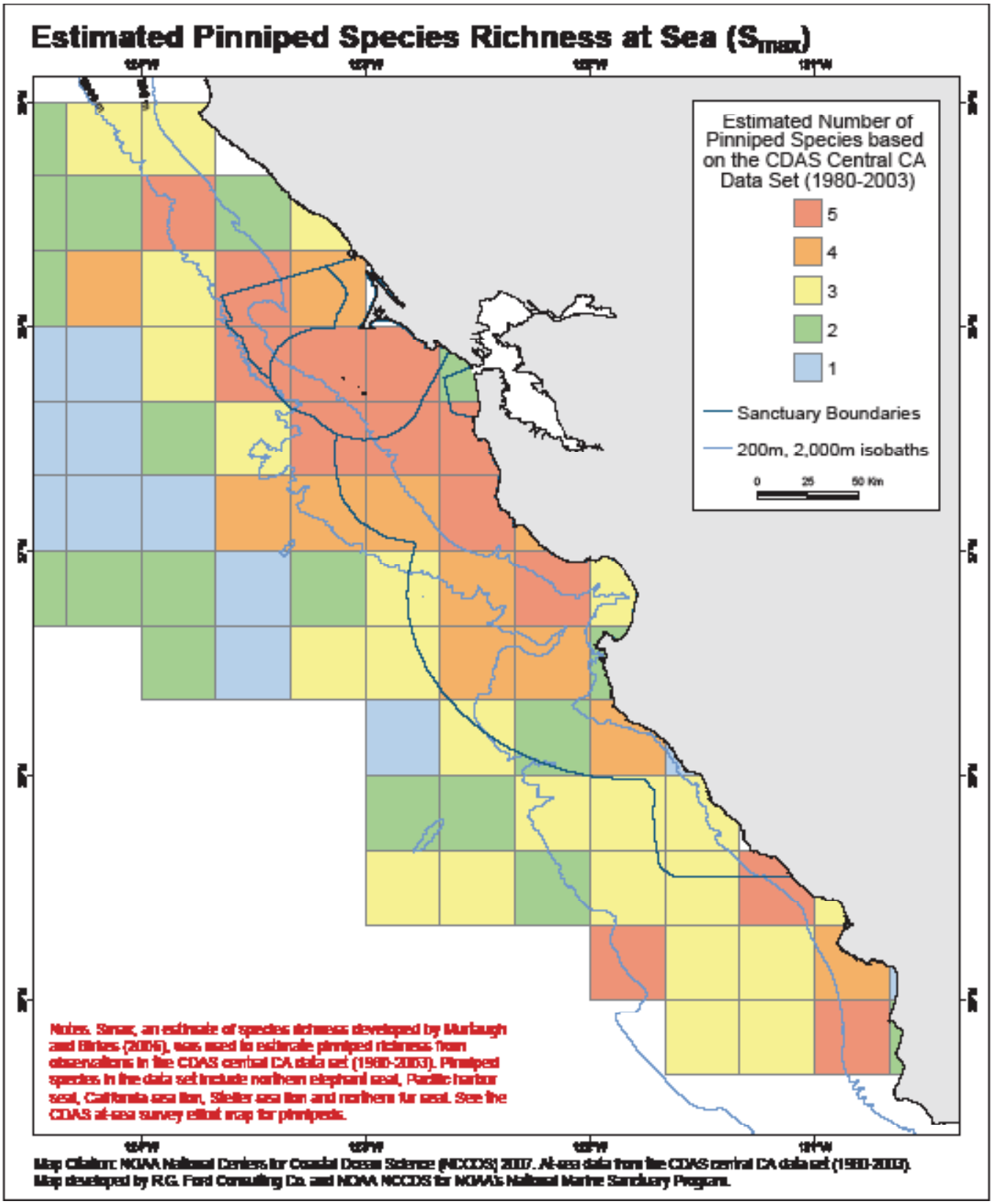

Figure 4.15. Map of estimated species richness for pinnipeds (seals and sea lions), based on the CDAS central California data set (1980-2003).

