SEASONAL ABUNDANCE AND DISTRIBUTION OF COASTAL SEABIRDS OFFSHORE SANTA BARBARA AND VENTURA COUNTIES, CALIFORNIA

Mark O. Pierson[1], Michael D. McCrary[1], and Michael L. Bonnell[2]

[1]Pacific OCS Region, Minerals Management Service, 770 Paseo Camarillo, Camarillo, CA 93010
(805) 389-7863, FAX 389-7874, E-mail: mark.pierson@mms.gov, michael.mccrary@mms.gov
[2]Institute of Marine Sciences, University of California, Santa Cruz, CA 95064
(831) 426-5844, E-mail: eci@netcom.com

ABSTRACT

Between January 1996 and August 1997, the Minerals Management Service (MMS), in cooperation with the University of California, Santa Cruz (UCSC), and the California Department of Fish and Game's Office of Oil Spill Prevention and Response (OSPR), conducted 12 aerial surveys of seabirds and marine mammals in the waters of the Santa Barbara Channel and the Santa Maria Basin. The goals of the study were to identify and characterize important habitats of seabirds known to be especially sensitive to oil spill impacts, and to update and provide a database for comparison with earlier studies of marine mammals and seabirds in these waters. This paper focuses on one aspect of this ongoing study: aerial surveys of divers and brown pelicans in the nearshore waters along the mainland shoreline of Santa Barbara and Ventura counties and along the north side of the northern Channel Islands. Western/Clark's grebes were the most abundant nearshore seabirds during most months of the year, reaching densities as high as 400 birds/km^2 in some areas. Other abundant species or groups of species included scoters (primarily surf scoters), brown pelicans, cormorants, and loons. Highest seabird densities consistently were recorded near Point Conception and along the Ventura County coast.

Keywords: Abundance, distribution, nearshore waters, seabirds, seasonality, southern California, western grebe (*Aechmophorus occidentalis*), Clark's grebe (*Aechmophorus clarkii*).

INTRODUCTION

In January 1996, the Minerals Management Service (MMS), in cooperation with the University of California, Santa Cruz (UCSC), and the California Department of Fish and Game's Office of Oil Spill Prevention and Response (OSPR), began a study of the abundance and distribution of seabirds and marine mammals in the Santa Barbara Channel and Santa Maria Basin. The last systematic studies of seabird distribution in these waters had been conducted from 1975 through 1983 (Briggs et al. 1981, 1983). These studies were large-scale, relatively coarsely grained surveys, which did not focus on nearshore seabird populations. Additionally, in the years since those studies many changes occurred in oceanographic conditions and the breeding status of colonial seabirds (Sowls et al. 1980; Carter et al. 1992).

The goals of the current MMS study were to identify and characterize important habitats of marine birds known to be especially sensitive to oil spill impacts, and to update and provide a database for comparison with the earlier studies of marine birds in these waters. The principal areas of interest were 1) nearshore populations of divers, mostly migrant and overwintering species in southern California (loons, grebes, cormorants, and scoters); and 2) pelagic populations, which include both migrants and local breeders (alcids, shearwaters, phalaropes, gulls, and pelicans). The coastal divers and the more pelagic alcid species, such as murres and auklets, are considered to be particularly vulnerable to the effects of oiling.

The information on seabird and marine mammal distribution and abundance collected during this study has been added to the MMS Pacific Outer Continental Shelf (OCS) Region's existing database (Ecological Consulting, Inc. 1992). These data can be used to identify important offshore habitats, be compared with previously acquired data to detect long-term changes in the distribution and abundance of key species, and be used to estimate potential impacts to these marine resources from accidental oil spills. This paper is a preliminary report on the results of the first 12 aerial surveys of the study, focusing on coastal seabird populations inhabiting the nearshore waters along the southern and central California mainland and the north side of the northern Channel Islands. More detailed analysis of the data will follow completion of the aerial surveys and compilation of the final study database.

