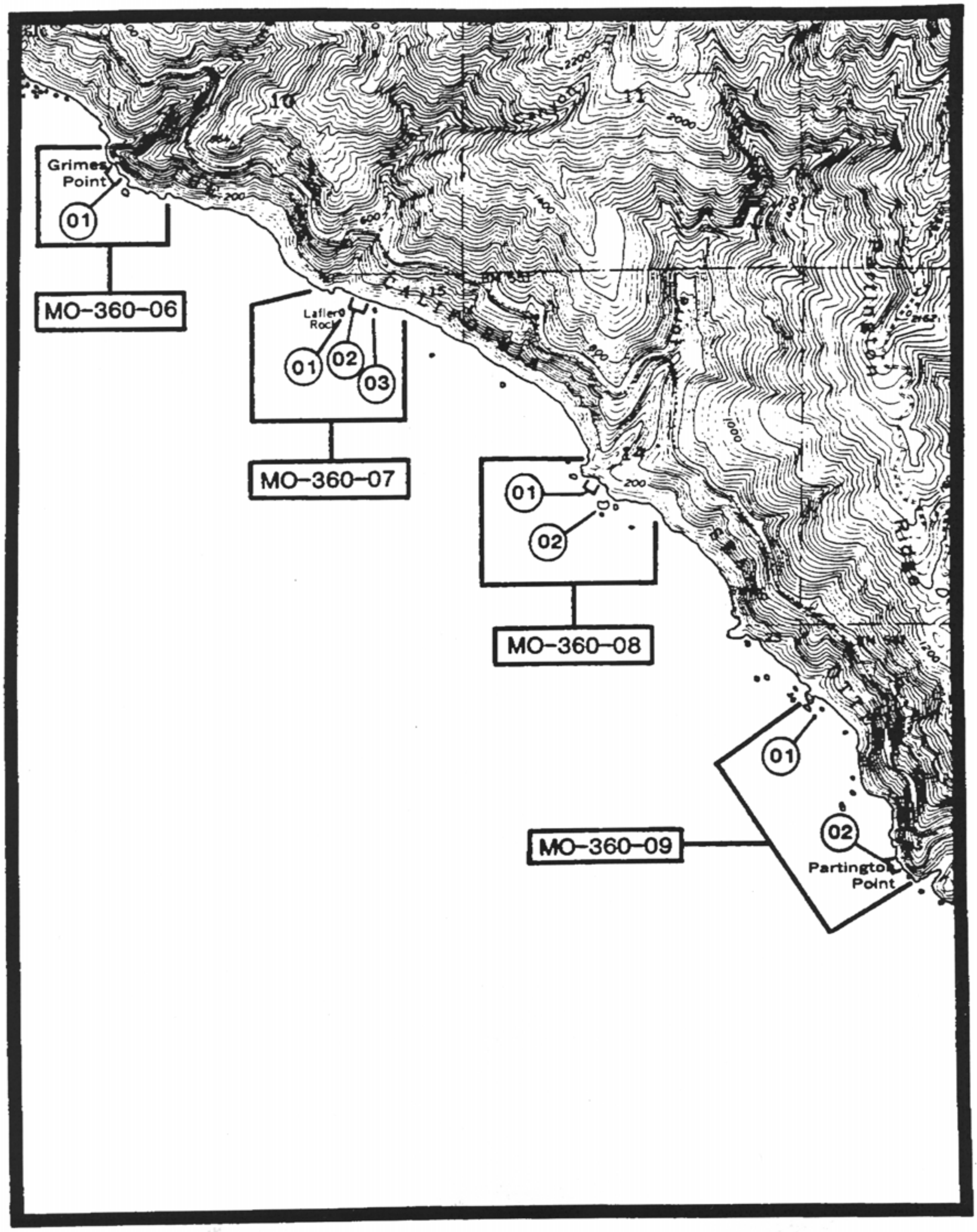
Figure 12. Kayaker in close proximity to roosting cormorants at Shell Beach Rocks, 6 June 2011.

APPENDIX 1

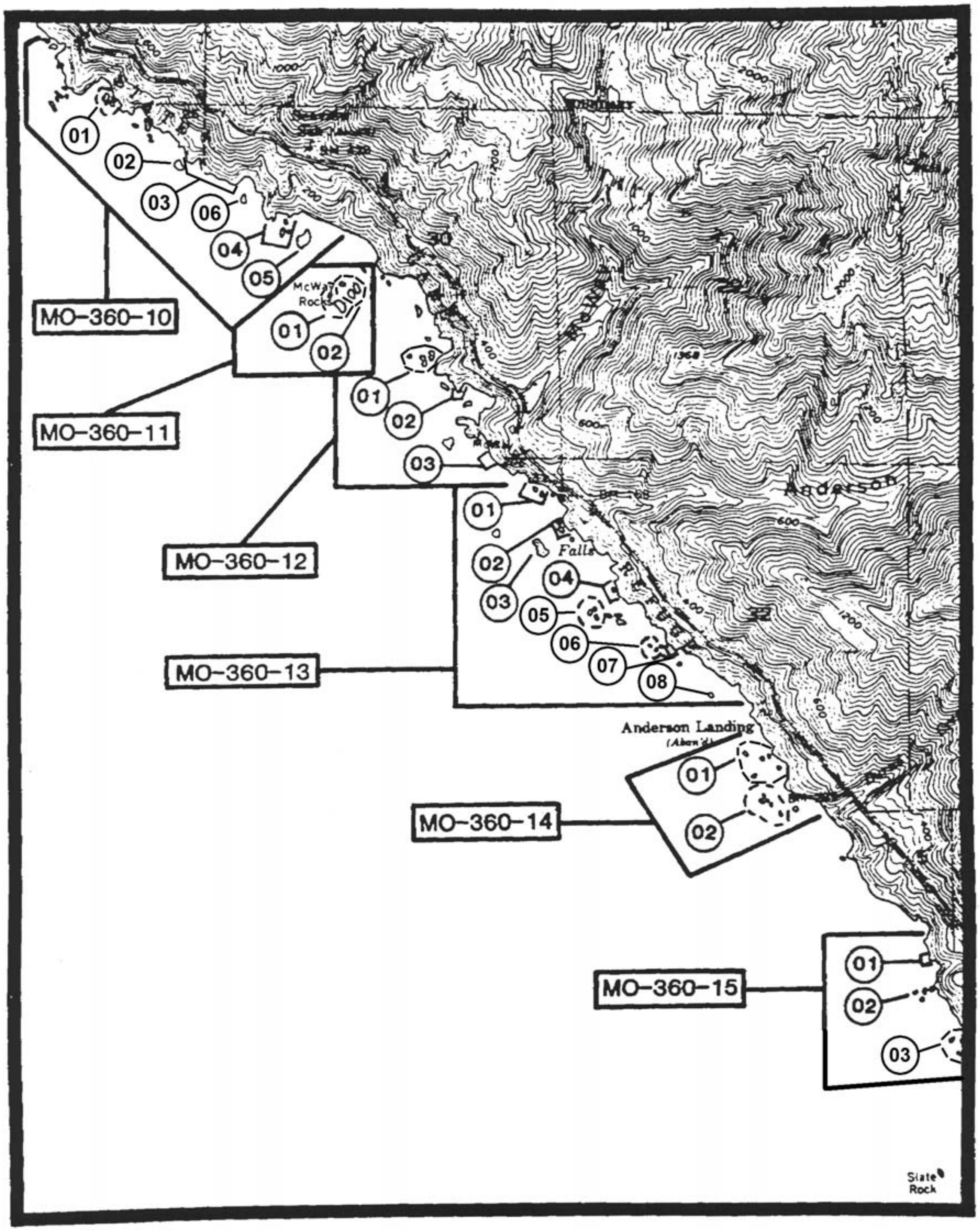
Maps of locations of seabird colonies and subcolonies, Point Sur-Point Mugu, California



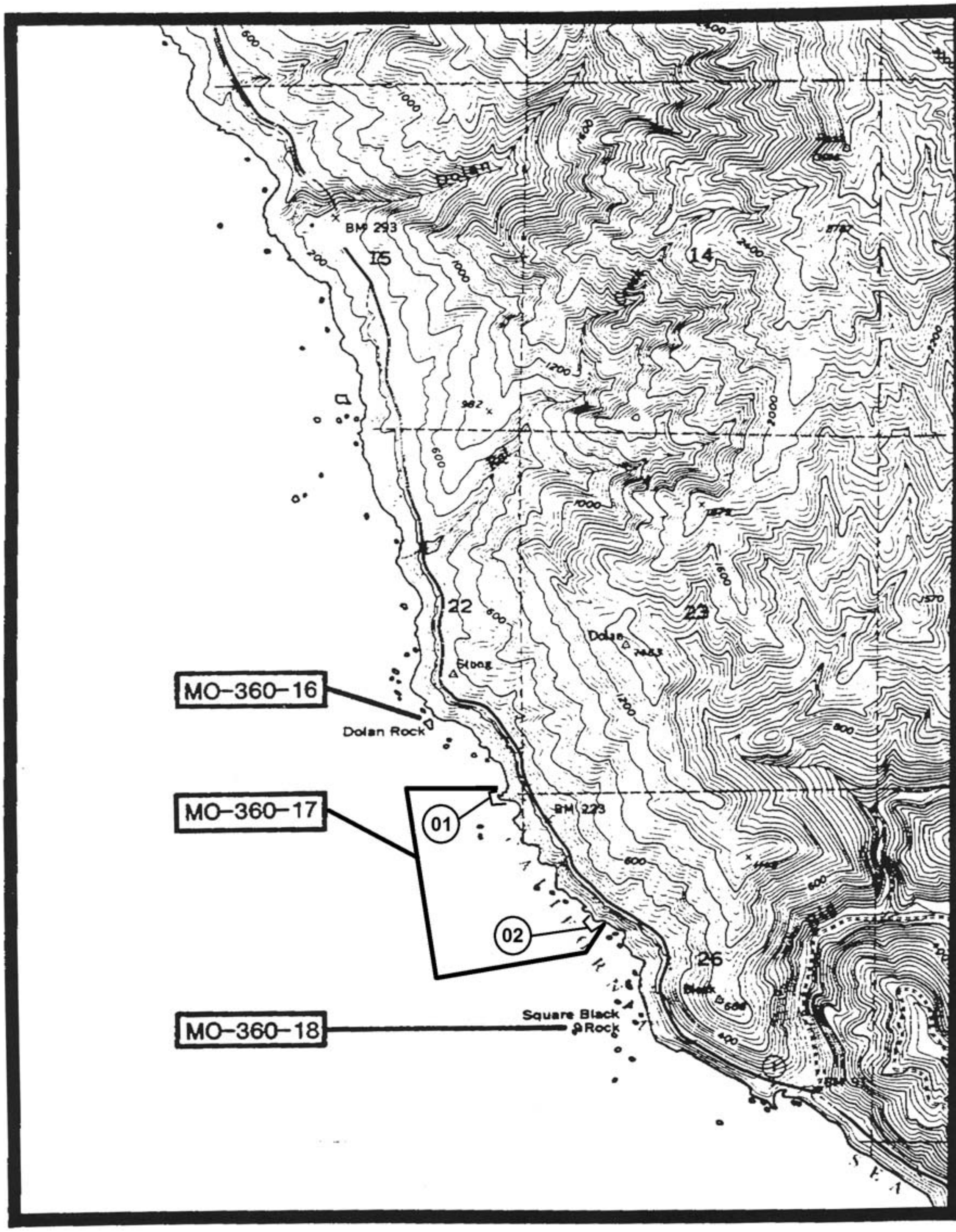
Map 1. Section from USGS map "Big Sur and Pfeiffer Point" (unmodified from Carter et al. 1992: II-137 [Map 135]), indicating colony and subcolony locations for Cooper Point and Islands (MO-360-03), Pfeiffer Point (MO-360-04), and Wreck Beach South (MO-360-05).



