

T H E S A N C T U A R Y E N V I R O N M E N T

The Gulf of the Farallones National Marine Sanctuary is significant as a local, regional, and national resource. Most of the sanctuary lies in the Gulf of the Farallones between the western edges of the continental shelf and the coasts of Marin and Sonoma counties. Some of the largest and most diverse eastern Pacific populations of seabirds and pinnipeds south of Alaska occur in this Gulf. Large numbers of whales and dolphins, including the California gray whale and the Pacific humpback whale, are found in the area. Intertidal and subtidal habitats contain a varied and abundant invertebrate fauna that in several locations has been monitored for almost twenty years. The site also includes two of the few relatively undeveloped estuaries remaining in California.

The resources and the strategic location of the area combine to support a variety of activities including commercial fishing and shipping, sportfishing, sailing, offshore nature excursions, and marine scientific research. Yet in spite of these activities, most parts of the sanctuary remain relatively undisturbed. But recent events and proposals for the site could herald change for the marine environment and therefore warrant the immediate concern of sanctuary management. This section of the management plan profiles the sanctuary briefly, and introduces many of the factors that may affect its management over the next ten years.



REGIONAL SETTING

(A) Sanctuary Location and Boundaries

The sanctuary represents an area of 948 square nautical miles (1756 square kilometers) off the central California coast, the second largest existing national marine sanctuary in the United States. It is located between 38° 18'N and 37° 29'N latitude (see figure 1). The sanctuary belongs to the Oregonian marine province of the Eastern Pacific Boreal Region (Briggs 1974). Habitats and subtidal and intertidal species of this area are representative of cold temperate marine waters extending from Point Conception north to British Columbia.

The offshore boundary of the sanctuary extends seaward 6 nautical miles from the mean high tide line in the northern part of the sanctuary (between Bodega Head and the Point Reyes Headlands). The boundary then follows a 12 nautical mile arc around the Farallon Islands (including Noonday Rock), and extends back to the shore at Rocky Point south of Bolinas Lagoon. The shoreward boundary of the sanctuary follows the mean high tide line except along the Point Reyes National Seashore where it follows the seaward boundary of the park that extends a quarter mile offshore. The sanctuary includes Bolinas Lagoon, Estero San Antonio, Estero de Americano, Tomales Bay, and Bodega Bay, but not Bodega Harbor (see figure 1). Coordinates for the sanctuary boundaries are included in Appendix 1.

(B) Regional Access and the Role of the Sanctuary in the San Francisco Bay Area

Over 58 coastal access points in Sonoma, Marin, San Francisco, and San Mateo counties provide a direct view over the sanctuary (NOAA 1984c). Most of these access points are located in Federal, state, and local parks adjacent to the sanctuary including the Golden Gate National Recreation Area, the Point Reyes National Seashore, several state beaches, and county parks. Access for private and chartered recreational vessels destined for the sanctuary is provided primarily at the marinas in San Francisco Bay, Bodega Harbor, Tomales Bay, and Half Moon Bay. It is expected that programs for this sanctuary will be directed at and will involve a large regional population viewing, gaining access, and experiencing the sanctuary from these many different vantage points.

The main sanctuary offices are located at Fort Mason in San Francisco, which is also the National

Park Service's headquarters for the Golden Gate National Recreation Area. All NOAA-funded management programs for the sanctuary are coordinated from this location which provides ready access to the region's many ocean-related government and private organizations and to the general public.

