Rhinoceros Auklet (Cerorhinca monocerata)

Rhinoceros Auklets breed from the Aleutian Islands, Alaska to San Miguel Island. Birds winter from southeast Alaska to southern Baja California, Mexico (Gaston and Dechesne 1996). In 1991, small numbers of Rhinoceros Auklets were found to breed at San Miguel Island and north of Point Conception, six small breeding colonies also were observed (H. Carter, unpubl. data; McChesney et al. 1995). The California breeding population was estimated to be 900 breeding pairs representing a five-fold increase over 1979–1980 (H. Carter, unpubl. data).

In 1975–1978, Rhinoceros Auklet densities in the SCB were lowest in the summer and greatest in January, February, and March (Briggs et al. 1987). In spring, birds occurred along the western margin of the SCB, in the passages between the northern Channel Islands, and along the shelfbreak from Point Arguello to Oregon (Briggs et al. 1987). In 1999–2002 in January, we observed Rhinoceros Auklets throughout southern California <100 km from shore (Fig. 45). Small numbers observed in May and September occurred near breeding colonies in the northern Channel Islands or north of Point Conception.

At-sea densities differed among seasons and sub-areas (Table 5). Rhinoceros Auklet densities were greatest in January and much lower in May and September (Tables 1a–e). In all months, at-sea densities were greatest in S1, lowest in S2, and intermediate in S3, S4, and S5 (Tables 1a–e). We observed only five Rhinoceros Auklets on coastal transects in 1999–2002, all near the northern Channel Islands. At-sea densities of Rhinoceros Auklets in 1975–1983 were greater than densities in 1999–2002 in the entire study area, S2, and S3, but were lower in S1 (Tables 7a, 7b). At-sea densities did not differ significantly in S4 or S5 (Tables 7b). Not consistent with lower densities in 1999–2002, populations on the west coast of North America have increased in recent years (Ainley et al. 1994, Gaston and Dechesne 1996).

Tufted Puffin (Fratercula cirrhata)

Tufted Puffins breed from California to the Bering and Chukchi seas, extending to Japan (Gaston and Jones 1998). Tufted Puffins did not breed in the SCB from 1912–1991, but small numbers were found breeding at Prince Island in 1991 and 1994 (H. Carter, unpubl. data; McChesney et al. 1995). At the Farallon Islands off San Francisco, California, puffins experienced a population decline from 1,000s of birds in the late 1800s to an estimated 100 breeders in 1982. Although their winter distribution is not well known, Tufted Puffins generally spend the winter well offshore and Briggs et al. (1987) found puffins most abundant off California in January, April, and May. During periods of annual maximum abundance in the winter and spring in 1975–1978, low thousands were estimated in the SCB (Briggs et al. 1987). Since few puffins breed south of British Columbia, these birds must have originated from British Columbia or Alaska.

We did not observe Tufted Puffins during our study. In the winter, we may have misidentified small numbers of Tufted Puffins as Rhinoceros Auklets but our population estimates still would be much lower than found by Briggs et al. (1987). We suggest that puffins were not migrating to southern California in 1999–2002, consistent with major declines in populations from southeast Alaska to California (Piatt and Kitaysky 2002).

DISCUSSION

In 1999–2002, we examined distribution and abundance of seabirds off southern California from Cambria to the Mexican border with the first comprehensive aerial surveys in two decades. Earlier surveys in 1975–1983 (Briggs et al. 1987) focused on describing temporal patterns of seabird abundance in at-sea habitats, with monthly surveys limited to a relatively small area that excluded coastal habitats in the SCB. In 1999–2002, we focused on completing: (1) better assessment of seabird abundance in five at-sea and five coastal sub-areas during 3 mo (May, September, and January); and (2) comparison of seabird abundance in these 3 mo for at-sea sub-areas between 1999–2002 and 1975–1983 to assess general trends.