MATERIALS AND METHODS

The California State Office of Aircraft Services, under support from OSPR, provided the survey aircraft and an experienced warden-pilot. The survey aircraft, a Partenavia PN68 Observer, was a two-engine, high-winged airplane that was well suited for overwater operations and equipped with bubble windows for observations.

The approach and methodology were first developed by UCSC biologists for Bureau of Land Management-funded baseline studies of marine mammals and seabirds offshore

southern California in the middle and late 1970s. The methodology was refined during subsequent MMS-funded baseline studies offshore central and northern California and off Oregon and Washington in the 1980s (Briggs et al. 1981, 1983, 1991).

On board the survey aircraft, a Global Positioning System (GPS) unit linked to a laptop computer was used to record latitude, longitude, and time at 5-sec intervals. Surveys were flown at an altitude of 60 m (200 ft) above sea level and ground speed of 90 kts. Observers searched a 50-m corridor on each side of the aircraft; boundaries were strictly defined using a clinometer and simple trigonometry. Both sides of the aircraft trackline were worked under optimum conditions. The 60-m altitude allowed the smallest birds (e.g., auklets, murrelets, storm-petrels, and phalaropes) to be seen and usually identified to the species level under good light conditions (Briggs et al. 1985a, b). Observations were recorded on audio-cassette and included counts; species; behavior; associations with boats, plankton, water-mass boundaries, other birds, mammals, etc.; and the time.

Post-survey computer data entry was done from transcriptions of audio-cassette tapes to produce a database of sighting information. For each observation, latitude and longitude were estimated using the time for interpolation between the previous and subsequent position fixes. These data were used to create GIS data layers for the aircraft trackline and for locations of bird observations. Numbers of birds observed and area sampled were binned into 5'-latitude/longitude blocks for the purpose of calculating densities. Densities, represented as birds/km^2, were displayed as rectangular latitude/longitude blocks and as isopleths of density. Density isopleths were generated using a standard linear interpolation model and smoothed with a Bezier spline.

The survey design was developed to optimize the sampling scheme, while balancing the level of areal coverage and the available airtime. Survey tracklines were flown in the two principal areas of interest: nearshore, along the mainland and the north side of the Channel Islands; and offshore in the Santa Barbara Channel and the Santa Maria Basin west to about 121°W longitude (Figure 1). The nearshore mainland tracklines extended from Leo Carrillo State Beach west and north to the Santa Maria River mouth (encompassing the Ventura and Santa Barbara County shorelines). The nearshore island tracklines extended from the east end of Anacapa Island west to Point Bennett on San Miguel Island. Based on analysis of historical data on seasonality and distribution, the months chosen for survey were January, February, April, May, June, August, October, and November (Bonnell and Ford 1996).

The California Marine Mammal and Seabird Database (Ecological Consulting, Inc. 1992), which incorporates sighting data from all previous California baseline surveys, made it possible to compare data collected offshore southern California over several decades and track possible changes in species composition, numbers, and distribution over time.

RESULTS

In this paper, we report the results of 12 nearshore aerial surveys conducted along the mainland and the north side of the northern Channel Islands, from January 1996 to August 1997 (Figure 1; Table 1). The paper focuses on the most abundant nearshore species of divers and the brown pelican (*Pelecanus occidentalis*). Among the divers, western/Clark's grebes (*Aechmophorus occidentalis/clarkii*) were the only species selected for analysis. The loons, cormorants, and scoters, which are all more difficult to identify to the species level from the air, were each grouped for analysis.

Although several species of gulls and, to a lesser extent, terns also were abundant and important components of the nearshore avifauna, they are not discussed in this paper. The same is true of alcids, phalaropes, and shearwaters, even though the latter occasionally occupied localized nearshore areas in the tens of thousands. These species will be considered in future works, which will include data from both nearshore and open-water transects.

Figure 1. Study area and standard aerial transect lines.

Table 1. MMS Coastal Seabird/Marine Mammal Aerial Surveys included for analysis in this paper.