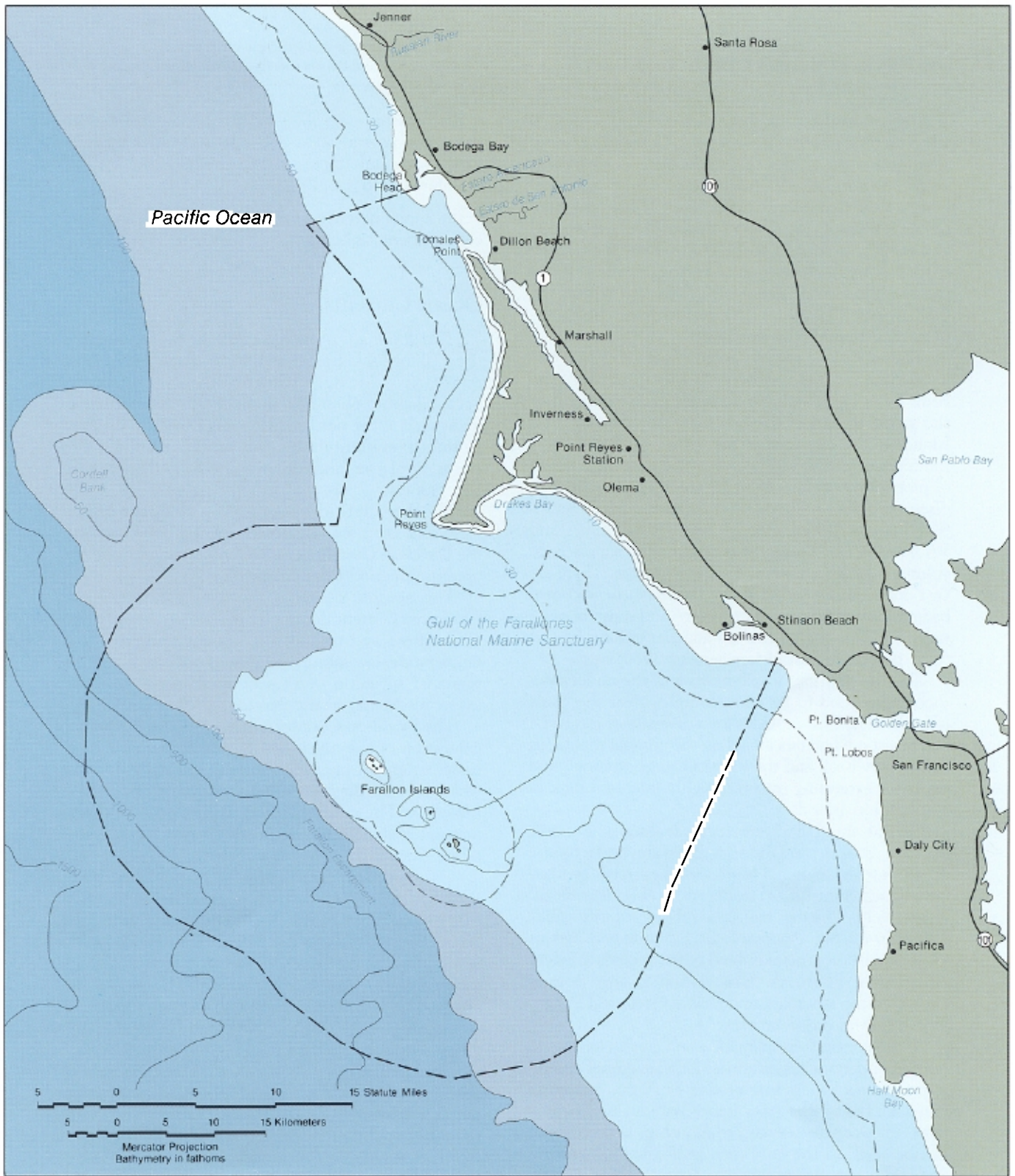
The future management of the sanctuary will be influenced by development trends in the broader San Francisco Bay area. As the regional population increases, there will be a greater demand for education and recreation-related services within the Gulf of the Farallones and adjacent coastal areas. Greater pressure will be exerted on the resources as the number and demands of users increase. The sanctuary management program should expand in accordance with overall program objectives.

There are many other regional trends that will affect the sanctuary's management. The sanctuary's location adjacent to the Bay partly overlaps one of California's busiest ocean traffic corridors. Approximately three tankers enter the Bay area every day and the area's refineries account for about 33 percent of the state's total refining capacity (Minerals Management Service 1983). Industrial activity is likely to continue to concentrate here.

The sanctuary borders some of California's least-developed coasts. Existing policies including the California Coastal Act call for limited development in both Sonoma and Marin counties except in the immediate vicinity of the existing small towns. Because the sanctuary is large and includes both an adjacent rural and urban component, the plan must be flexible enough to deal with a broad range of concerns. These will vary greatly in scale, from local problems of sedimentation in estuaries to regional problems of increasing ocean traffic.

SANCTUARY RESOURCES

Our knowledge of the sanctuary's resources, particularly those dependent on the Farallon Islands and the Point Reyes Peninsula, is extensive in comparison to knowledge of other areas in northern and central California. Several parts of the sanctuary have been set aside as protected areas and their special resources have been subject to study for some time. In recent years, investigations initiated as part of the sanctuary research program have added to our understanding of the areas offshore, and the relationships among coastal, near-shore, and oceanic parts of the sanctuary. What is known about the sanctuary's resources and the many questions that remain are briefly introduced here as a basis for future programs.