While our study design was directed at reducing variability between our study and Briggs et al. (1987), we flew similar, but not identical, transect lines. Our effort within the SCB was greater than Briggs et al. (1987), and we concentrated effort around the northern Channel Islands. Aircraft type and observers differed between the two studies, and we sampled intensively during 3 mo of the year, whereas Briggs et al. (1987) sampled year-round. Thus, although they were more likely to record annual peaks in abundance, we averaged their survey data across months (April–June) to reduce variation in peak abundance between studies. However, we used the same analytical approach to estimate densities from both datasets to derive comparable estimates.

While direct comparisons are complicated by these differences in survey coverage, our

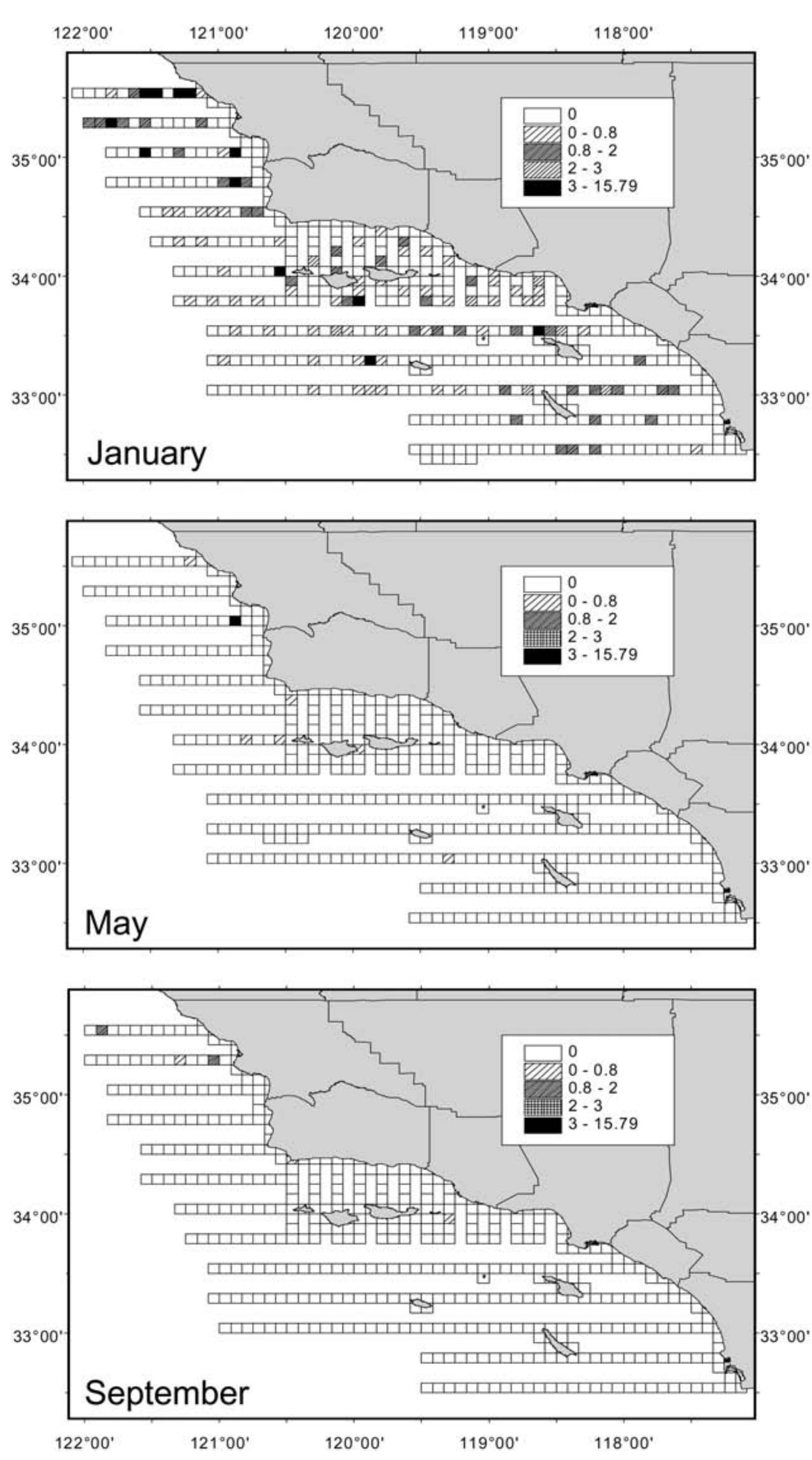

FIGURE 45. Rhinoceros Auklet densities (birds/km^2) and distribution off southern California from 1999–2002 during January, May, and September.

