
CHAPTER 1: INTRODUCTION

1.1 PROJECT BACKGROUND

Phase I. In 2001, NOAA's National Marine Sanctuary Program partnered with the Biogeography Branch of NOAA's National Centers for Coastal Ocean Science (NCCOS) to conduct biogeographic assessments to support updates to sanctuary management plans. The first assessment conducted in this partnership focused on three sanctuaries off north/central California: Cordell Bank, Gulf of the Farallones and Monterey Bay. Phase I of this assessment was conducted from 2001 to 2004; the primary goal was to identify and gather the best available data and information to characterize and identify important biological areas and time periods within the study area and provide a suite of products for use in sanctuary management, research and other sanctuary needs.

The study area encompasses the three marine sanctuaries extending along the coastal ocean off north/central California from Point Arena to Point Sal (Figure 1.0). This partnership project was led by the Biogeography Branch, but included over 90 contributors and 25 collaborating institutions. Phase I results include: 1) a report on the overall assessment that includes hundreds of maps, tables and analyses; 2) an ecological linkage report on the marine and estuarine ecosystems along the coast of north/central California; and 3) geographic information system (GIS) and related data files, which are available for viewing and download, in several formats, at the following website:

http://ccma.nos.noaa.gov/products/biogeography/canms_cd/welcome.html

Phase II. The goals of Phase II were to update and complete the mammal and bird analyses and products of the Phase I assessment and provide a suite of Phase II products to sanctuary staff to support management and research activities.

The overall research objectives for marine birds and mammals were to: 1) analyze updated sighting and related data and apply density corrections to mammal maps, where possible; and 2) identify, summarize and communicate summary information on the spatial and temporal patterns, key areas and time periods, and relevant life history information for marine birds and mammals of the study area.

Phase II was implemented in the Fall of 2004 with the following specific objectives:

- Update at-sea density maps for mammals to incorporate specific correction factors, such as sightability of species.
- Update colony data and maps for marine birds, sea otter and pinnipeds.
- Develop maps of marine physiographic features in the study area.
- Develop a report on the biogeographic assessment of marine birds and mammals.
- Provide a website and CD-ROM for downloading reports, maps and related data.

Phase II resulted in significant updates to the bird and mammal chapters, including new summary maps for marine mammals. An environmental settings chapter was also added, containing new and existing data and maps for the study area. Specifically, the following Phase II topics and items were either updated or developed new for Phase II:

- environmental, ecological settings – a new chapter with maps on marine physiographic features, sea surface temperature and fronts, chlorophyll and productivity
- all bird colony or roost maps, including a summary marine bird colony map (new)
- most text and tables in the bird chapter (updated)
- at-sea data CDAS data set for mammals (1980-2003) (updated)
- all mammal maps and most text of the mammal chapter (new)
- overall density maps for eight mammal species (updated)
- summary pinniped rookery/haulout map (new)
- maps of at-sea richness for cetaceans and pinnipeds (new)
- summary tables of mammal population status and summary spatial and temporal map patterns (new)

This report and related products (report, maps, tables, data) will be available in hardcopy, on CD-ROM and at the following website by December, 2007; http://ccma.nos.noaa.gov/products/biogeography/canms_cd/welcome.html

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Results of this assessment off north/central California are currently being used to assist the NMSP and the state of California in addressing issues such as: 1) evaluating potential modifications of sanctuaries and other marine protected area boundaries, and 2) changes in management strategies or administration, based on the data and analyses of these biogeographic products.

In addition to the north/central biogeographic assessment, another biogeographic assessment was completed for the Channel Islands National Marine Sanctuary in 2005. Because it is adjacent to the central California study area and is influenced by similar environmental conditions, it contains biogeographic analyses and products that are relevant to the central California study area. See the following website for more information: <http://ccma.nos.noaa.gov/products/biogeography/cinms/>

The Study Area. The study area extends offshore from Point Arena in the north to Point Sal in the south, and offshore to the extent of data availability. Although the assessment is focused on ocean waters, the study area was extended for the bird and mammal assessment to include seabird colonies and pinniped haulouts and rookeries when data were available. The study area includes three National Marine Sanctuaries (Cordell Bank, Gulf of the Farallones and Monterey Bay) and encompasses marine habitats along the central and northern coast of California. Together, these contiguous national marine sanctuaries include more than 650 km of coastline, from Bodega Bay, north of San Francisco, to Cambria, near San Luis Obispo, encompassing a total area of approximately 18,000 km². See Figures 1.1, 1.2 and 1.3 below for information on place names and selected study area features.