- Gulf of the Farallones National Marine Sanctuary Boundary
- Inner Shelf (<50 fa)
- Continental Slope (>100 fa)
- Nearshore (<10 fa)
- Outer Shelf (50-100 fa)

Figure 2
Bathymetry

(A) Environmental Conditions

Southwest of the Farallon Islands, the shelf drops abruptly to depths of 400 fathoms (2400 feet). The 1000 fathoms (6000 feet) line is about 15 nautical miles southwest of the islands. The islands are located about 26 to 28 nautical miles from the mainland on a submarine ridge that extends north about 17 nautical miles to Cordell Bank. The Gulf of the Farallones is a broad and shallow extension of the continental shelf, interrupted along its western edge by the granite ridge of the Farallon Islands (see figure 2). Depths within the Gulf average 30 fathoms (180 feet) with the shelf gently sloping towards the northwest.

The submarine geology is broadly divided into two areas. Fine silt and clay deposits prevail north of the Point Reyes Headlands. A flat sandy plain extends over the southern part of the sanctuary from the Farallon Islands to the entrance of San Francisco Bay. This is the most extensive sandy area in California's offshore — probably evidence of large volumes of sediments discharged over millions of years by the Sacramento-San Joaquin Rivers through the Bay (Welday and Williams 1975). These rivers continue to supply large volumes of fine sediments to the nearshore. There are two documented sedimentary basins with unknown hydrocarbon resources located north and south of sanctuary boundaries (the Bodega and Santa Cruz basins) (U.S. Bureau of Land Management 1980).

The distribution of sediments and the underwater topography tend to be more complex near the coast (see figure 3). This provides for a diversity of intertidal and nearshore habitats including the unusual shale reefs at Duxbury Reef, and the wave-cut surge channels and sea caves extending into the highly fractured rock of the Farallon Islands.

Several small bays are located along the coast. Bolinas, Drakes, and Bodega Bays are open to the ocean, but are sheltered from coastal currents by Duxbury Point, Point Reyes Headlands, and Bodega Head, respectively. Tomales Bay is a submerged rift valley formed by the San Andreas Fault. Estuaries and lagoons are located along the mainland coast, including Estero Americano, Estero de San Antonio, and Bolinas Lagoon in the sanctuary, and Drakes Estero and Limantour Estero in adjacent areas.

These contrasts in submarine and coastal landforms provide important opportunities for educational and interpretive activities. Interpretive activities can communicate basic differences among habitats in the sanctuary. They can also explain relationships between what can be seen on the land (i.e., geological formations) and the ocean floor.

Other implications of the site's coastal and submarine geology are:

- the residence time of oil and other pollutants in near-shore and coastal areas and relative vulnerability of various coastal types to accidental discharge of pollutants; and
- the appropriateness of different oil spill cleanup and containment techniques.

Ocean Currents

The dominant oceanic current in the sanctuary is the California Current, which flows southward from Alaska to Mexico. During the year, several oceanographic phenomena affect this general movement such as the northward flowing Davidson Counter Current prevailing during the winter, upwelling processes, local gyres and eddies, and tidal exchanges with San Francisco Bay.