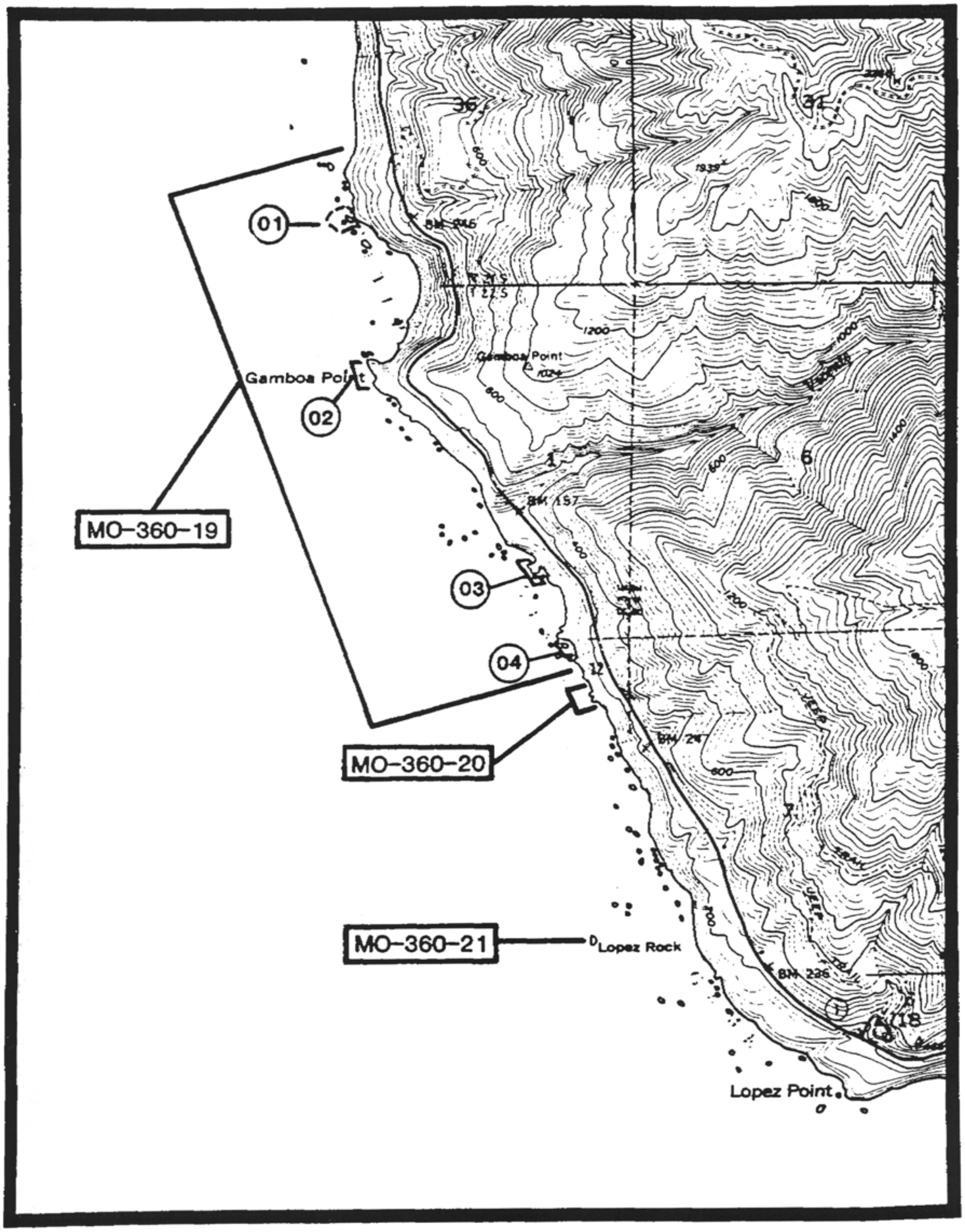
Map 2. Section from USGS map "Partington Ridge" (unmodified from Carter et al. 1992: II-138 [Map 136]), indicating colony and subcolony locations for Grimes Point (MO-360-06), Lafler Rock and Mainland (MO-360-07), Torre Canyon Rocks (MO-360-08), and Partington Point (MO-360-09).



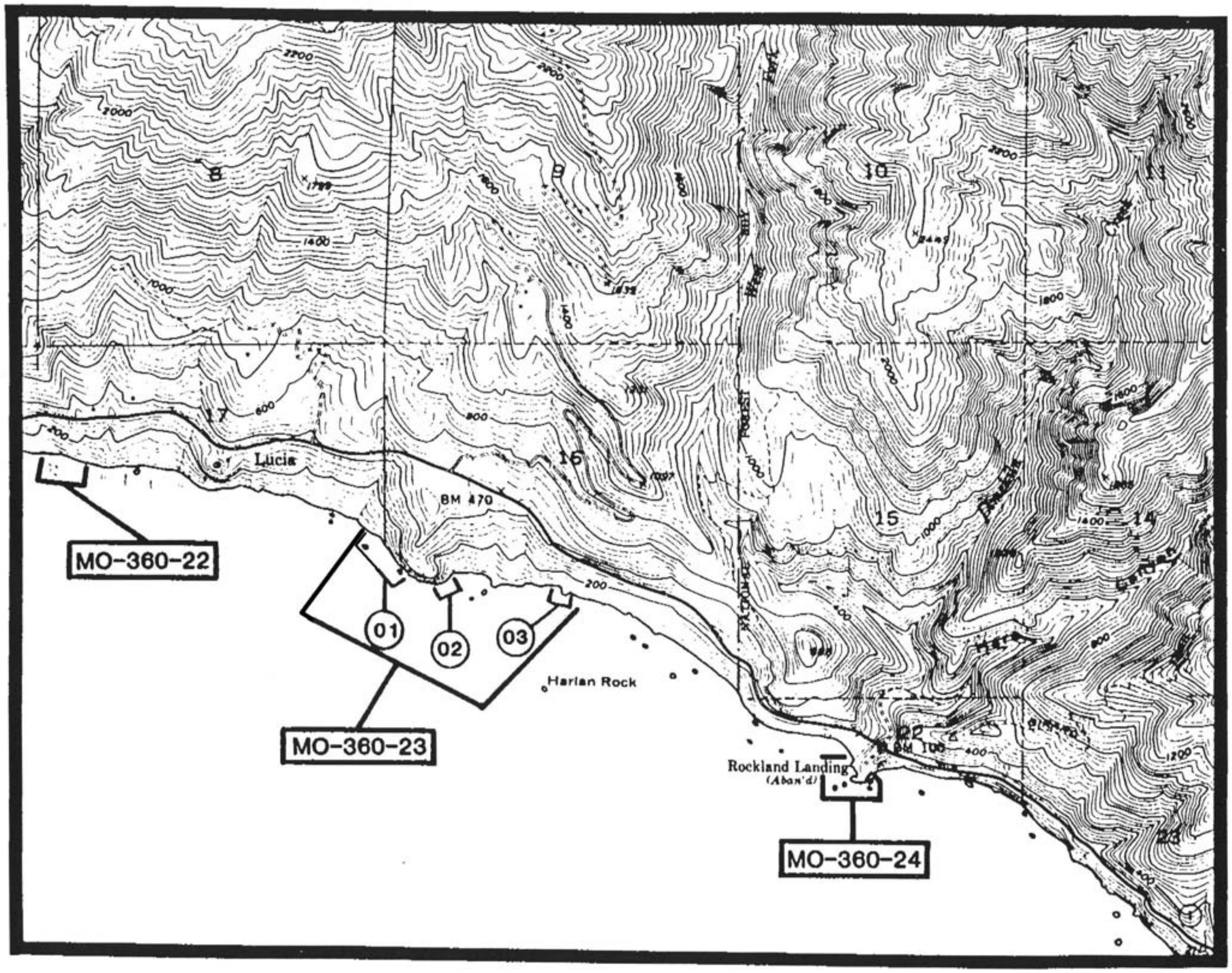
Map 3. Section from USGS map "Partington Ridge" (modified from Carter et al. 1992: II-139 [Map 137]), indicating colony and subcolony locations for Partington Ridge North (MO-360-10), McWay Rocks (MO-360-11), Partington Ridge South (MO-360-12), Anderson Canyon Rocks (MO-360-13), Burns Creek Rocks (MO-360-14), and Buck Creek (MO-360-15).



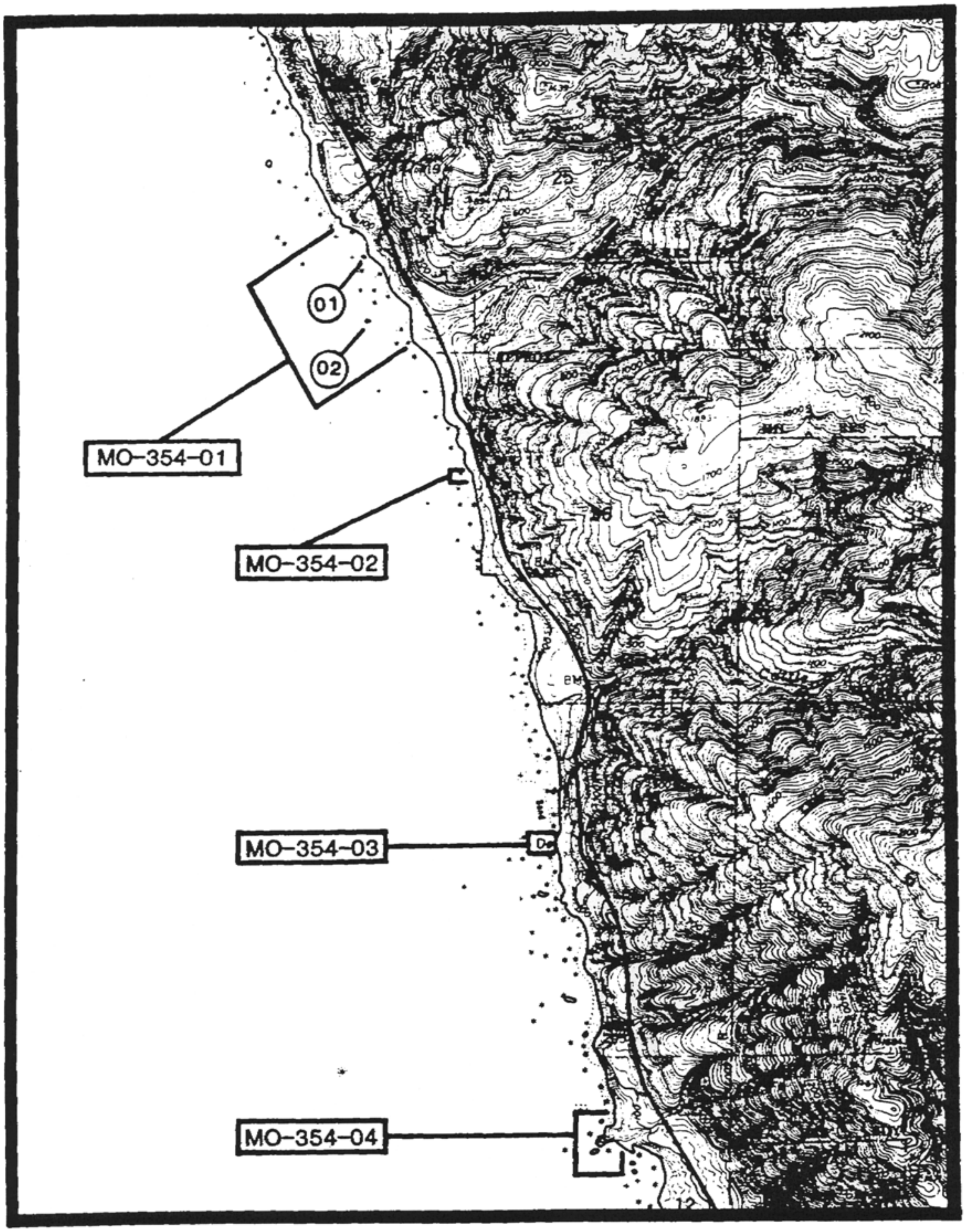
Map 4. Section from USGS map "Lopez Point" (modified from Carter et al. 1992: II-140 [Map 138]), indicating colony and subcolony locations for Dolan Rock (MO-360-16), Bench Mark 223 (MO-360-17), and Square Black Rock (MO-360-18).