National Marine Sanctuaries of the Study Area. The Gulf of the Farallones National Marine Sanctuary, established in 1981, includes an area of 3,250 km² off the northern and central California coast; see Figure 1.1. The Gulf of the Farallones extends beyond the Sanctuary's boundaries and is one of the broadest sections of the continental shelf off the U.S. West Coast. In addition to the relatively broad shelf, the major oceanographic feature that affects this coastal region is the San Francisco Bay Plume, which, under certain conditions, extends outwards to all areas of the Gulf. Habitats within the Gulf of

the Farallones National Marine Sanctuary include rocky shores, sandy beaches, estuaries, lagoons and bays, as well as the Farallon Islands and the subsurface Farallon Ridge and Escarpment. The entire stretch of the broad shelf is strongly influenced by coastal upwelling and the San Francisco Bay Plume. The upwelled waters, which support tremendous phytoplankton production, are advected offshore into the California Current (see Figure 2.11) as eddies and jets. These productive waters stimulate growth of organisms at all levels of the marine food web. In periods when upwelling is reduced, the nutrient input from the San Francisco Plume becomes important. The Farallon Islands, which are protected as a National Wildlife Refuge, are home to the largest concentration of breeding seabird species in the contiguous United States (12 species), as well as one of the richest assemblages of pinnipeds (5 species). About 163 species of marine, coastal, and estuarine birds and over 30 species of marine mammals use the Sanctuary during breeding or migration. Further, great white sharks are attracted to marine mammal colonies on the Farallon Islands, Point Año Nuevo, and Año Nuevo Island.

The Cordell Bank National Marine Sanctuary, designated in May 1989, includes an area of 1,362 km² off the coast of central California; see Figure 1.1. Cordell Bank is located at the edge of the continental shelf, about 80 km northwest of the Golden Gate Bridge and 33 km west of Point Reyes. The main feature of the Sanctuary is an offshore granite bank, 7 km wide and 15 km long. The rocky bank emerges from the soft sediments of the continental shelf, reaching within 37 m of the ocean's surface. The base of the Bank is over 120 m deep. The combination of oceanographic conditions and undersea topography of Cordell Bank supports a diverse and productive marine ecosystem. A persistent upwelling plume projects southward and offshore from Point Arena and Point Reyes, transporting nutrients and organisms suspended in the water column into the bank's relatively shallow waters. Insolation fuels primary productivity and eventually influences the entire food web through direct and indirect trophic linkages. This high local productivity supports abundant resident populations of invertebrates, fishes (240 species), seabirds (69 species), and marine mammals (28 species) and attracts many migratory species.