Survey Number	Dates
96-1	22-23 January 1996
96-2	22-23 February 1996
96-3	9-10 April 1996
96-4	8-9 May 1996
96-5	26-27 June 1996
96-6	12-13 August 1996
96-7	24-25 October 1996
96-8	11 November 1996
97-1	26-27 February 1997
97-2	9-10 April 1997
97-3	11-12 June 1997
97-4	13-14 August 1997

Western/Clark's Grebes

These two species could not be distinguished from the air and henceforth will be referred to simply as 'western' grebes. Densities of western grebes were calculated for two periods: September through March, which encompasses most of the fall and spring migrations, plus the overwintering birds; and April through August, when most adults are nesting at freshwater locations in the western U.S. and Canada (Palmer 1962; Garrett and Dunn 1981).

During the September -to-March period, highest densities of western grebes were recorded in nearshore waters along the Ventura County shoreline and Santa Barbara County north of Point Conception, particularly between Arguello and Purisima points (Figure 2). Sampled densities reached a peak of 400 birds/km^2 off western Ventura County. Based on the recorded densities, we estimated that approximately 71,300 western grebes were present at sea in the study area during this period (Table 2).

Recorded densities were substantially lower during the April-to-August period (Figure 3). Although relatively high numbers of grebes may still be present in area waters in April, near the end of the spring migration, numbers observed dropped sharply during the summer months. Only a few hundred western grebes were recorded during the August 1996 aerial survey. As was the case for the September to March period, highest densities were recorded along the Ventura County shoreline and north of Point Conception. Sampled densities reached a peak of 142 birds/km^2 off western Ventura County. Based on the recorded densities, we estimated that approximately 21,600 western grebes were present at sea in the study area during this period (Table 2).

Figure 2. Western grebe (*Aechmophorus occidentalis/clarkii*) densities (number/km^2) recorded for the months of September through March.

Table 2. At-sea population estimates for coastal seabirds derived from data collected on MMS Seabird Study aerial surveys from January 1996 through August 1997.

		Density/km^2			
Seabird	Survey Months	Mean	Standard Deviation	Surveyed Area (km^2)	Population Estimate
Western Grebe	Sep-Mar	13.58	43.45	8,902.2	71,320
	Apr-Aug	3.66	15.77	9,258.8	21,591
Scoters	Sep-Mar	6.41	27.45	8,901.1	35,696
	Apr-Aug	1.37	5.71	9,255.8	8,965
Cormorants	Jan-Dec	1.49	4.27	9,542.4	10,455
Loons	Sep-Mar	0.79	4.13	8,899.7	5,971
	Apr-Aug	0.39	1.05	9,258.2	2,562
Brown Pelican	Feb-May	0.95	2.32	9,327.4	8,242
	Jun-Jan	1.38	3.80	9,186.7	10,363

Figure 3. Western grebe (*Aechmophorus occidentalis/clarkii*) densities (number/km^2) recorded for the months of April through August.

Scoters

Three species of scoters occur in southern and central California waters: surf scoter (*Melanitta perspicillata*), white-winged scoter (*M. fusca*), and black scoter (*M. nigra*). The vast majority of scoters in the study area waters (and of those identified from the air) are surf scoters; black scoters are relatively uncommon (Garrett and Dunn 1981; Briggs et al. 1987).

As was the case for western grebes, densities of scoters were calculated for the September-to-March and April-to-August periods. The highest overall densities during September to March were observed at the Channel Islands and along the mainland north of Point Conception (Figure 4). Peak densities of nearly 267 birds/km^2 were recorded north of Point Sal near the Santa Maria River mouth. Based on the recorded densities, we estimated that approximately 35,700 scoters were present at sea in the study area during this period (Table 2).

During April to August, overall scoter densities declined (Figure 5). Highest densities again were recorded along the mainland north of Point Conception, while moderate densities were observed off Ventura County and at the Channel Islands. Peak densities of 51 birds/km^2 were recorded in nearshore waters north of Purisima Point. Based on the recorded densities, we estimated that approximately 9,000 scoters were present at sea in the study area during this period (Table 2).