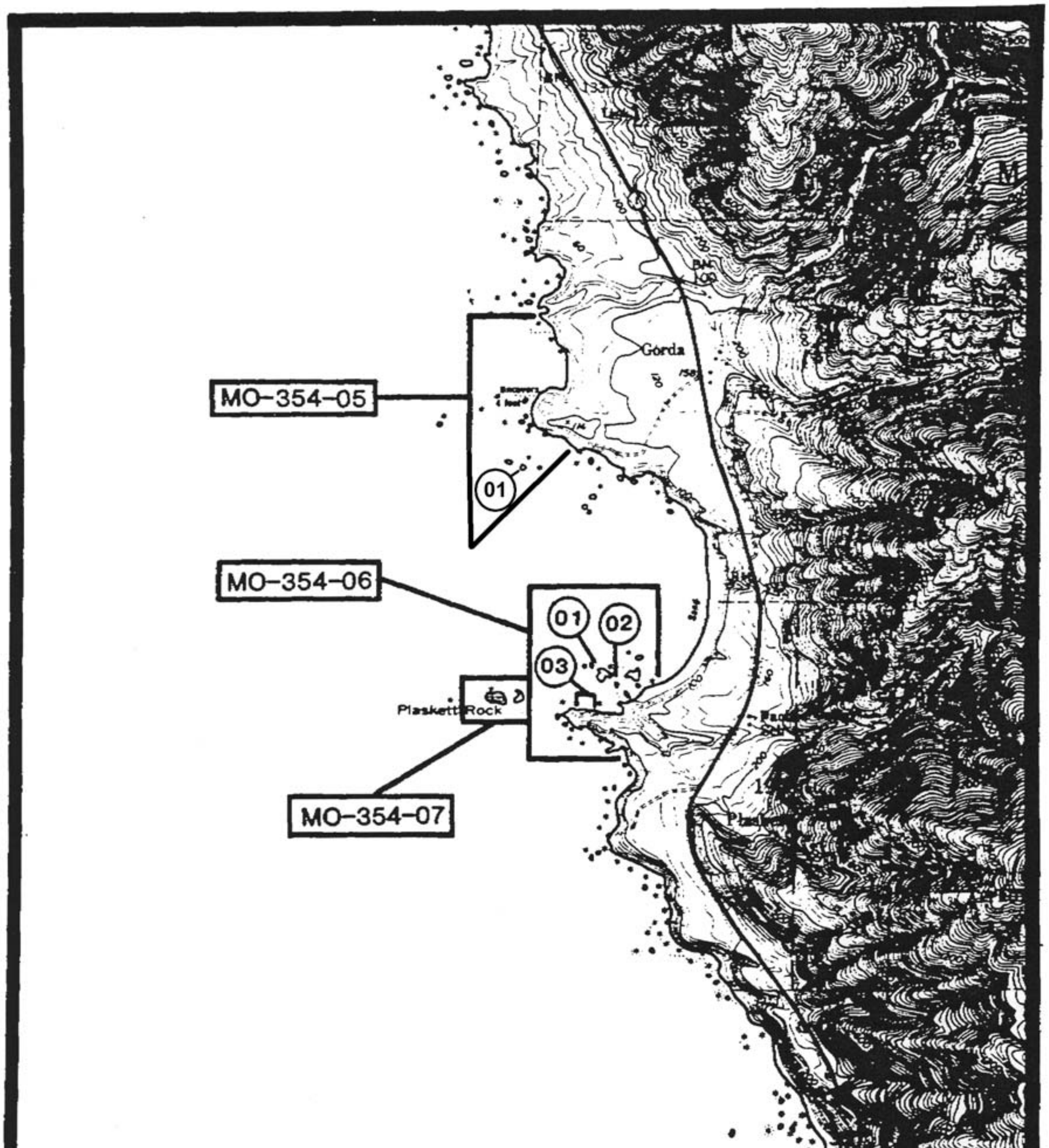
Map 5. Section from USGS map "Lopez Point" (unmodified from Carter et al. 1992: II-141 [Map 139]), indicating colony and subcolony locations for Gamboa Point (MO-360-19), Bench Mark 247 (MO-360-20), and Lopez Rock (MO-360-21).



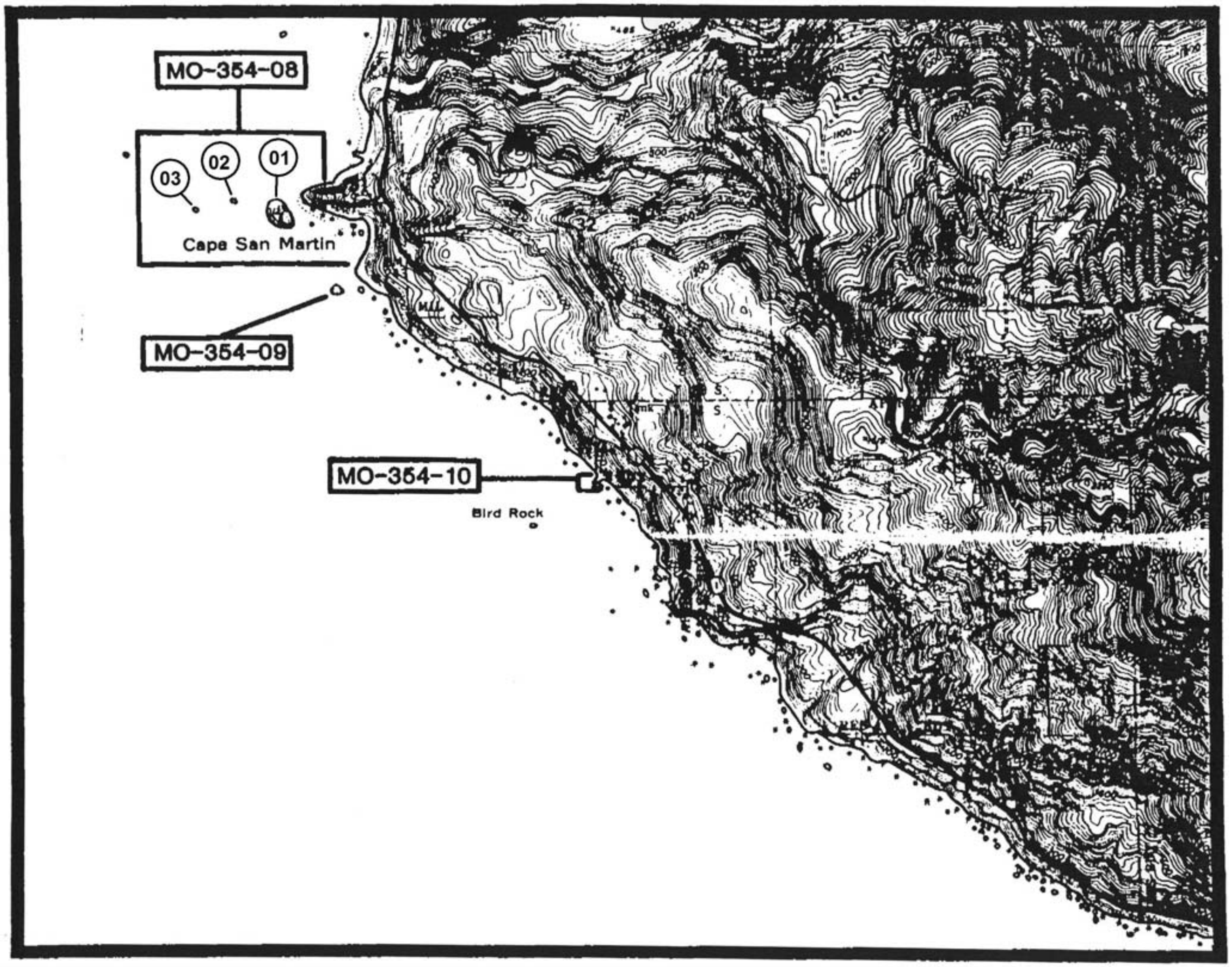
Map 6. Section from USGS map "Lopez Point" (modified from Carter et al. 1992: II-142 [Map 140]), indicating colony and subcolony locations for Lopez Point South (MO-360-22), Rockland Landing North (MO-360-23), and Rockland Landing (MO-360-24).



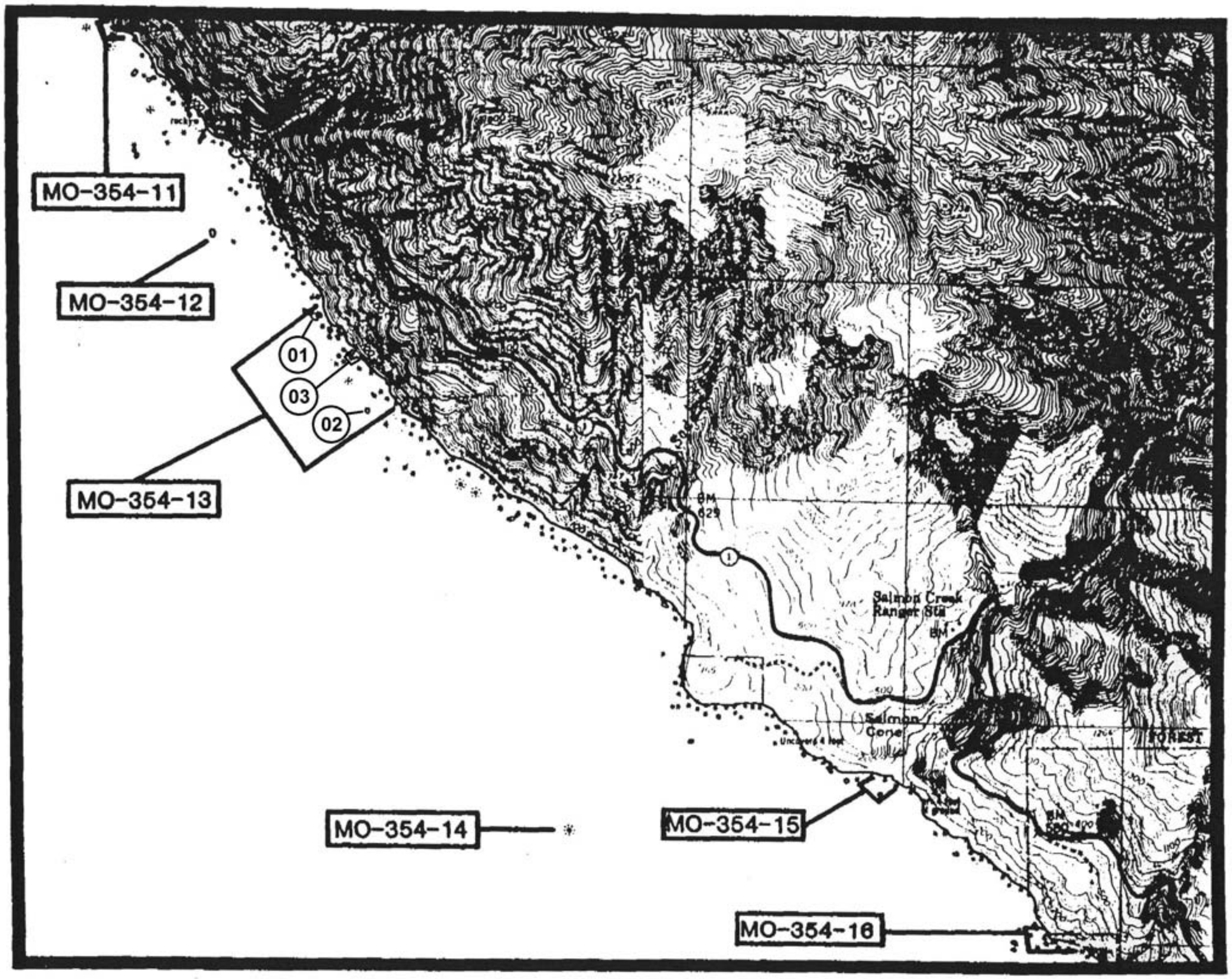
Map 7. Section from USGS map “Cape San Martin” (unmodified from Carter et al. 1992: II-143 [Map 141]), indicating colony and subcolony locations for Kirk Creek to Mill Creek (MO-35401), 36 North (MO-354-02), Larus Rock (MO-354-03), and Unnamed Point (MO-354-04).