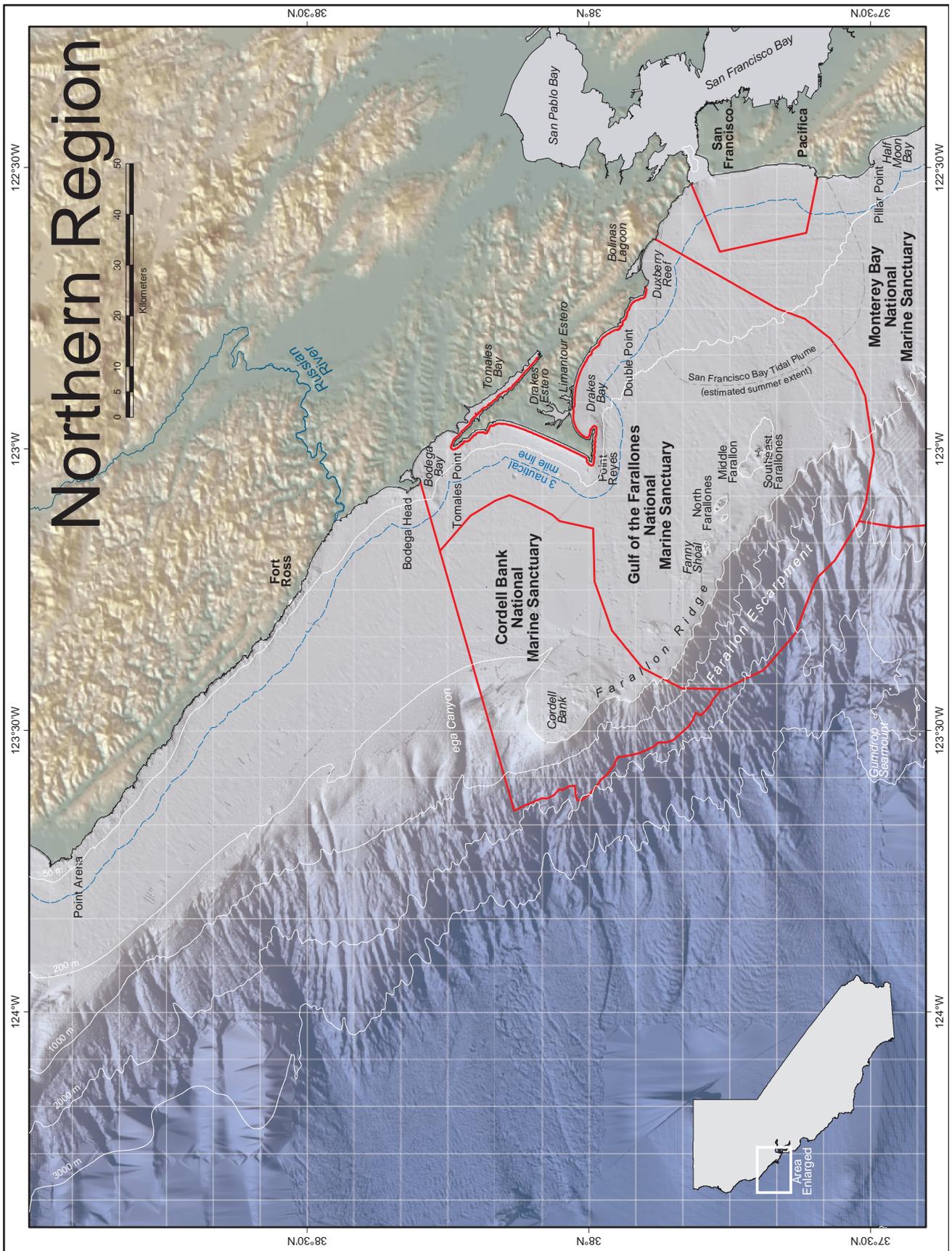


Figure 1.1. Locator map of northern region of study area.

