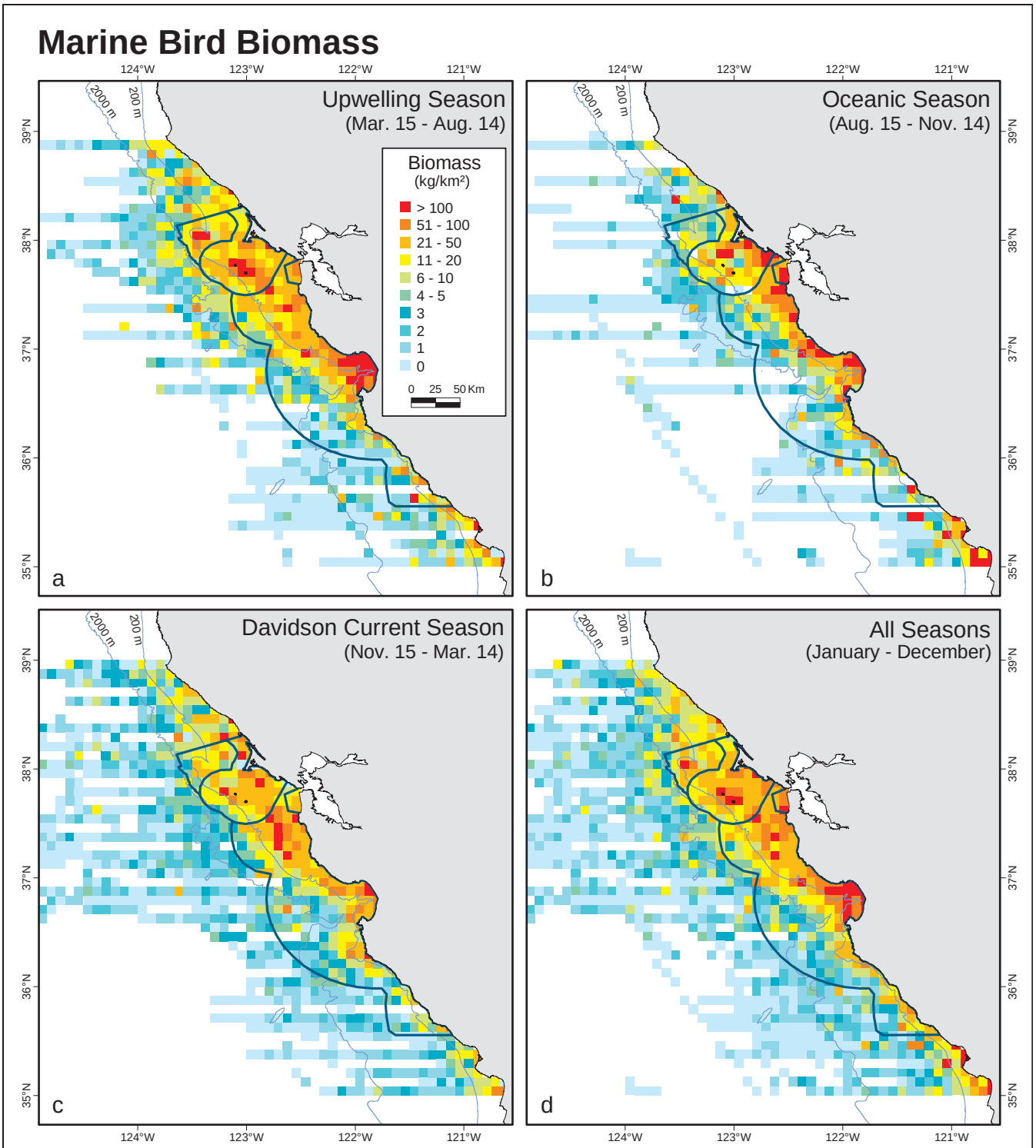

Map Citation: NOAA National Centers for Coastal Ocean Science (NCCOS) 2007. At-sea data from the CDAS Central California Data Set (1980-2001), 2003.

Figure 3.40. Marine bird biomass, by season and for all seasons.

ABOUT THESE MAPS

Maps a, b and c show the combined biomass density (birds/km^2) of 76 species of marine birds at sea in three ocean seasons - the Upwelling, Oceanic, and Davidson Current, displayed in 5' latitude by 5' longitude cells. Map d shows density for all seasons and years combined. Densities are based on the combined data sets of several studies; see the Data and Analyses section of this chapter. These analyses provide an example of how marine birds may respond to short-term excursions from

the usual marine climate. For a description of how these periods were chosen, see the following topic in the introduction and summaries sections of the bird chapter: “Response to Variation in Marine Climate”.

In this comparison, densities were converted to biomass by multiplying density by body mass of each species. This comparison, where it includes all species, emphasizes the larger-bodied species, such as Sooty Shearwater and Common Murre, which make a larger contribution to the overall biomass.

The color and mapping intervals were selected to show the most structure and highlight significant areas. Cells that were surveyed but in which no birds 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.

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.

Calculating Biomass. Data on average biomass for each species were derived from Body Weights of 686 Species of North American Birds (Dunning, 1993); see Appendix 2. In a few instances, a species was not listed in this reference; in these cases, the biomass of a closely related bird of a similar size was used. Four overall biomass maps were developed: three ocean season biomass maps and one “all seasons” biomass map. The length and width of the survey trackline in a given cell were used to estimate the area sampled on a particular survey. The number of marine birds seen in a cell was divided by the area sampled in the cell to estimate overall marine bird density per cell. If a cell was surveyed more than once, densities were averaged, with an adjustment made for effort. Once the weighted densities had been determined for each species in each cell, densities of each species were multiplied by the average body mass of that species. These ‘biomass densities’ were then summed for each cell and the results plotted.

RESULTS AND DISCUSSION

In general, the biomass maps are dominated by two, relatively heavy-bodied, numerically dominant species: Common Murre and Sooty Shearwater. These maps are also influenced, to a lesser degree, by the species identified as abundant in the study area (see Table 3.11).

High biomass densities generally occurred over the shelf and upper slope. More specifically, looking first at a summary of all seasons, high biomass densities occurred in: Gulf of the Farallones, especially around the Farallon Islands; San Francisco Bay tidal plume; the area off Half Moon Bay; the area just south of Point Año Nuevo; and in inner Monterey Bay.

During the Upwelling Season, high biomass densities occurred over the shelf and upper slope, with highest density areas occurring mainly at Monterey Bay, Farallon Ridge, and Cordell Bank. The distribution of high biomass during the Upwelling Season mimicked that described in the all seasons map (map d), likely because upwelling dominates the processes that bring avian prey to the region.

During the Oceanic Season high biomass was concentrated more over the inner shelf than in the Upwelling Season, particularly evident from Pt. Reyes to Monterey, as well as in San Luis Obispo Bay. The inner shelf is fragmented into more, mostly depth-defined, microhabitats, thus offering more feeding opportunities to birds.

During the Davidson Current Season, virtually the entire continental shelf from Pt. Reyes to Pt. Sur exhibited high marine bird biomass. With the counter current in full swing, additional factors (e.g., other than upwelling, depth, etc.) were affecting the availability of prey in the region.