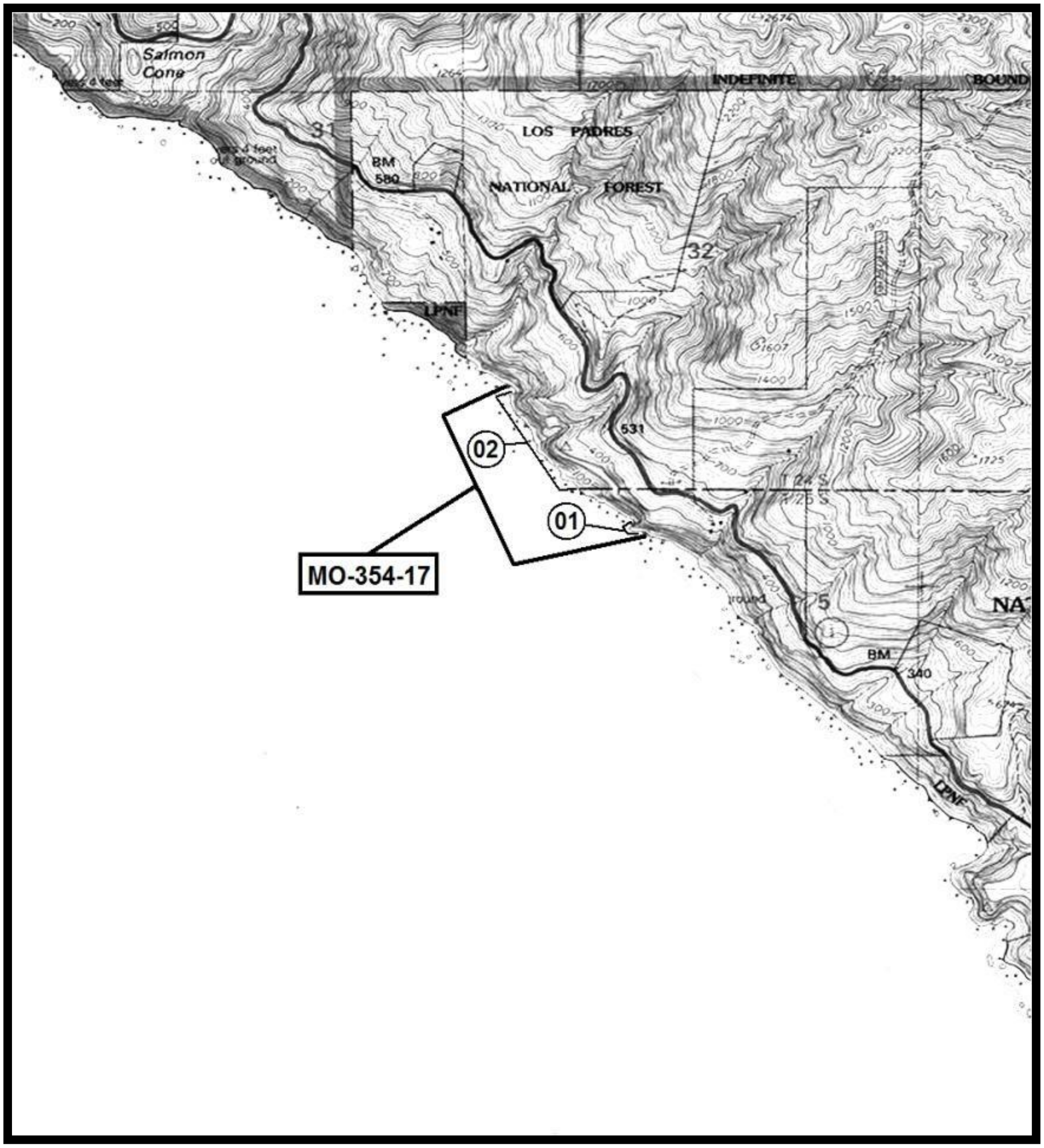
Map 8. Section from USGS map "Cape San Martin" (modified from Carter et al. 1992: II-144 [Map 142]), indicating colony and subcolony locations for Gorda Area (MO-354-05), Small Rocks and Mainland North and East of Plaskett Rock (MO-354-06), and Plaskett Rock (MO-354-07).



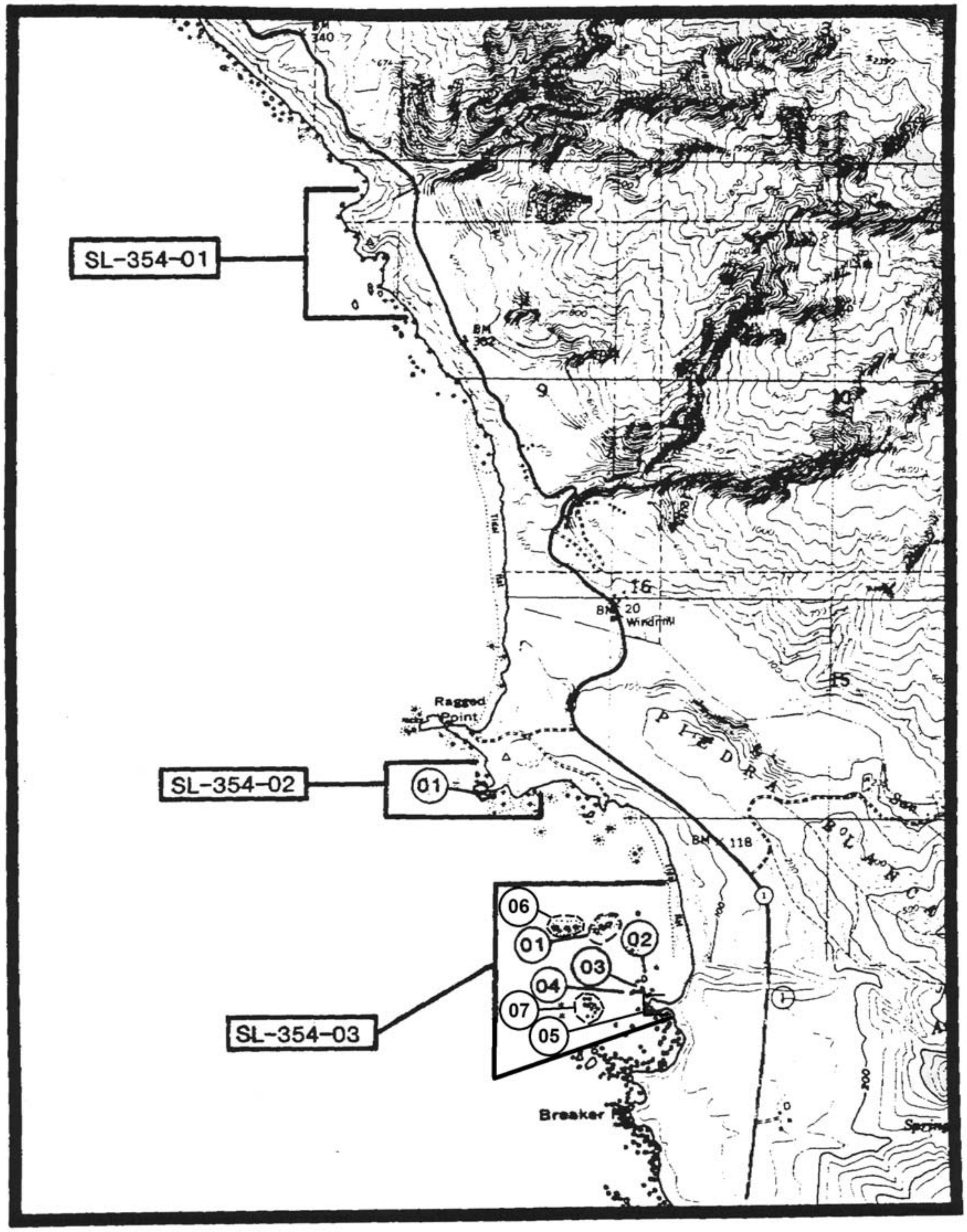
Map 9. Section from USGS map "Cape San Martin" (modified from Carter et al. 1992: II-145 [Map 143]), indicating colony and subcolony locations for Cape San Martin (MO-354-08), Unnamed Rock (MO-354-09), and Mainland Point Across from Bird Rock (MO-354-10).



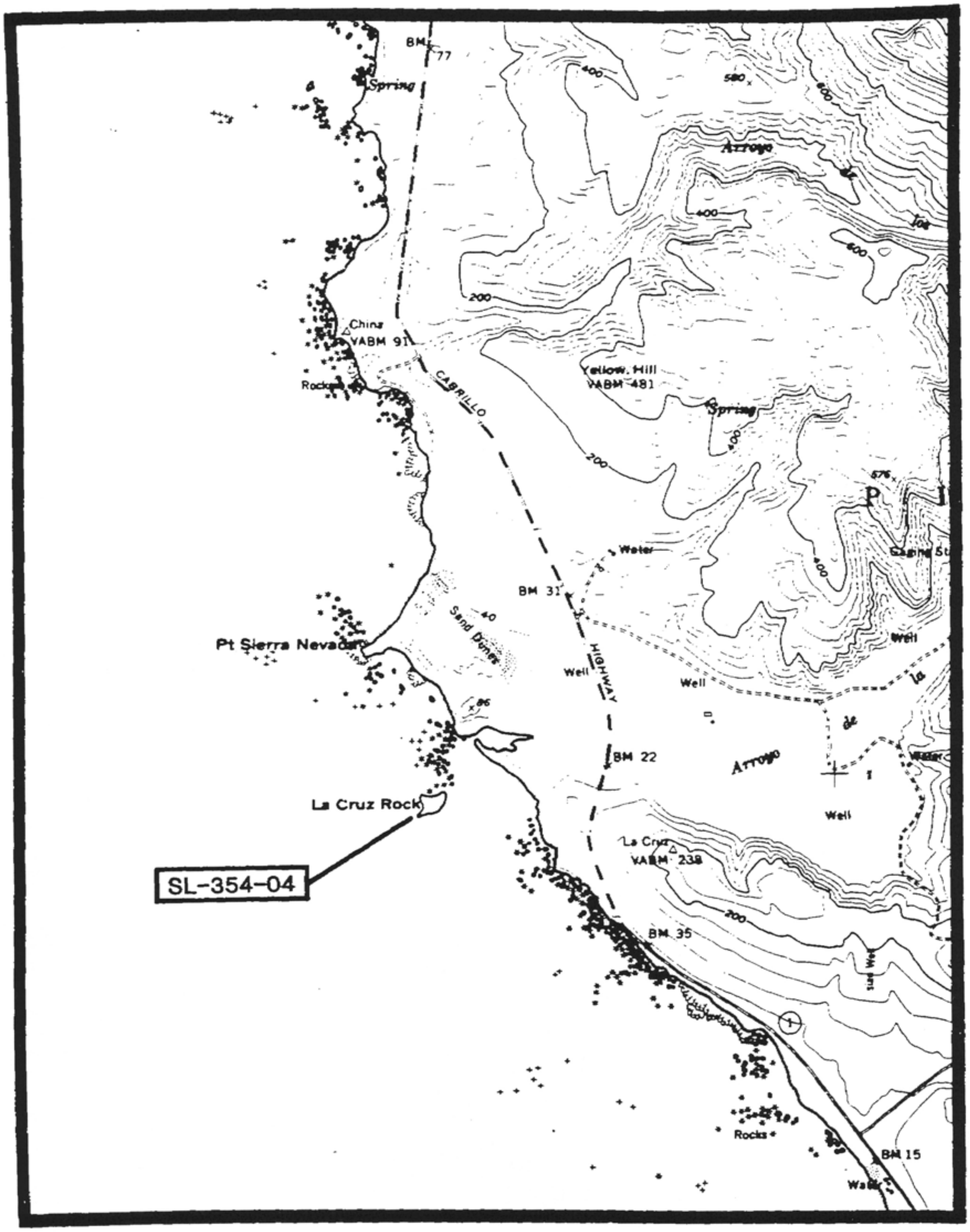
Map 10. Section from USGS map "Villa Creek and Burro Mountain" (modified from Carter et al. 1992: II-146 [Map 144]), indicating colony and subcolony locations for Point North of Redwood Gulch (MO-354-11), Redwood Gulch Rock (MO-354-12), Seastack South of Redwood Gulch (MO-354-13), Unmapped Island (MO-354-14), Salmon Creek (MO-354-15), and Arched Peninsula South of Salmon Creek (MO-354-16).



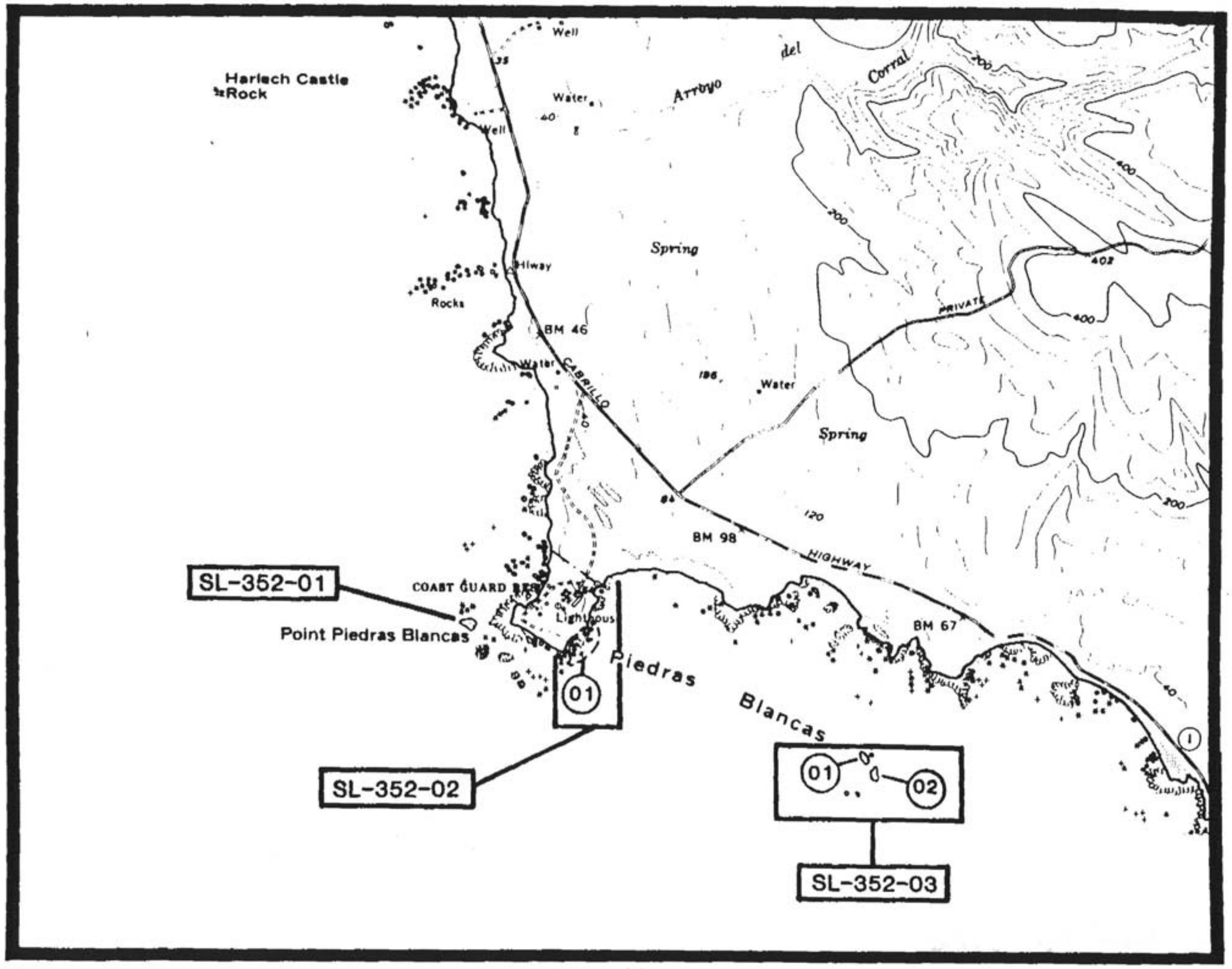
Map 11. Section from USGS map "Burro Mountain", indicating colony and subcolony locations for Crystal Point (MO-354-17; new colony, not previously mapped).