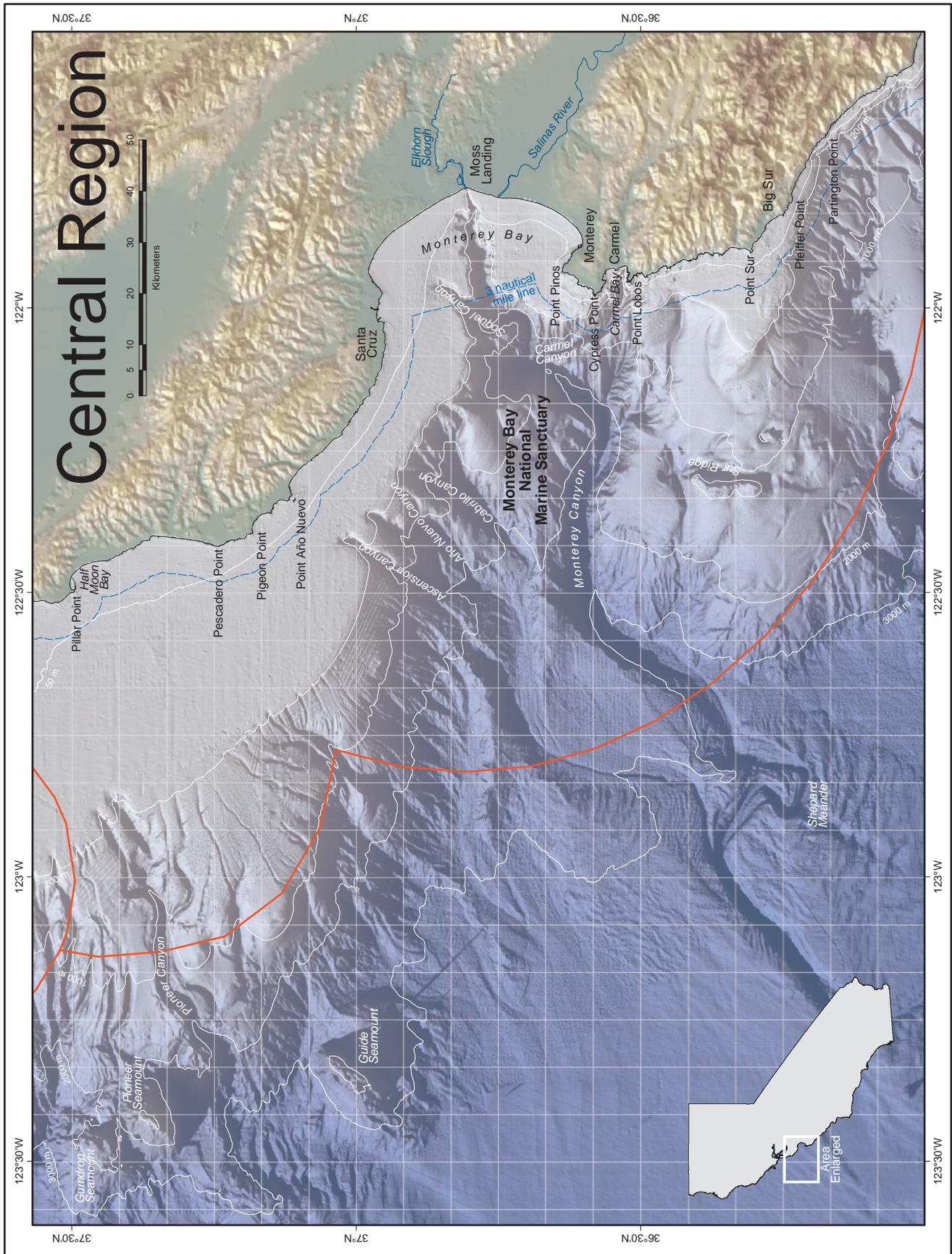


Figure 1.2. Locator map of central region of study area.



Figure 1.3. Locator map of southern region of study area.

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The Monterey Bay National Marine Sanctuary, established in 1992, is one of the largest of 13 marine sanctuaries administered by the National Marine Sanctuary Program (see Figures 1.0). The Sanctuary extends from Rocky Point to Cambria Rock, encompassing nearly 450 km of shoreline and 13,780 km² of ocean, extending an average distance of 32 km from shore. At its deepest point, the Sanctuary reaches a depth of 3,250 m. The Sanctuary includes a variety of coastal and marine habitats, such as rugged rocky shores, lush kelp forests, and several underwater canyons, the largest of which is the Monterey Submarine Canyon. North of Partington Point and within the Gulf of the Farallones, the continental shelf is relatively wide and shallow. South of Partington Point, the Sanctuary generally protects deep ocean, owing to the consistently narrow continental shelf that extends south to Point Conception. The diverse array of habitats in the Sanctuary is home to 33 marine mammals, 94 species of seabirds, at least 345 species of fishes, and numerous invertebrates and plants.

1.2 BIOGEOGRAPHY

Biogeography is the study of the relationship of species' distribution patterns relative to the distribution patterns of their environment. An understanding of biogeographic patterns and how they are influenced by the environment enables sanctuary management decisions to be placed in a spatial context relative to the distribution of biological marine resources. Distributions of marine species are determined by climatic and oceanographic phenomena, physical tolerances and biological interactions. Each species responds to these factors in slightly different ways. Despite the physiological and ecological differences between species' response, there are many similarities in species' distributions, which can be used to define biogeographic regions, provinces and life zones (see Chapter 2).