statistical comparisons indicate that for all seabirds combined, a definite decline in abundance has occurred in the SCB from 1975–1983 to 1999–2002. We estimated average densities of 11.3 seabirds/km^2 on at-sea transects and 70.9 seabirds/km^2 on coastal transects, while Briggs et al. (1987) estimated densities of 110 seabirds/km^2 over the continental shelf. In 1999–2002, total seabird abundance was 14% lower in January, 57% lower in May, and 42% lower in September than in the earlier study.

Species with dramatically decreased densities included the Common Murre (≥75% decline in each season), Sooty Shearwater (55% in May and 27% in September), and Bonaparte's Gull (≥95% in each season). Compared with Briggs et al. (1987), we observed significantly lower densities of Sooty Shearwaters in the SCB in May and September. Many researchers have noted recent declines in Sooty Shearwater abundance throughout the CCS (Veit et al. 1996, 1997; Oedekoven et al. 2001, Hyrenbach and Veit 2003). Reasons for this apparent decline are unclear but Spear and Ainley (1999) hypothesized that Sooty Shearwaters had changed their migration routes in response to a cooling trend in the central North Pacific resulting in a distribution shift and reduction in the CCS. However, declines at breeding colonies also have been noted in recent years, indicating a more general effect in decline possibly associated with larger forces such as global change.

Common Murres, the most abundant breeding seabird species in California, were seasonally abundant in the SCB in 1975–1978 (Briggs et al. 1987), but we rarely observed them during this study. Murre densities were significantly lower in all sub-areas compared with Briggs et al. (1987). Decline in Common Murre numbers in southern California may reflect earlier decline in the central California breeding population in the 1980s (Takekawa et al. 1990, Carter et al. 2001). Factors contributing to this decline included gill netting, oil spills, and effects from the 1982–1983 El Niño event (Takekawa et al. 1990). Central California breeding populations recovered to a great extent prior to 1999, but they may not have redeveloped wintering movements to the SCB. Decline in Bonaparte Gull numbers is difficult to assess because of a lack of historical data due to their remote breeding habits and poor enumeration of wintering populations (Burger and Gochfeld 2002).

Conversely, ten species were more abundant in 1999–2002 than in 1975–1983. Brown Pelicans (167% overall), Xantus's Murrelets (125% overall), Cassin's Auklets (100% overall), Ashy Storm-Petrels (450% overall) and Western Gulls (55% in May), and Brandt's Cormorants (450% in September) were among the most notable species with increased densities. All six of these species also breed in the SCB. Brown Pelicans have responded positively with increased local breeding populations since the mid-1970s, possibly related to reduced DDE concentrations in the SCB. However, increasing populations in the Gulf of California, which migrate into SCB waters after breeding, are primarily responsible for the Brown Pelican increases that we found. Higher numbers of Xantus's Murrelets may reflect changes in at-sea distribution and survey differences, since a Pacific Coast analysis indicated no significant change in at-sea population size (Karnovsky et al. 2005). Even though a decline has been noted at Santa Barbara Island (H. Carter, unpubl. data; W. Sydeman, unpubl. data; D. Whitworth, unpubl. data), an increase is suspected at the Coronado Islands (D. Whitworth, unpubl. data) and trends at other colonies are poorly known. For Cassin's Auklets, colony declines have been found in the SCB, the South Farallon Islands, and Triangle Island, British Columbia, which may suggest that increased numbers on our 1999–2002 surveys represent differences in survey coverage. Similarly, little change in Ashy Storm-Petrel numbers at SCB colonies may suggest that increases we recorded reflect survey differences. However, increased numbers of Western Gulls and Brandt's Cormorants likely represent increased breeding populations in southern California.