Cormorants

The three cormorant species occurring in the study area include Brandt's cormorant (*Phalacrocorax*

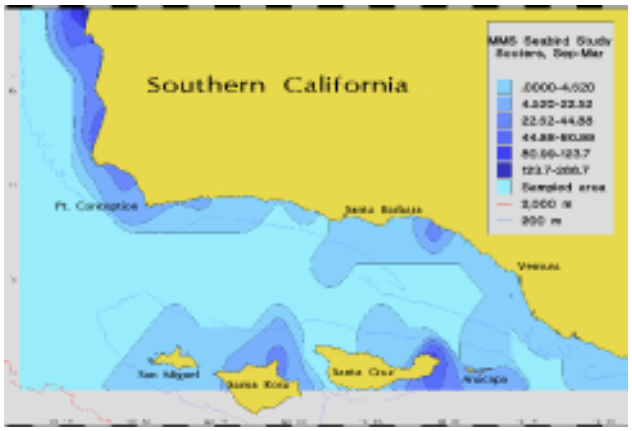

Figure 4. Scoter (*Melanitta* spp.) densities (number/km²) recorded for the months of September through March.

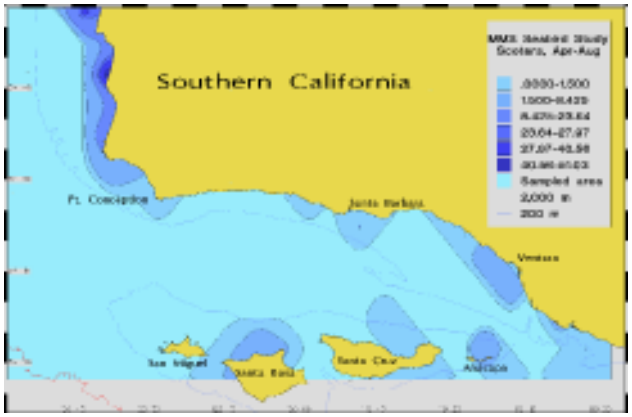

Figure 5. Scoter (*Melanitta* spp.) densities (number/km²) recorded for the months of April through August.

penicillatus), double-crested cormorant (*P. auritus*), and pelagic cormorant (*P. pelagicus*). All three species breed locally. Since the cormorant species could not always be reliably distinguished from the air, they were combined for analysis.

Because cormorants are year-round residents in the study area, densities were calculated for all months surveyed (Figure 6). Cormorants were most abundant in nearshore waters, especially along the southwestern Santa Barbara County shoreline and around the Channel Islands. Peak densities of approximately 49 birds/km² were observed along the mainland near Gaviota. Based on the recorded densities, we estimated that approximately 10,500 cormorants were present at sea in the study area (Table 2).

Loons

Three species of loon migrate through and overwinter in southern California waters: Pacific loon (*Gavia pacifica*), red-throated loon (*G. stellata*), and common loon (*G. immer*). Because the loon species could not always be reliably distinguished from the air, they were combined for analysis.

Loon densities were calculated for the September-to-March and April-to-August periods. During September to March, relatively low densities of loons were observed

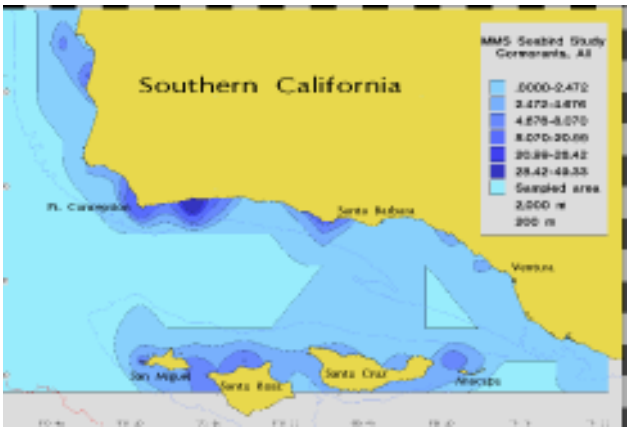

Figure 6. Cormorant (*Phalacrocorax* spp.) densities (number/km²) recorded for all months surveyed.

scattered along the mainland and Channel Island shorelines (Figure 7). The peak densities of about 9 birds/km² were recorded at Santa Rosa Island. Based on the recorded densities, we estimated that approximately 6,000 loons were present at sea in the study area during this period (Table 2).