Biogeographic assessments focus on the broader distribution of species rather than local occurrences of species and hence provide a basis for improving understanding and conservation of habitat uses within a biogeographic province. Assessments of species involves mapping reproductive, feeding and resting areas, as well as migratory routes and areas where species are harvested or have high mortality. This provides valuable information for determining essential habitat for protection. In addition to the information these assessments provide on a single species, they can provide information

on community metrics, such as the distribution of species diversity and richness of biota. These assessments can be useful in identifying which species form assemblages or communities, and how population and community measures, such as species diversity and richness, vary within and across a region. These assessment results can be useful to coastal resource managers because they provide a basis for determining biota that are typical of an area and are appropriate for management of species or habitats. These assessments also highlight hot spots of density and diversity in time and space, as well as information gaps for certain areas, species and life stages.

Marine Biogeography along the West Coast. A number of biogeographic provinces occur along the California coast. There are two coastal biogeographic provinces, Oregonian and San Diegan. The Oregonian Province primarily extends from southeastern Alaska to Point Conception, and is part of the Eastern Boreal Pacific Region (Briggs, 1974, 1995). The Oregonian Province also extends southward beyond Point Conception along the outer islands of southern California, and in part reappears in upwelling areas off Baja California Mexico (Hubbs, 1949). The San Diegan Province (part of the warm-temperate California region, which also includes the Cortez Province of the Gulf of California) extends from Point Conception, California to Magdalena Bay, Baja California Sur (Briggs, 1974). However, in warm-regime years, some San Diegan species extend their ranges northward.

Offshore are two provinces of the cold temperate Oceanic Boreal Pacific Region (McGowan, 1971). The Subarctic Province extends south along the California coast to Cape Mendocino, and the Transition Zone extends south from Cape Mendocino to Magdalena Bay.

The Biogeographic Assessment Process Used in this Assessment

Species Selection. Criteria for the selection of marine bird and mammal species included: 1) species that had a mostly marine distribution in the study area, and 2) adequate survey data and information on the species was available and in a usable format for analysis. Additional considerations included abundance in the study area, Federal or state-listed endangered or threatened status, or California state species of concern.