ABOUT THIS MAP

Figure 4.15 is a map of species richness for pinnipeds (seals and sea lions), at sea off north/central California, based on the CDAS central California data set (1980-2003). Richness refers to the number of species that are

in a geographic region, and is an indicator of community structure and composition. Richness is not a measure of community diversity, which combines both number of species and relative density into a single index. Richness is an explicit measure of the number of species present in a community and is independent of their relative abundances.

The color and mapping intervals were selected to emphasize spatial structure and to highlight significant areas. Areas not surveyed appear white; no information is available for these areas. See below and the Data and Analyses section of this chapter for more information on the data and methods.

DATA SOURCES AND METHODS

Observations of marine mammals at sea in this assessment are based on the CDAS central California data set (2003), developed using the Marine Mammal and Seabird Computer Data Analysis System (CDAS), developed by the R.G. Ford Consulting Co. This data set contains data from eight major survey programs (five aerial surveys, three ship surveys) conducted between 1980 and 2003; the data extends from Pt. Arena to Pt. Sal in the study area, and offshore to the extent of data availability. See the Data and Analyses section of this chapter for information on the at-sea survey data sets.

The number of species in a community or geographic region is a basic descriptive parameter that has been widely studied and utilized (Ludwig and Reynolds, 1988). In practice, however, estimating the number of species is difficult because there is a strong relationship between sampling intensity and the number of different species detected, a situation exactly analogous to the species-area curve described by MacArthur and Wilson, 1967. In general, the number of species detected increases as the intensity of sampling increases. The relationship is typically asymptotic, and eventually additional sampling effort within the same geographic region yields no new species. The estimates of species richness presented here are based on approximations of the asymptotic limit of the species-sampling relationship. Although measures of richness are designed to be independent of effort, Figures 4.1 and 4.2 show summary maps of CDAS sampling effort for pinnipeds and cetaceans for comparison.

To estimate pinniped richness S_{max} was used, a statistical species richness estimator developed by Murtaugh and Birkes (2006). This metric has been shown to work well on the type of data used in this study. This method infers the asymptotic limit of the species curve, i.e. the estimated number of species that would be found if the survey effort were very large, estimated using the relative frequency of observations of different species. For our purposes, we defined a single observation as being the sighting of either one individual or of a group, since the detection of an individual was equivalent to detecting the entire group. For pinnipeds, richness estimates were calculated for 20' x 20' latitude-longitude cells.

RESULTS AND DISCUSSION

The CDAS survey database (1980-2003) for north/central California includes sightings of five pinniped species. Except for the occasional Guadalupe fur seal, all pinniped species known to occur in the study area were recorded in the CDAS database.

Combining all years and seasons of the at-sea CDAS data, the distribution of pinniped species richness at sea showed several patches of high species richness. These areas occurred over the shelf, slope, and deep ocean habitats, both within and outside of the National Marine Sanctuary boundaries in the study area. Richness estimates for these species ranged from one to five, with five being the maximum number of pinnipeds evaluated for this study (Guadalupe fur seal was not included).

Relatively high richness estimates of four and five pinniped species occurred in the following areas:

- throughout and adjacent to all of the Cordell Bank NMS, including one 20' cell about 30 km west and another 20' cell 25 km northwest;
- throughout and adjacent to all of the Gulf of the Farallones NMS (GFNMS);
- throughout over half of the Monterey Bay NMS area, including the shelf and slope from the GFNMS bound south to about Pt. Año Nuevo, where the high richness area widens to include waters over the shelf, slope and deepwater habitats associated with Monterey Canyon, as well as an area off Pt. Sur, including Sur shelf and Sur canyon system;
- three 20' shelf and upper slope cells extending south from Pt. Piedras Blancas to just off Pt. Sal; and
- one 20' cell, about 80 km west of Pt. San Luis and straddling the 2,000 m contour.

All study area cells in the CDAS Central CA data set had at least one pinniped species recorded in it, and over half of the cells had three-to five pinniped species; average pinniped richness was 2.73 pinniped species per cell. This average is likely low, as pinnipeds are likely undersampled at sea in the study area.

These areas of estimated species richness are likely associated with important foraging areas and pinniped haulouts and rookeries, such as the major haulouts at Point Reyes, the Farallon Islands, Point Año Nuevo, and Pt. Piedras Blancas; see Figure 4.14, the summary pinniped haulout and rookery map.