The numbers of loons in the study area dropped during April to August, when highest densities were recorded along the mainland north of Point Conception, at the east end of the Santa Barbara Channel, and at the Channel Islands (Figure 8). Peak densities of approximately 9 birds/km² were observed along the mainland north of Purisima Point. Based on the recorded densities, we estimated that approximately 2,600 loons were present at sea in the study area during this period (Table 2).

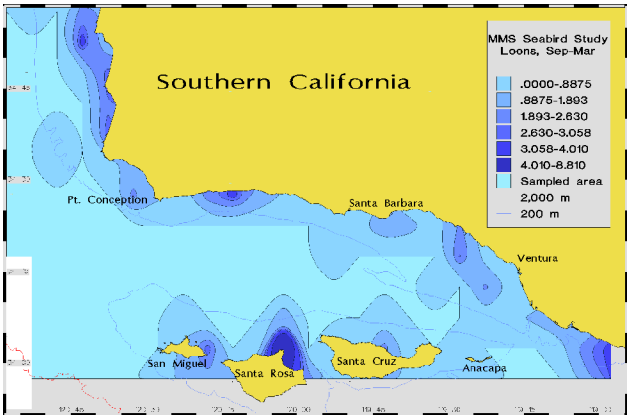

Figure 7. Loon (*Gavia* spp.) densities (number/km²) recorded for the months of September through March.

Brown Pelican

The brown pelican, which currently breeds in our study area only on Anacapa Island, is listed as an endangered species under the federal Endangered Species Act of 1973. On aerial surveys conducted during the months of February through May, corresponding to the pelican breeding season, densities of up to 26 birds/km² were recorded (Figure 9). Highest densities were observed near the rookery on West

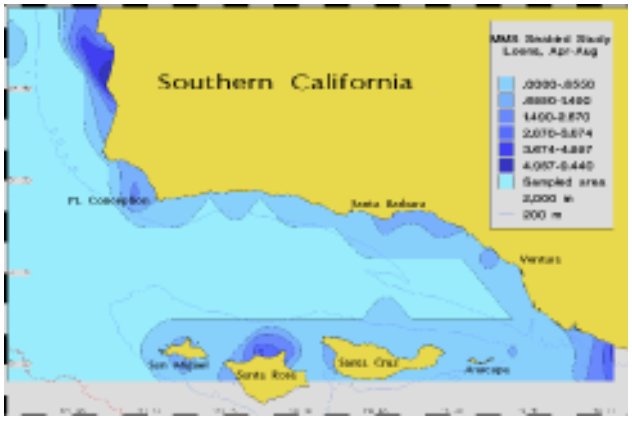

Figure 8. Loon (*Gavia* spp.) densities (number/km^2) recorded for the months of April through August.

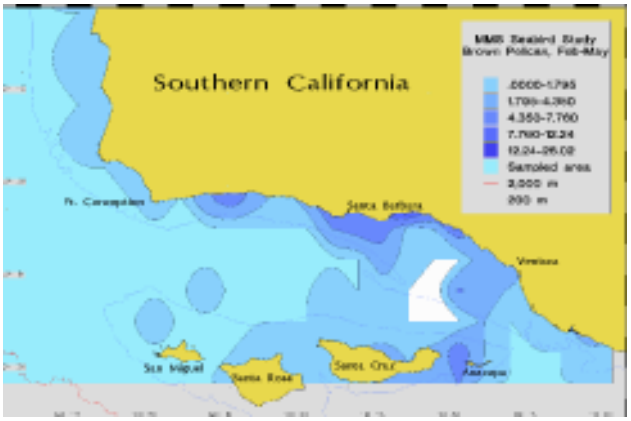

Figure 9. Brown pelican (*Pelecanus occidentalis*) densities (number/km^2) recorded for the months of February through May.