For seasonal visitors such as Western Grebes, Surf Scoters, and loons, abundance increased in the SCB but decreased north of Point Conception. A similar pattern was found during limited aerial surveys conducted in 1996–1997 (Pierson et al. 2000). Recent aerial and boat surveys in Puget Sound, Washington, have indicated a 95% decline in Western Grebes, 57% decline in Surf Scoters, and 79% decline in loons over a 20-yr period (D. Nysewander, unpubl. data). Thus, increased numbers in the SCB may indicate a southern shift in distribution of these over-wintering populations. The lack of SCB aerial coastal surveys in 1975–1978 likely led to under-representation of these coastal species in the past.

The SCB has been described as a complex transition zone for cold and warm temperate biotas, partly because this is where colder, upwelled waters from north of Point Conception meet warmer waters of sub-tropical origin (Horn and Allen 1978, Murray and Littler 1981). Recent studies have indicated a blurring of this line as some marine species from warmer-water masses have recently expanded their ranges north of Point Conception (Stepien and Rosenblatt 1991, Sagarin et al. 1999). Similar factors may be affecting the distributions of seabirds. Ainley et al. (1994, 1996) demonstrated an inverse relationship between seabird reproductive success and ocean temperature at the Farallon Islands. However, locally breeding seabirds are tied to feeding in SCB waters due to their breeding colony locations on the Channel Islands, Coronado Islands, and along the mainland coast from Cambria to Point Conception (Sowls et al. 1980, H. Carter, unpubl. data). Thus, it is not possible for these birds to shift their feeding areas to a great degree, unless they also change breeding colonies which does not occur frequently. Recent increases in local breeding populations, even during warm periods, indicate that the SCB may be able to buffer changes in ocean temperature and the associated effects.

Three severe El Niño events (1982–1983, 1992–1993, and 1997–1998) occurred between the 1975–1978 and 1999–2002 survey periods. Severe El Niño events cause poor reproduction and high adult mortality of certain locally-breeding seabirds (and greater mortality for some visiting species) while others are not affected. Our surveys began in May 1999, 2 yr after the 1997–1998 El Niño event. The 1999–2002 period featured a series of cold water La Niña events which led some researchers to postulate that the CCS had undergone a fundamental climate shift, on the scale of those documented in the 1920s, mid 1940s, and mid 1970s (Schwing et al. 2002). While La Niñas often follow El Niños (Ainley and Boekelheide 1990), these La Niña events have corresponded with generally stronger than normal upwelling in the CCS and have generated the greatest 4-yr mean upwelling index value on record (Schwing et al. 2002). Briggs et al. (1987) conducted 1975–1978 surveys during another climate shift leading to increased temperatures throughout the CCS (Mantua et al. 1997). They surveyed north of Point Conception in 1980–1983 after a transition to warmer water had occurred in the California Current, when negative effects of the warmer water on seabird abundances might have occurred. Still, overall numbers were greater, indicating that ocean temperatures are not entirely responsible for trends in seabird abundances.

Recently, the health of coastal oceans has been highlighted as a major issue of concern (U.S. Commission on Ocean Policy 2004). In addition to continuing impacts from DDT and PCB contamination and oil pollution, increased urbanization in southern California may be threatening the health of the SCB through runoff and increased use of marine resources. Since the 1975–1983 aerial surveys, the human population has increased by >10 million in California and >25% in the Los Angeles region (Censusscope 2005). Seabirds are sensitive indicators of change in the marine environment due to both natural and anthropogenic factors (Bost and Le Maho 1993, Ainley et al. 1996, Jones et al. 2002). Changes in seabird populations may be warning signs for environmental degradation caused by coastal development, as well as for larger forces that alter marine systems such as climate change. Thus, periodic at-sea surveys of seabirds, with direct comparison to past studies, may provide an effective indication of how well, or how poorly, we are managing and conserving our coastal marine resources.

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