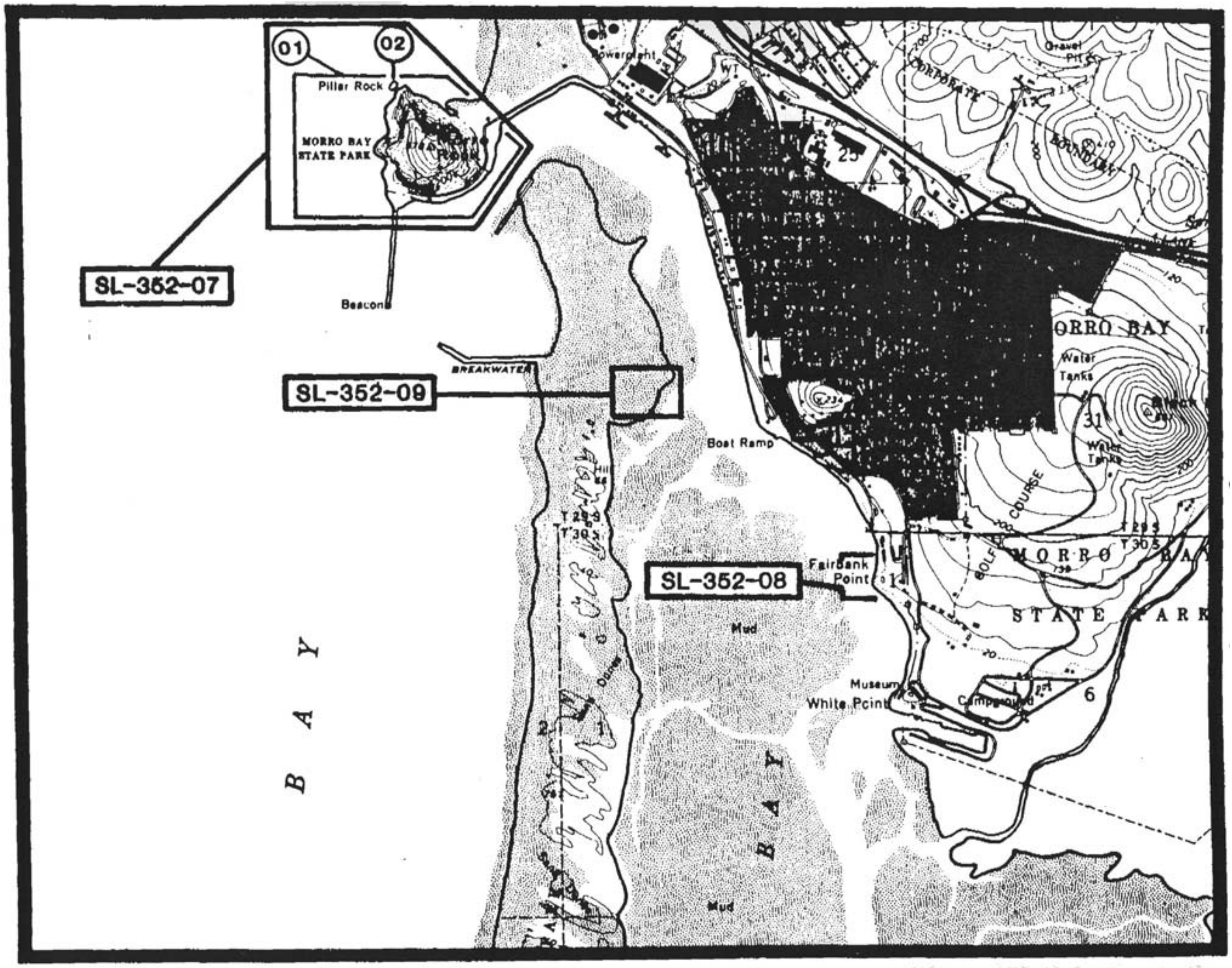
Map 12. Section from USGS map "Burro Mountain and Piedras Blancas" (modified from Carter et al. 1992: II-147 [Map 145]), indicating colony and subcolony locations for Ragged Point Lodge Colony (SL-354-01), Ragged Point South (SL-354-02), and 3 Rocks (SL-354-03).



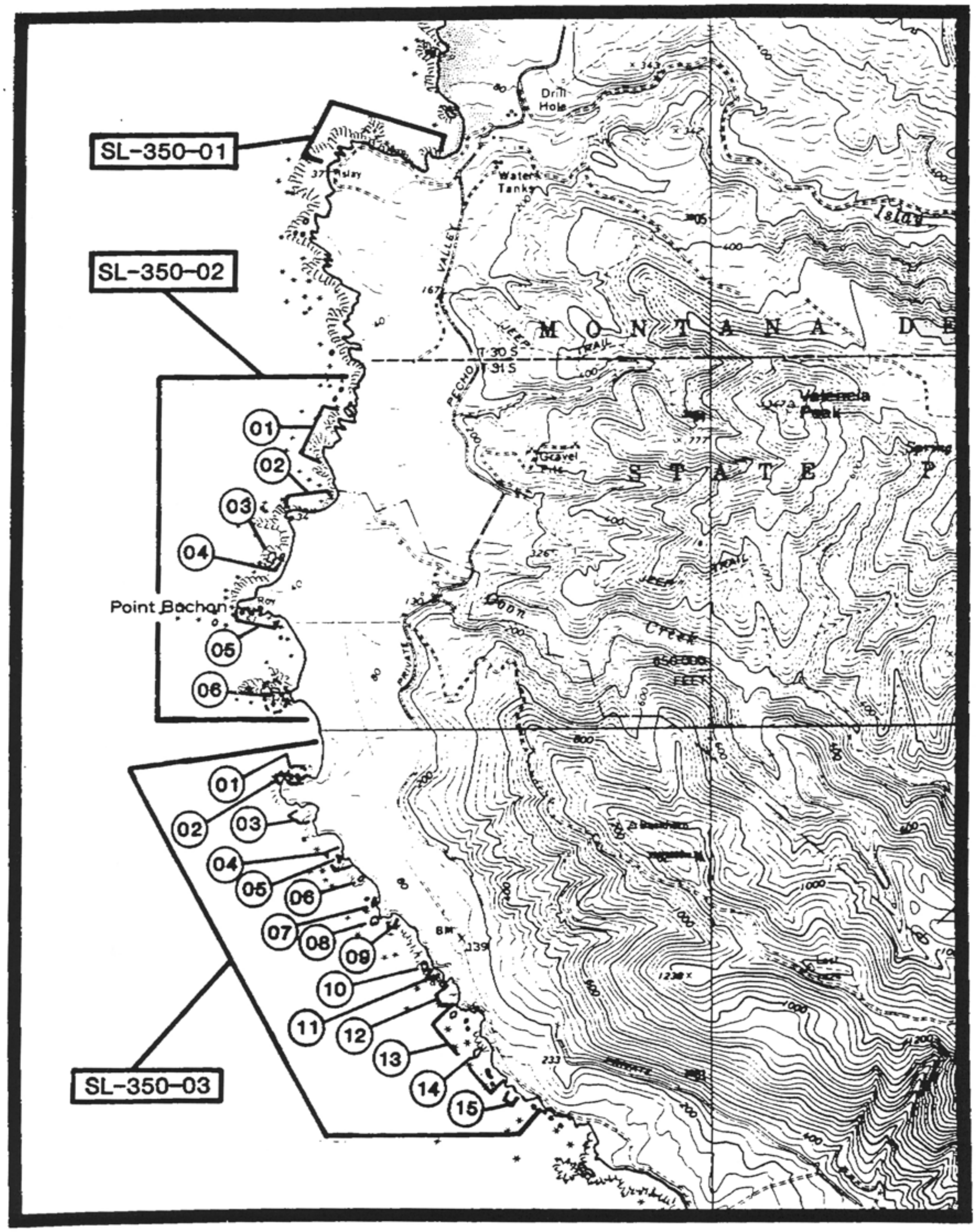
Map 13. Section from USGS map “Piedras Blancas” (unmodified from Carter et al. 1992: II-148 [Map 146]), indicating colony and subcolony locations for La Cruz Rock (SL-354-04).



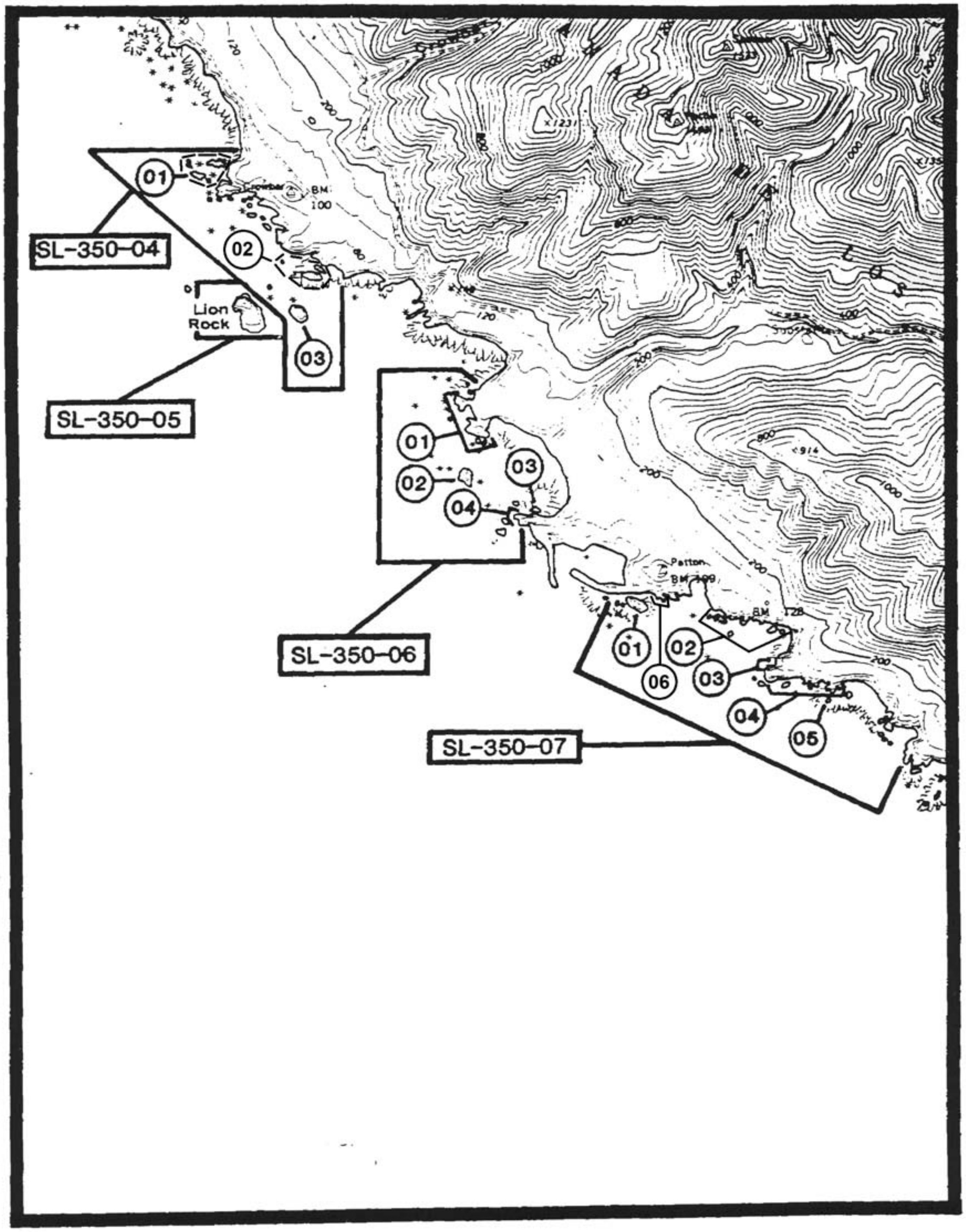
Map 14. Section from USGS map "Piedras Blancas" (unmodified from Carter et al. 1992: II-149 [Map 147]), indicating colony and subcolony locations for Piedras Blancas Island (SL-352-01), Point Piedras Blancas (SL-352-02), and Two Rocks South of Point Piedras Blancas (SL-352-03).