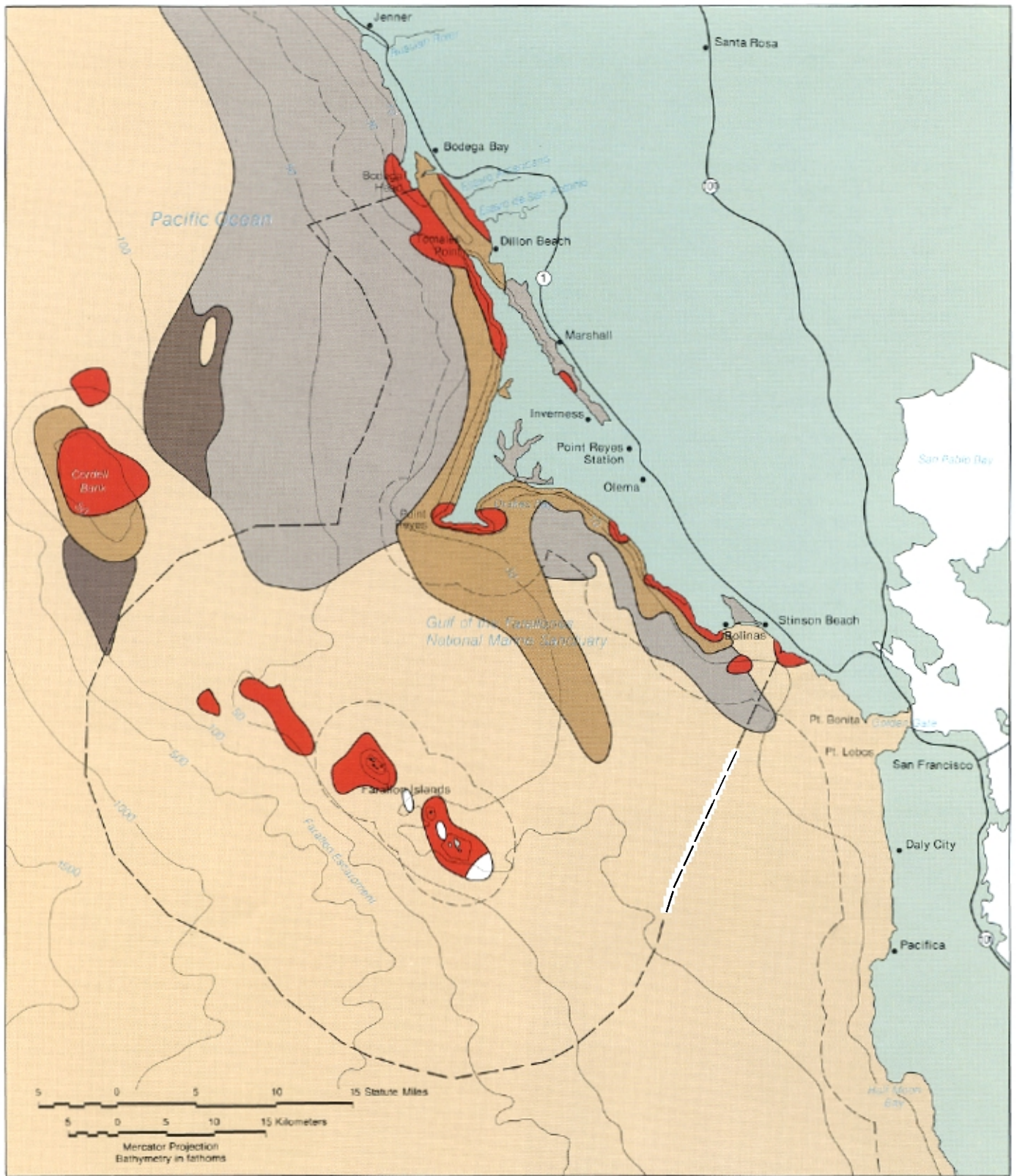
The three distinct ocean seasons along the central California coast are: the oceanic period (July-October); the Davidson Current period (October-March); and the upwelling period (March/April-July).

The oceanic period is the season in which the California Current dominates the circulation pattern. This diffuse and meandering current transports low-temperature, low-salinity, high-nutrient, and highly oxygenated subarctic water southward along the coast (Minerals Management Service 1983).

The Davidson Counter Current may be the surface expression of the northward flowing Equatorial water undercurrent. It appears nearshore during the winter when the wind direction is northward along the California coast. The current carries oxygen-poor, nutrient-rich waters that are characteristically warmer and more saline than the California Current.

Coastal upwelling takes place when northwest winds drive the current south. This has the effect of transporting surface layers of the ocean offshore, allowing the deeper layers to move to the surface. The upwelled water is usually characterized by low temperatures, high salinities, and high nutrient levels. The process increases the primary productivity of surface waters by supporting large phytoplankton blooms. Rich zooplankton and fisheries production ensues.

This general annual sequence varies from year to year depending on global weather conditions. For example, normal oceanographic conditions were significantly disrupted during the 1982-83 El Niño condition that brought abnormally warm waters into the Gulf of the Farallones.



Source: Weday and Williams, 1975.

Figure 3
Sediments

Surface currents in central California are primarily wind driven, leading to seasonal variability in patterns. Water circulation in nearshore waters has been investigated at only a few locations such as Duxbury Reef, Tomales Point, and along the Point Reyes Peninsula. In many of these areas, strong currents produced by wave backwash, tidal currents, and treacherous rip currents have been reported (Minerals Management Service 1983).

