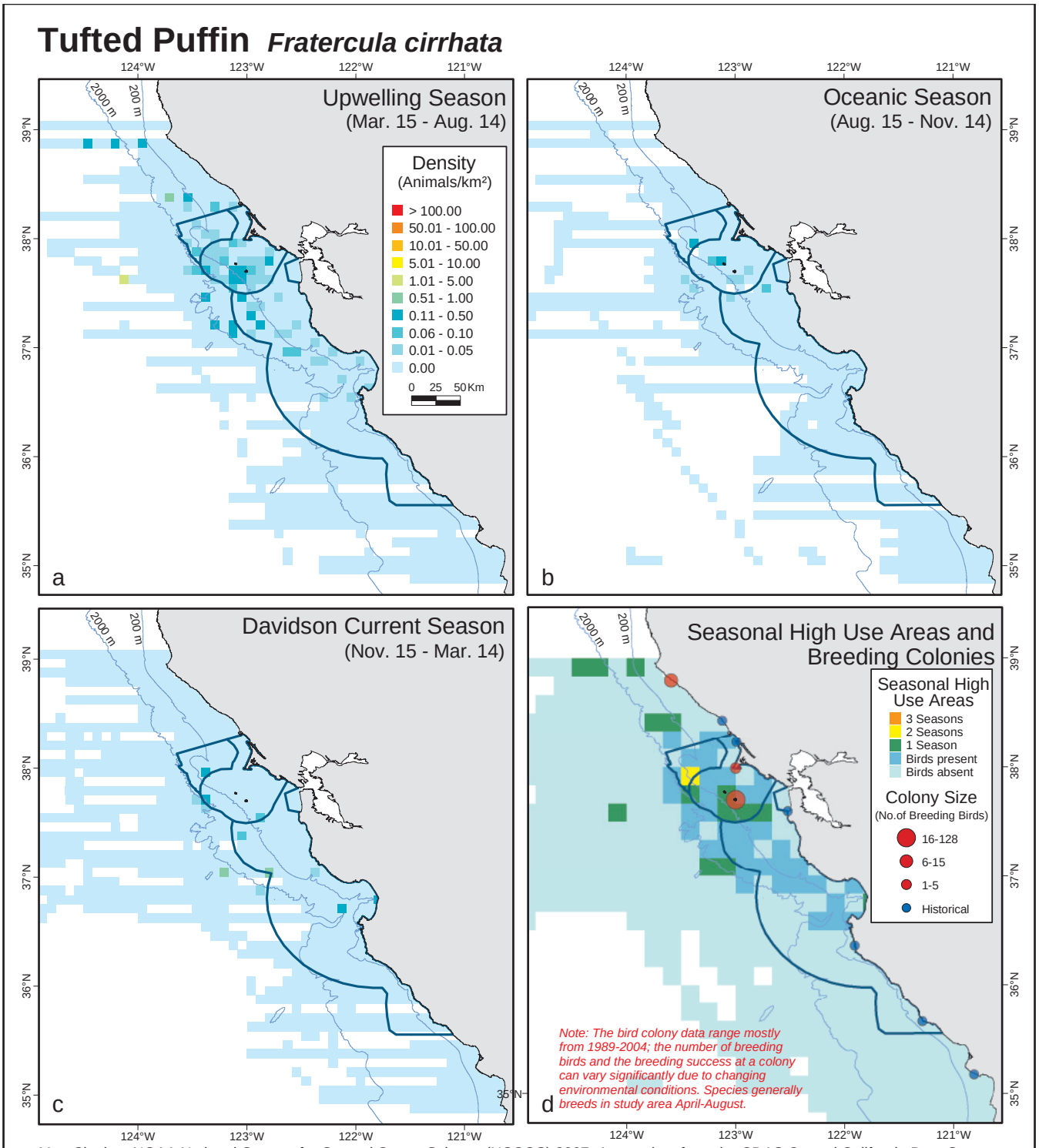

Figure 3.36. Tufted Puffin: maps of seasonal density, high use areas, and breeding colonies.