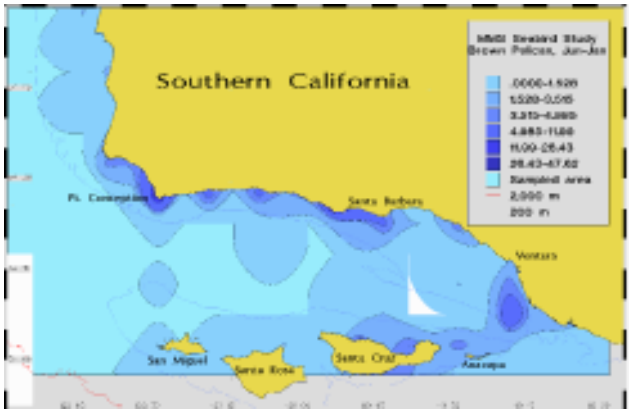

Figure 10. Brown pelican (*Pelecanus occidentalis*) densities (number/km^2) recorded for the months of June through January.

Anacapa Island and along the mainland in the eastern Santa Barbara Channel. Based on the recorded densities, we estimated that approximately 8,200 brown pelicans were present at sea in the study area during this period (Table 2).

Higher overall densities were recorded outside the breeding season, from June through January, when birds from the larger Mexican colonies moved northward into southern California (Figure 10). Brown pelicans were somewhat more widely distributed than during the breeding season, with highest densities recorded along the mainland shoreline from Point Arguello eastward and near the Channel Islands. Peak densities of about 48 birds/km^2 were observed near Point Conception. Based on the recorded densities, we estimated that approximately 10,400 brown pelicans were present at sea in the study area during this period (Table 2).

DISCUSSION

The results reported in this paper are preliminary, since they represent only the first 12 aerial surveys of the MMS Seabird Study. However, some generalizations can be drawn about the seasonal distribution and abundance of the selected nearshore species. Additionally, some limited comparisons can be made with earlier seabird research in the study area.

Western grebes were the most abundant coastal seabirds in the study area except during the late spring and summer months. Bonnell and Ford (1996), reanalyzing data from earlier MMS studies in our study area (Briggs et al. 1981, 1983), reported that peak numbers of western grebes were recorded from about October through March. Similarly, Briggs et al. (1987), in their monograph on California seabird communities, identified western grebes as one of the predominant nearshore species along the mainland from October to May. They estimated a peak winter population of about 27,000 birds south of Point Conception, with most birds concentrated in shallow waters at the eastern end of the Santa Barbara Channel. Summer populations were much smaller, on the order of 500 to 800 birds.

Although we estimate a much larger fall-winter population of western grebes (approximately 71,300) than that presented by Briggs et al. (1987), the two estimates cannot be compared directly. First, our estimate represents a mean population for a seven-month period, rather than a peak population. Second, the two areas overlap, but are not identical; the Briggs et al. (1987) estimate was for birds south of Point Conception, while our study area extended approximately 65 km north of that point (but did not extend south of the northern Channel Islands). Finally, unlike the studies summarized in Briggs et al. (1987), the field effort in this study focused much more intensively on the nearshore waters where these birds are concentrated.

Scoters were the second most abundant nearshore species in our study area in the September to March period. Briggs et al. (1987) estimated that about 12,000 scoters overwintered in southern California waters. In our study area, they identified the most heavily used areas as the eastern end of the Santa Barbara Channel and the northern shores of the northern Channel Islands. We recorded a similar distribution, although we also found scoters to be abundant in nearshore waters north of Point Conception. Again, and probably for the same reasons discussed above, we estimate a much larger fall-through-winter population (approximately 35,700 birds).