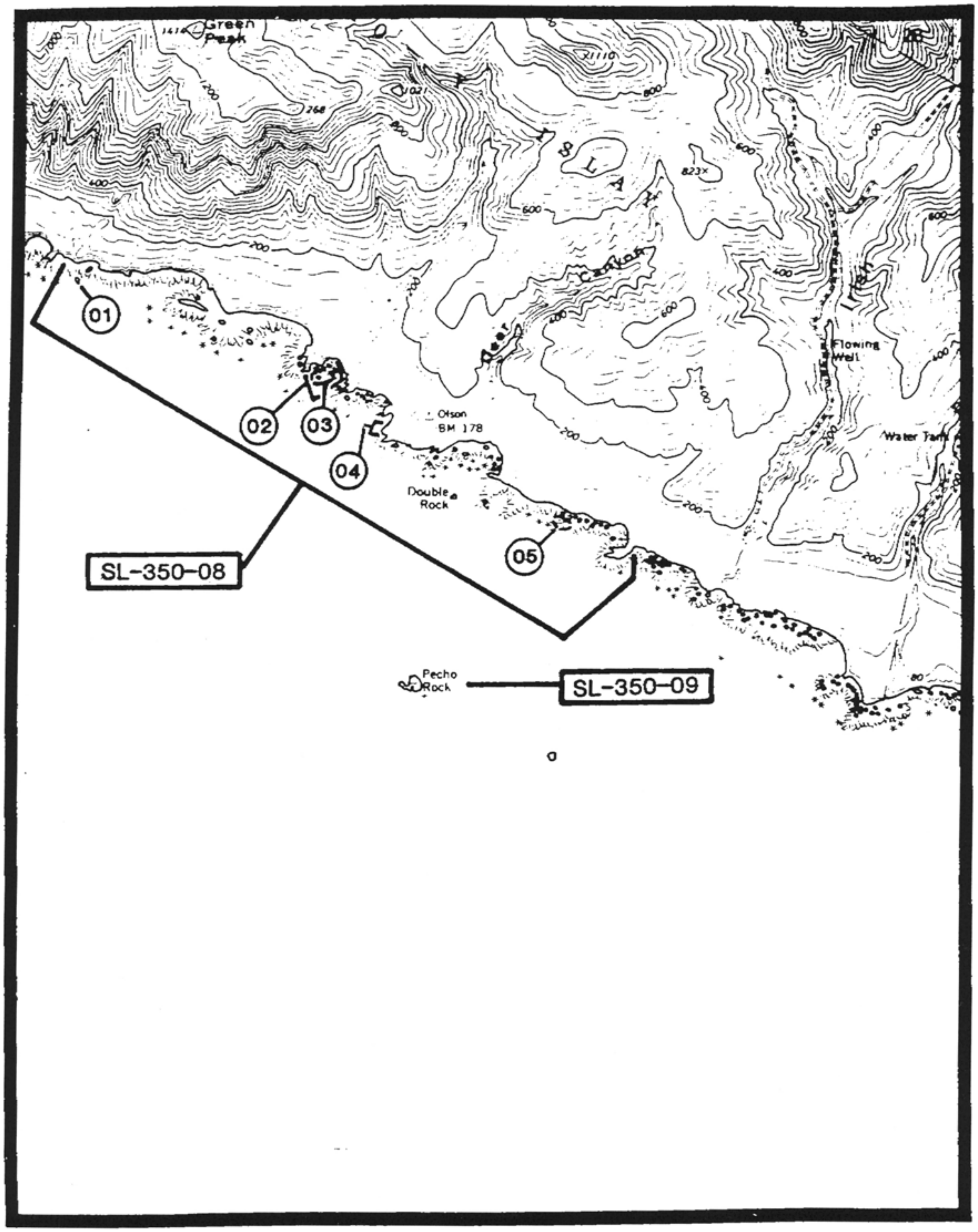
Map 15. Section from USGS map “Morro Bay South” (unmodified from Carter et al. 1992: II-152 [Map 150]), indicating colony and subcolony locations for Morro Rock and Pillar Rock (SL-352-07), Fairbank Point (SL-352-08), and Morro Bay Spit (SL-352-09).



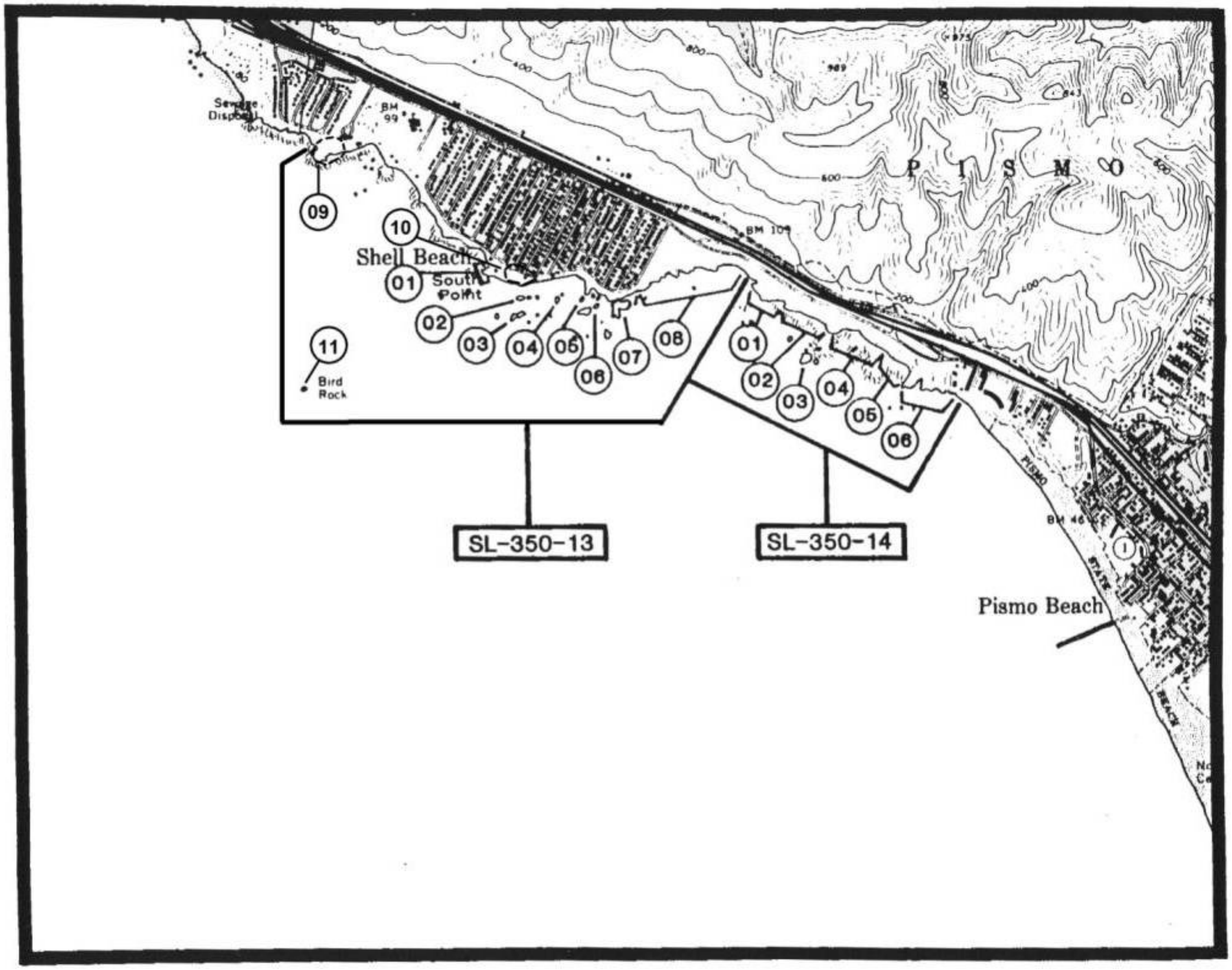
Map 16. Section from USGS map "Morro Bay South and Port San Luis" (unmodified from Carter et al. 1992: II-153 [Map 151]), indicating colony and subcolony locations for Spooner's Cove (SL-350-01), Point Buchon (SL-350-02), and Unnamed Rocks (SL-352-03).



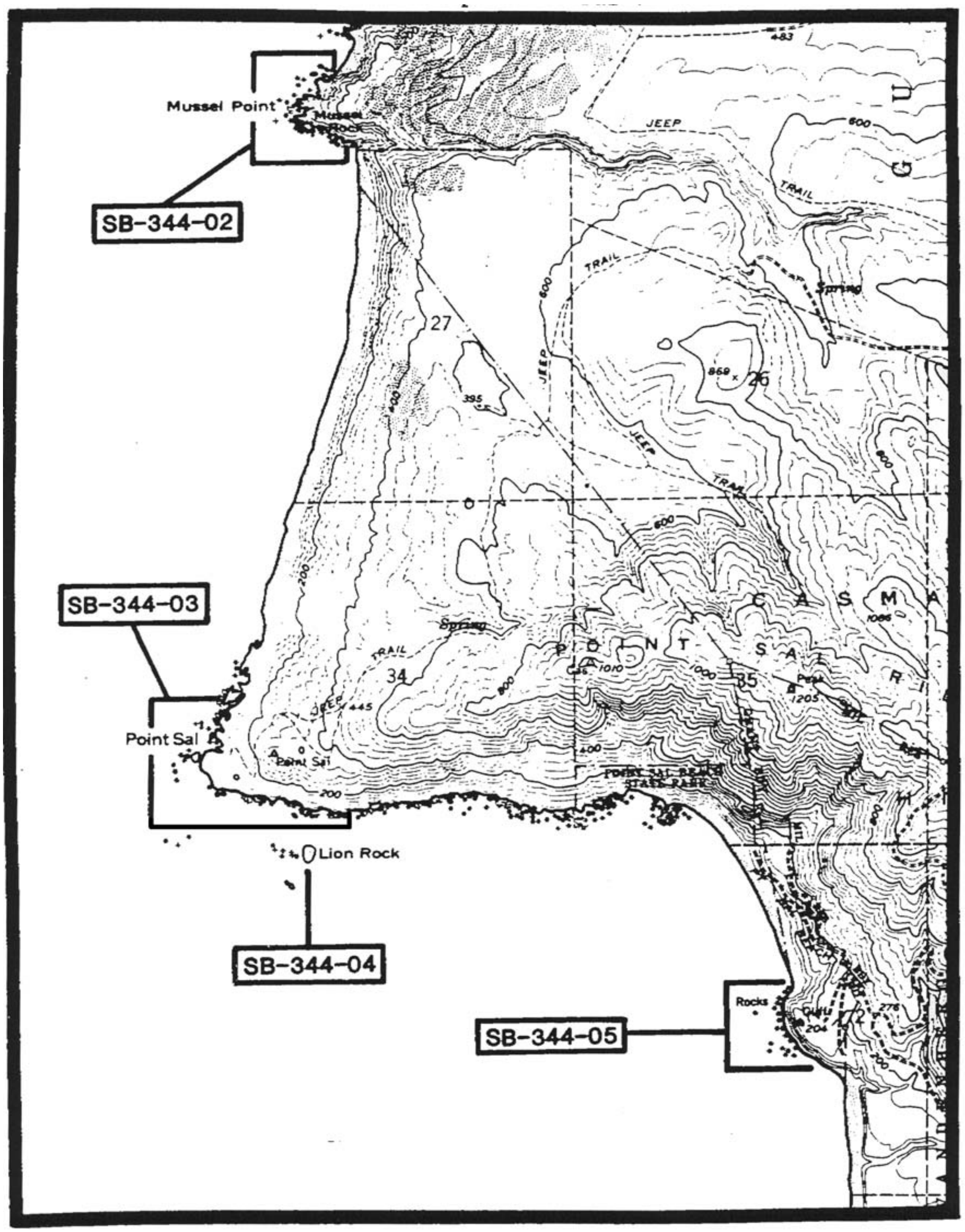
Map 17. Section from USGS map "Port San Luis" (modified from Carter et al. 1992: II-154 [Map 152]), indicating colony and subcolony locations for Pup Rock and Adjacent Mainland (SL-350-04), Lion Rock (SL-350-05), Diablo Rock and Adjacent Mainland (SL-350-06), and Diablo Canyon Nuclear Power Plant South (SL-350-07).