Biogeographic Assessment Process Used in Phase II

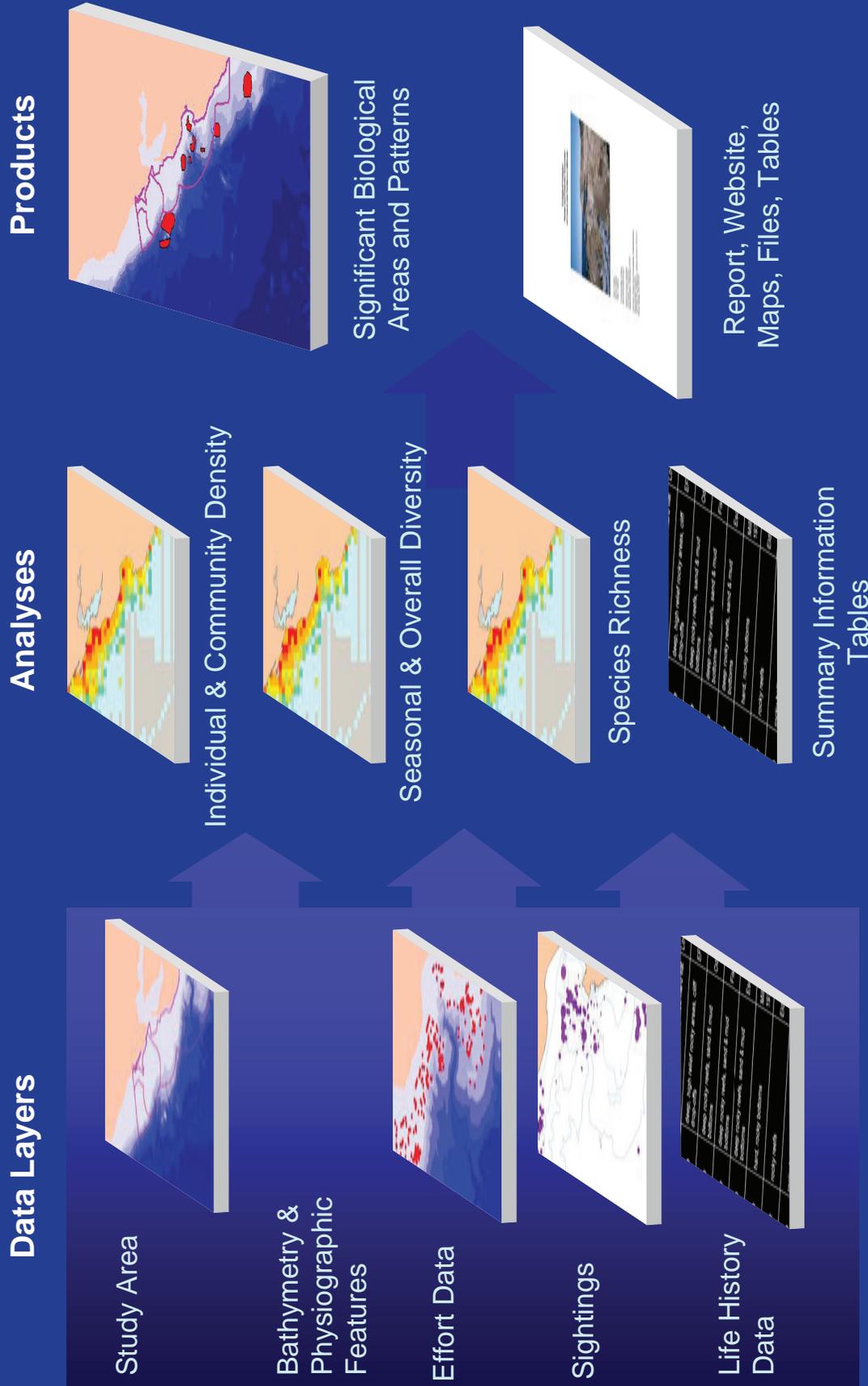


Figure 1.4. Biogeographic Assessment Process for Phase II Marine Birds and Mammals.

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Data Collection, Synthesis and Analysis. Several researchers along the west coast, including Federal and state agencies, non-governmental organizations, and academia were contacted to identify available existing distributional data and literature relevant to the species selected. Once a data set was identified, its utility was evaluated through examination of its spatial extent, and quantity and quality of information provided. As this study was dependent on pre-existing data, the type and quality of information collected was extremely variable. Among the complexities of working with these inherently variable data were varying spatial and temporal coverages, as well as different methodologies employed in data collection (e.g., aerial vs. shipboard data). Combining and synthesizing these data into one spatial framework required significant processing; this is described in subsequent chapters. When differences precluded data sets from being combined and analyzed together, they were kept separate. Depending on the quantity and robustness of the data, a variety of different analyses and map products were created; for example, seasonal and year-round sea surface temperature maps, seasonal and year-round species density maps, mammal sighting and effort maps, pinniped haulout maps, and community metric maps such as richness, density, and diversity. See Figure 1.4 for an overview of the process.

Review. All analyses completed as part of the biogeographic assessment were reviewed by experts. If available, data providers, together with others familiar with the data sets, were consulted to obtain feedback on the analytical methods used and results to ensure accurate presentation of the data and interpretation of the resulting patterns.

Production, Publication and Dissemination. An important part of the assessment process is making the resulting data products and information available for the staff of the National Marine Sanctuaries and other interested users. The final report is provided in a format (PDF) that will be available on the web, along with final maps, GIS and other data tables and files; see http://ccma.nos.noaa.gov/products/biogeography/canms_cd/welcome.html.

1.3 REPORT OUTLINE

This assessment begins with a description of the project background and biogeography of the area and the assessment process used for this project

(Chapter 1). The report moves into the environmental and ecological setting of the study area in Chapter 2, where the study area is described in terms of the physical and biotic environment (e.g., climate, oceanography, habitats). Included are discussions of regional patterns of sea surface temperature, chlorophyll *a*, ocean currents, and bathymetry, and as they relate to the study area. Chapter 2 provides context for the subsequent analytical chapters and focus of this report: marine birds (Chapter 3) and marine mammals (Chapter 4). Where data were sufficient, the bird and mammal chapters include seasonal density maps by species, as well as analysis of community metrics (e.g., marine bird density and diversity, cetacean richness), and summary tables on spatial patterns, and other analysis results. The bird and mammal chapters each have an introductory section with methodology, a section of analytical map results and descriptions of the maps and species, and a chapter summary of overall results and findings, including summary tables on life history, management status, and spatial and temporal patterns.

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