Cormorants were the third most abundant group of nearshore divers in our study area, with a mean at-sea population estimate of approximately 10,400 birds. Briggs et al. (1987) found Brandt's cormorants to be the most abundant of the three cormorant species in southern California, with highest densities recorded from late summer through late spring. They estimated that numbers in southern California increased from about 5,500 nesting birds in late spring and summer to more than 20,000 by late September, with the arrival of central California birds after the nesting season. Carter et al. (1992) estimated that more than 27,000 cormorants bred in our study area in 1989 to 1991. Almost all of these were on the northern Channel Islands, and more than 85% were Brandt's cormorants.

Briggs et al. (1987) found Pacific loons to be most abundant in southern California waters during fall migration, estimating that 40,000 to 60,000 may have been present at one time in mid-December. Bonnell and Ford (1996) reported that Pacific loons accounted for about 74% of all loons identified during the earlier MMS studies (Briggs et al. 1981, 1983). Although we did not observe such abundance, the timing of our surveys (i.e., we surveyed the study area only once in the months of November and December) made it difficult to observe such brief migratory events (Table 1). One of us (Pierson, unpubl. obs.) observed thousands of loons migrating southward across the western Santa Barbara Channel in late November 1995.

According to Briggs et al. (1987), only about 5,000 Pacific loons overwintered in California waters south of Point Conception in each of the winters from 1976 to 1978, although densities as high as 80 birds/km^2 were recorded over the shallows east of Anacapa Island. In nearshore mainland waters, red-throated loons were more abundant, with estimated peak numbers of 1,000 to 3,000 birds. Common loons were recorded in greatest numbers north of Point Conception, where 5,000 to 10,000 birds were estimated to occur at sea during spring migration (March to May). Our estimate for the September-through-March period (approximately 6,000 birds) is generally comparable to the earlier figures for overwintering birds of all three species.

The brown pelican population continues to recover from the declines recorded in the 1960s and 1970s. Carter et al. (1992) estimated that nearly 12,000 brown pelicans nested in southern California in 1989 to 1991, most of these on West Anacapa Island in our study area. In general, our observations correspond well with those of the earlier studies (Briggs et al. 1981, 1983). Briggs et al. (1987) reported that pelican numbers were lowest from December through March, when 5,000 to 6,000 pelicans (half of which were breeders) were present in southern California. From about May through December, these numbers were augmented by tens of thousands of pelicans that moved north from the Mexican colonies. In September and October, when maximum numbers of pelicans were in California waters, 70 to 80% of the statewide population occurred south of Point Conception (resulting in an estimated population as high as 80,000 to 90,000 in southern California). Although our population estimates are much lower (approximately 10,400), we surveyed only a portion of the species' southern California range and did not include pelicans onshore.

Although our results are preliminary, we can draw some conclusions about nearshore seabird populations in the study area. Overall, abundance was greatest in the fall and winter, between September and March or April. Greatest densities occurred along the Ventura County mainland shoreline (particularly between Mugu Lagoon and Rincon Point), and along the Santa Barbara County shoreline north of Point Conception (particularly between Point Arguello and the Santa Maria River mouth). Relatively high densities also were observed along the north sides of the northern Channel Islands, particularly in the vicinity of Anacapa and Santa Cruz islands.

Tens of thousands of seabirds occupied the nearshore waters during these months. Most of these birds were western grebes and surf scoters, although thousands of cormorants, loons, pelicans, and gulls were also present. Occasionally, aggregations of thousands to tens of thousands of shearwaters or phalaropes appeared in nearshore waters along the mainland or islands.

Numbers were much lower during the summer months, when the nearshore avifauna was dominated by locally breeding gulls and cormorants and by brown pelicans. Overall distribution patterns during these months did not differ substantially from those observed during fall and winter.

Completion of the MMS Seabird Study database will allow us to address these and other questions on the abundance and distribution of seabirds in the study area. We also hope to be able shed some light on the possible effects of the 1997 to 1998 El Niño episode on area seabird populations.

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