ABOUT THESE MAPS

Maps a, b and c show the at-sea density (birds/km^2) of Tufted Puffin (*Fratercula cirrhata*) in three ocean seasons – Upwelling, Oceanic, and Davidson Current, displayed in cells of 5' latitude by 5' longitude. Densities are based on the combined data sets of several studies; see the Data and Analyses section of this chapter. The color and mapping intervals were selected to show the most structure and highlight significant areas, while allowing comparisons among marine bird species.

Cells that were surveyed but in which no Tufted Puffins were observed have a density of zero. Areas not surveyed appear white; no information was available for these areas. Blue lines indicate the boundaries of the National Marine Sanctuaries in the study area: Cordell Bank, Gulf of the Farallones and Monterey Bay. Bathymetric contours for the 200 m and 2,000 m isobaths are shown in light blue.

In order to provide an integrated look at the patterns of a species' spatial and temporal occurrence and abundance in the study area, map d shows seasonal high-use areas, displayed in cells of 10' latitude by 10' longitude, and also breeding colonies (when available). The seasonal high use map provides a further synthesis of densities presented in maps a, b and c, and portrays the relative importance of various areas to the species. Areas with consistently high use are highlighted. See the Data and Analyses section of this chapter for further explanation of high-use areas.

DATA SOURCES AND METHODS

The at-sea data set is referred to as the CDAS central California data set (1980-2001) and was developed using software called Marine Mammal and Seabird Computer Data Analysis System (CDAS), by the R.G. Ford Consulting Co. The data set extends from Pt. Arena to Pt. Sal in the study area, and the surveys used were conducted between 1980 and 2001. See the Data and Analyses section of this chapter for more information on the at-sea survey data sets and methods.

Most data on colony sizes were obtained from Carter *et al.,* (1992), with additional updates from Warzybok *et al.,* (2002) for South Farallon Islands. Because this species nests in burrows and crevices, estimating breeding population size is difficult. However, they have a distinct diurnal pattern of when they sit by cavity entrances, especially during the evening (Ainley and Boekelheide 1990). Therefore, most estimates were based on bird counts adjusted with a correction factor (based on time of day) to account for breeding birds not observed on the survey (Carter *et al.,* 1992). Estimates at South Farallon Islands were based on counts and monitoring of potential nesting pairs throughout the breeding season (Warzybok *et al.,* 2002).

RESULTS AND DISCUSSION

Tufted Puffin is listed by the State of California as a "Species of Special Concern" because of long-term declines and contraction of the breeding range (McChesney *et al.,* in press b). The largest colony in California is at the South Farallon Islands; even so, that population included only 128 breeding birds in 2002. Overall, the species is considered to be uncommon in the study area. Surveys in CDAS recorded 197 sightings of 245 individuals. Accordingly, a high density "halo" of puffins extended around those islands (including the Farallon Escarpment), with scattered individuals elsewhere during the Upwelling Season. The National Marine Sanctuary boundaries encompass these areas of high density. Having migrated north after breeding during the Upwelling Season, Tufted Puffins are all but absent during the remainder of the year.

A multiple-regression model of nine independent variables explained only 10.1% of the variation in this species' cell density; the top three variables were negative relationships with distance to colony, year, and distance to the 200 m isobath; see Table 3.8. These results are consistent with the maps: presence was strongly affected by the location of the Farallon colony, and the preferred habitat over the upper slope (mean depth of occurrence was 487 m). This species' negative relationship between density and year reflected an appreciable decrease in abundance within the study area between 1985 and 2002.

In the study area, few Tufted Puffins nest outside the South Farallon Islands colony; see also Appendix 1A, the bird colony data table. During the 19th and early 20th centuries, this species was more common and widespread in California. Now only a remnant population exists. Reasons for the decline and lack of recovery are unclear but include introduction of feral animals to large islands and alterations of the marine food web due to overfishing and changes in climate (Ainley and Lewis, 1974).

Tufted Puffins can dive to depths exceeding 100 m when foraging on fish and invertebrates (such as squid). See Tables 3.5, 3.7, 3.9, 3.10 and 3.11 for related summary information.