Map 18. Section from USGS map "Port San Luis" (unmodified from Carter et al. 1992: II-155 [Map 153]), indicating colony and subcolony locations for Double Rock Region (SL-350-08) and Pecho Rock (SL-350-09).

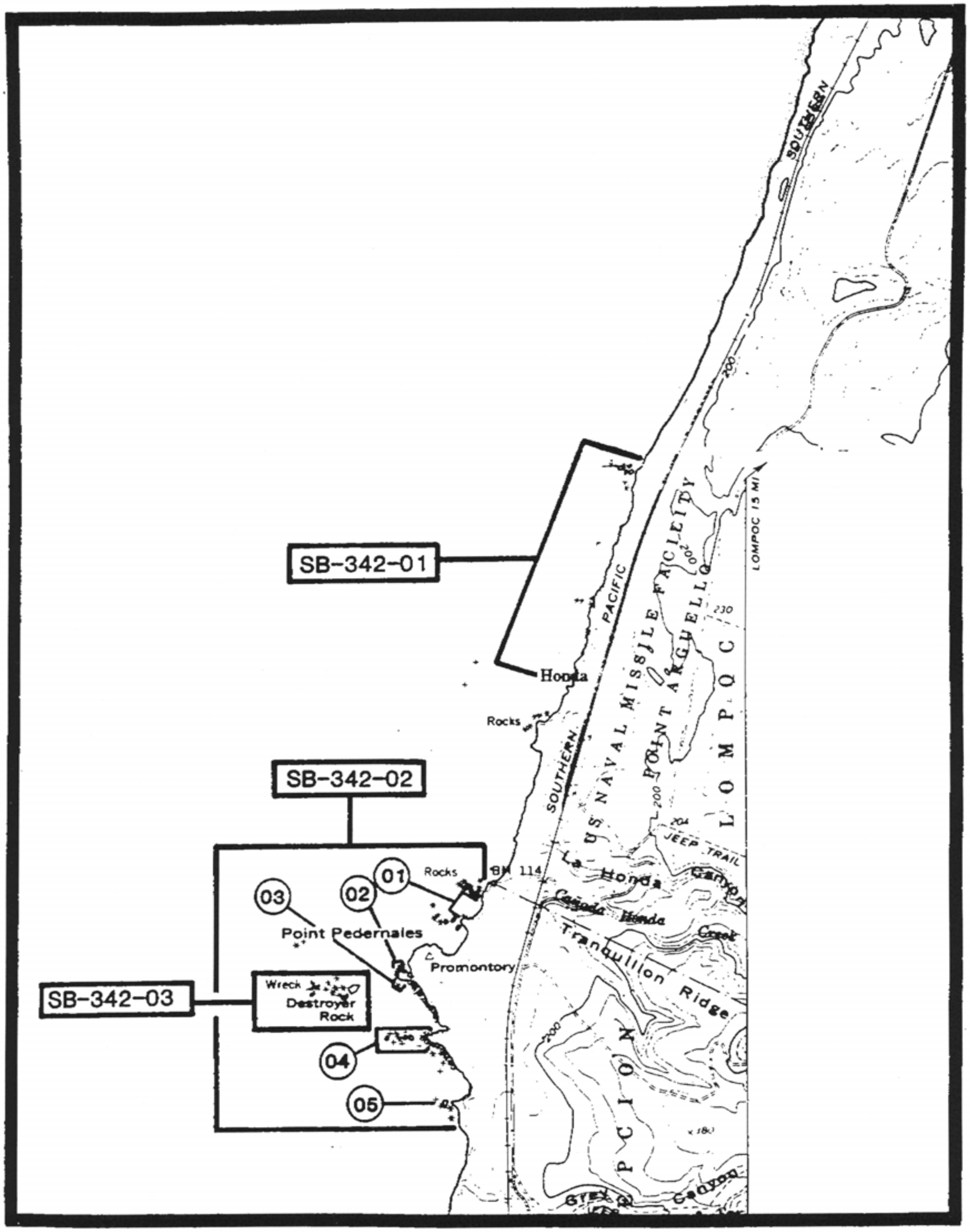


Map 19. Section from USGS map "Pismo Beach" (modified from Carter et al. 1992: II-157 [Map 155]), indicating colony and subcolony locations for Shell Beach Rocks (SL-350-13) and North Pismo Beach Rocks (SL-350-14).

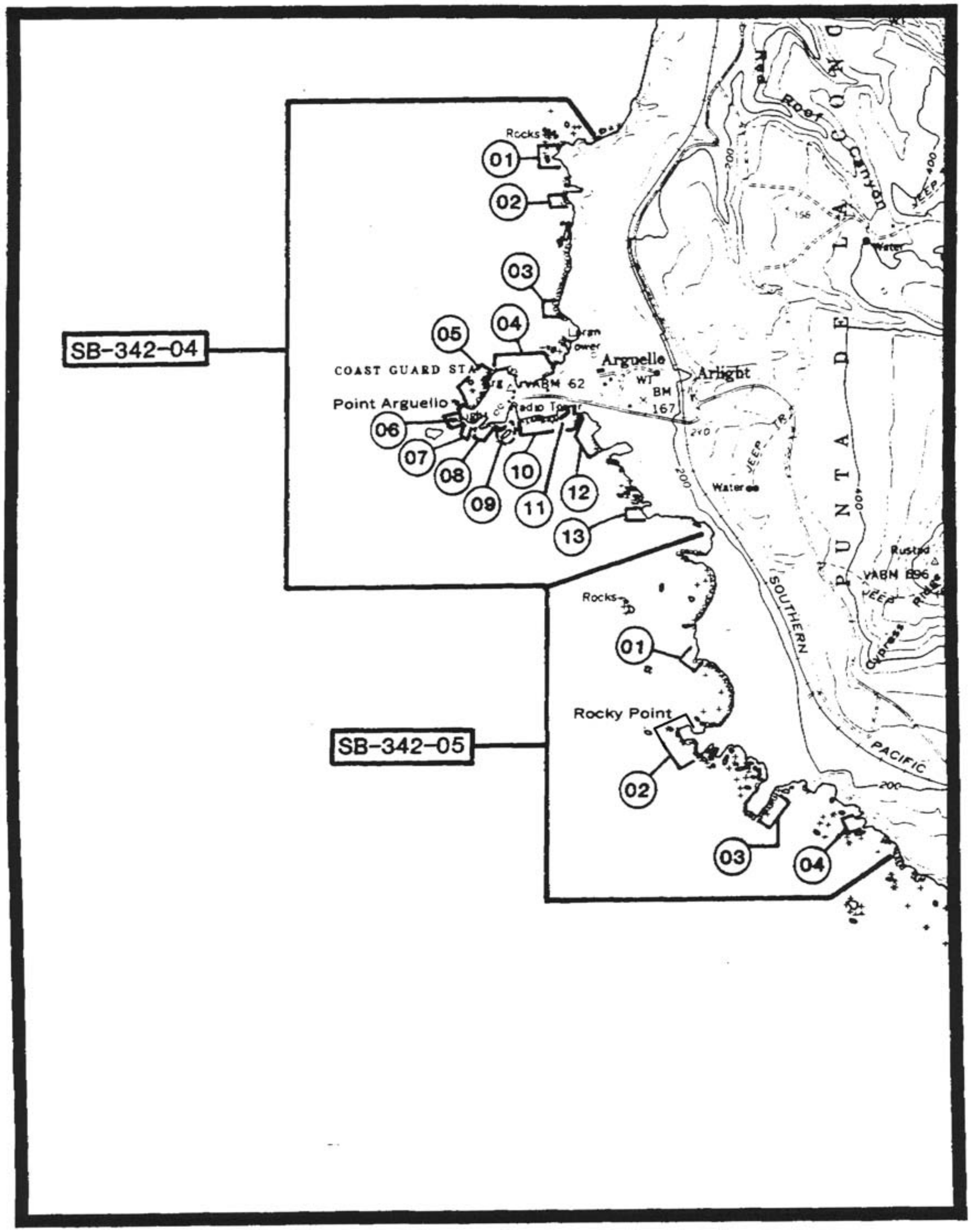


Map 20. Section from USGS map "Point Sal" (modified from Carter et al. 1992: II-161 [Map 159]), indicating colony and subcolony locations for Mussel Point (SB-344-02), Point Sal (SB-344-03), Lion Rock at Point Sal (SB-344-04), and Point Sal Beach South (SB-344-05).

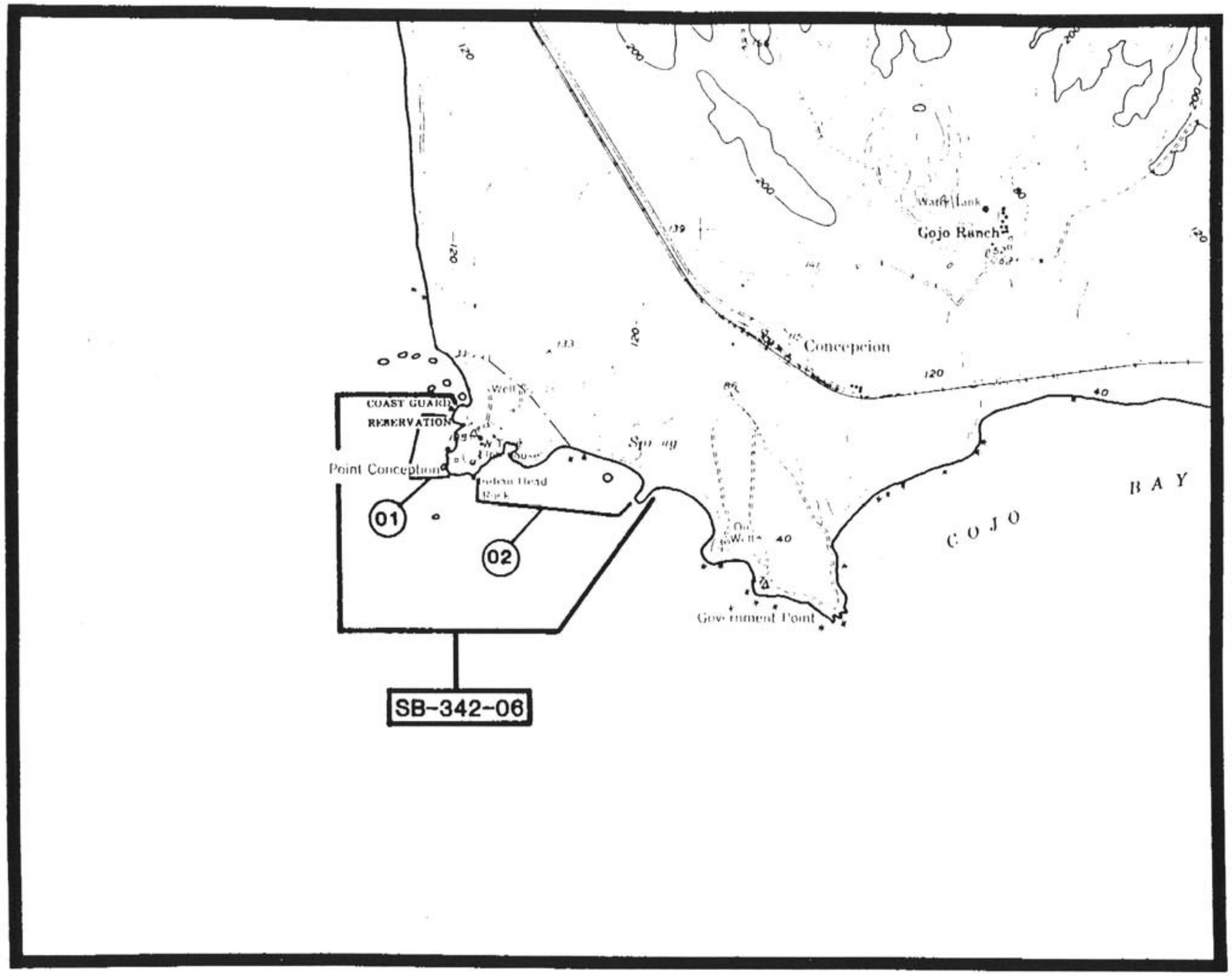
03).



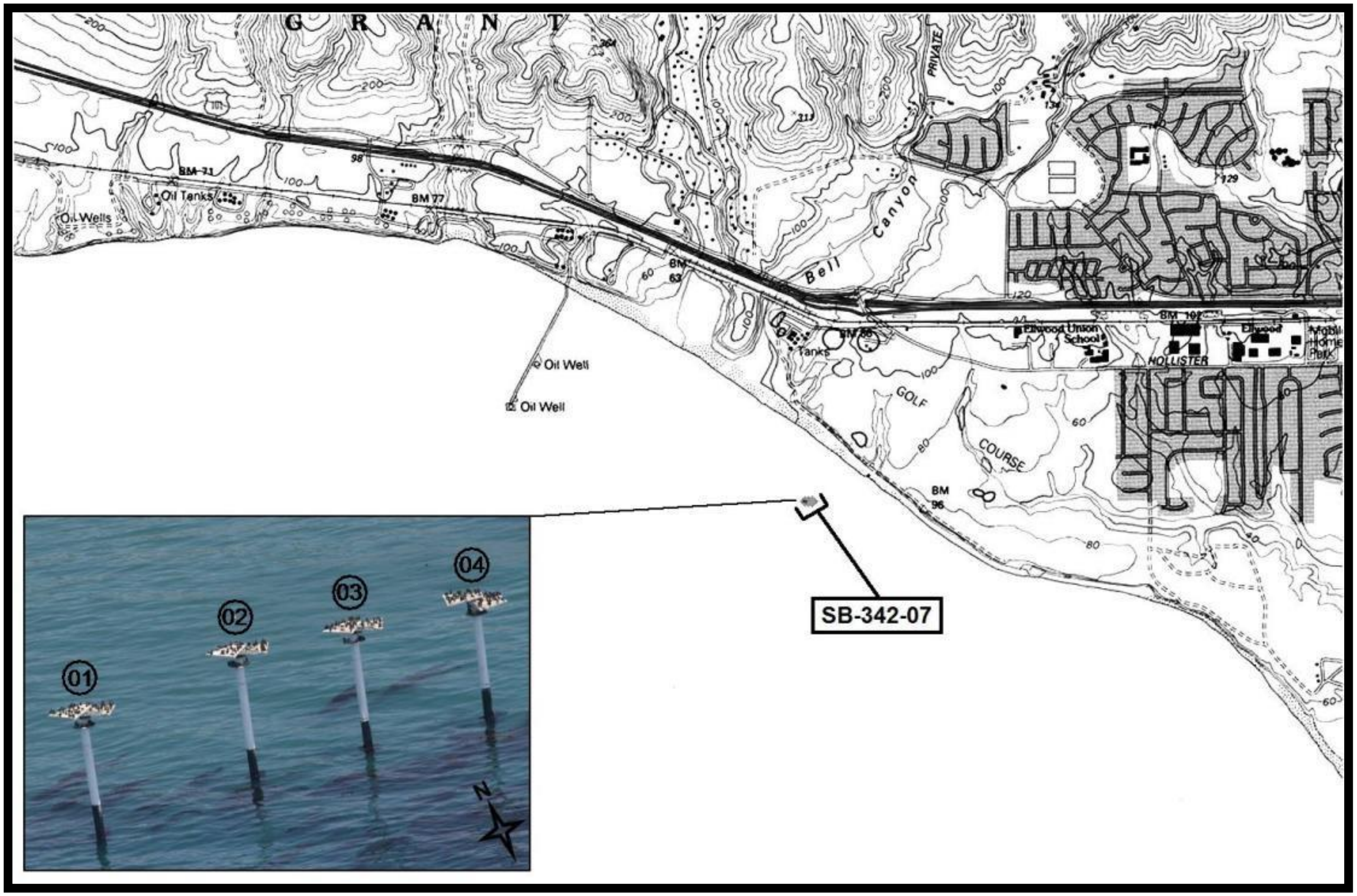
Map 21. Section from USGS map "Surf and Point Arguello" (unmodified from Carter et al. 1992: II-166 [Map 164]), indicating colony and subcolony locations for North Honda (SB-342-01), Mainland and Rocks East of Destroyer Rock (SB-342-02), and Destroyer Rock (SB-342-03).



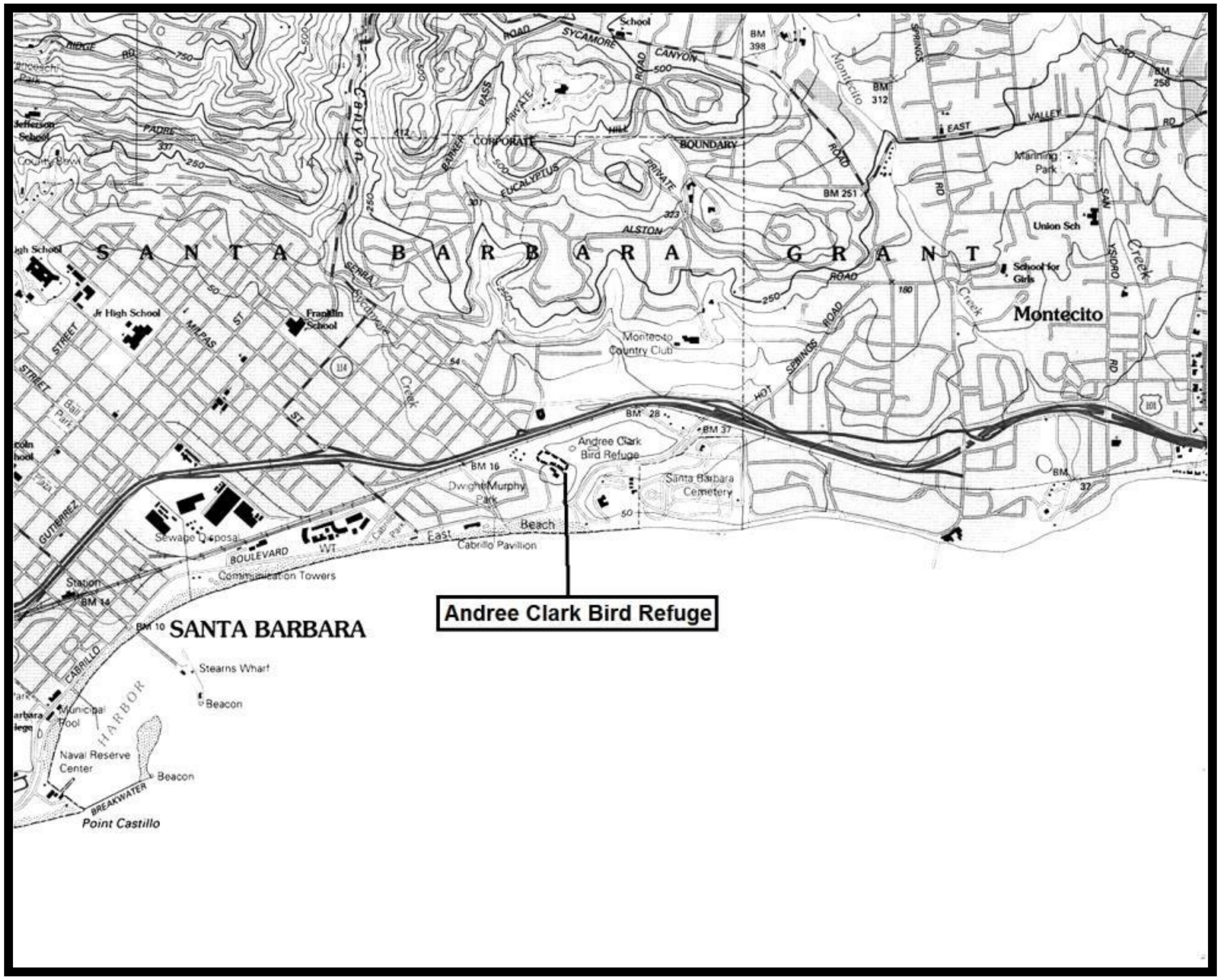
Map 22. Section from USGS map "Point Arguello" (modified from Carter et al. 1992: II-167 [Map 165]), indicating colony and subcolony locations for Point Arguello (SB-342-04) and Rocky Point (SB-342-05).



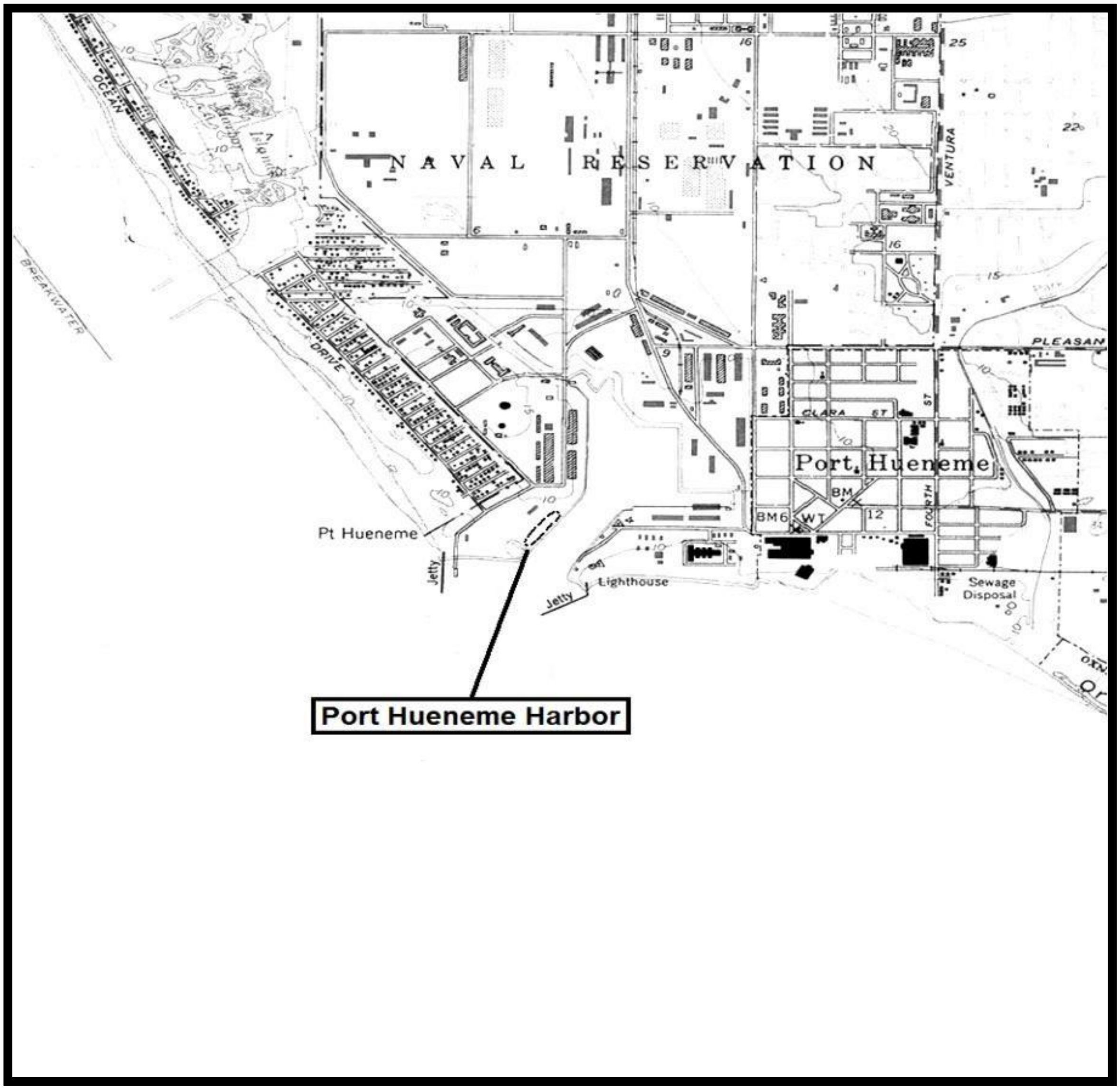
Map 23. Section from USGS map "Point Conception" (modified from Carter et al. 1992: II-168 [Map 166]), indicating colony and subcolony locations for Point Conception (SB-342-06).



Map 24. Section from USGS map "Dos Pueblos Canyon" (modified from McChesney et al. 1998: 20 [Figure 2]), indicating colony and subcolony locations for Sandpiper Pier Foundation (SB-342-07).



Map 25. Section from USGS map “Santa Barbara”, indicating colony and subcolony locations for Andree Clark Bird Refuge.



Map 26. Section from USGS map “Oxnard”, indicating colony and subcolony locations for Port Hueneme Harbor.