Ocean currents can affect resource management in the sanctuary. For example, since currents are poorly understood and often vary from year to year, they are unpredictable and difficult to forecast, an important consideration for predicting oil spill trajectories and for planning oil spill containment measures.

Water Quality and Chemistry

Studies of the nearshore water chemistry of the central California coast acknowledge the lack of data necessary to characterize any specific area. Oceanic water quality along central California generally ranges from very good to high except in areas adjacent to population centers such as San Francisco Bay (Minerals Management Service 1983).

As part of the state and national mussel watch program, mussels (*Mytilus spp.*) in the sanctuary region have been analyzed for selected trace metals (Moss Landing Marine Laboratories) and hydrocarbons (Bodega Bay Marine Laboratory). Kauner, Gordon, and Martin (1979) have conducted trace metal analyses of marine waters from within San Francisco Bay and oceanic waters adjacent to San Francisco Bay. The trace metal levels from water samples within and outside San Fran-

cisco Bay were found to be higher than the trace metal levels along the general central-northern California coast. This finding reflects the influence of San Francisco Bay activities on adjacent oceanic waters.

Although vessels discharging their bilges prior to entering the Bay are also thought to be a problem, very little documentation is available to confirm this. Since 1970, there have been regular reports of oil-soaked birds at the Farallon Islands (California State Water Resources Control Board 1979c; Point Reyes Bird Observatory 1985) suggesting that there are frequent offshore releases of hydrocarbons from vessels.

There have been at least two significant accidental oil spills in the vicinity of the sanctuary during the last two decades. Observations made by Chan (1972, 1974) following the 1971 collision and spill of two vessels at the entrance to the Bay indicate that the oil did have at least a temporary effect on intertidal fauna; however, populations did appear to recover to pre-spill levels. The effects on environmental quality of the 1984 T/V *Puerto Rican* spill, and subsequent chronic releases from the vessel's sunken stern are not yet known (U.S. Coast Guard 1985; Chan 1984).

Climate and Weather

The sanctuary is characterized by cool, foggy summers and mild stormy winters. This pattern is controlled by the North Pacific Subtropical High Pressure system. The Pacific High is most dominant in the summer when it is located to the west and north of California. Stable weather therefore persists all summer. Fog is most prevalent during this season as warm air associated with stable atmospheric conditions meets the cold waters at the ocean's surface during the upwelling period. Fog is an important climatic variable since it also maintains low summer temperatures. The lighthouse at the Point Reyes Headland is reported to be one of the foggiest stations on the Pacific coast.

The Pacific Ocean tends to reduce the seasonal temperature range. Measurements taken at the Point Reyes Lighthouse indicate that the daily mean temperatures fluctuate less than 7° F (3.9° C) between the coldest and warmest months of the year (January and September) (Schenk 1970).

Wind patterns reflect the same seasonal variations. The winds during the summer come from the northwest, averaging about 10 to 13 miles per hour (16 to 20 kilometers per hour) at the Lighthouse. During the summer, the prevailing westerlies have a high moisture content, thereby accounting for the persistent fog which often blankets coastal areas north of San Francisco Bay.



(B) Biological Resources

The area was selected and designated as a national marine sanctuary because of concentrations of the following living marine resources: (1) seabirds and aquatic birds; (2) marine mammals (pinnipeds and cetaceans); (3) fish; (4) marine flora (particularly kelp, salt marsh vegetation, and eelgrass); and (5) benthic fauna (U.S. Department of Commerce 1980).

Seabirds

The nesting seabird population is the most significant resource of the sanctuary (see figure 4). The Farallon Islands support the largest concentrations of breeding marine birds in the continental U.S. (Ainley and Lewis 1974). These populations forage in nearshore areas and in the Gulf of Farallones, and are highly dependent on the productive waters of the sanctuary. The area is also noted for its unusually high diversity of its seabird populations. Twelve of the sixteen species of marine birds known to breed along the U.S. Pacific Coast have colonies on the Farallon Islands (Ainley and Lewis 1974) and feed in the sanctuary. These species are:

- Ashy storm petrel
- Leach's storm petrel
- Brandt's cormorant
- Double-crested cormorant
- Pelagic cormorant
- Black oystercatcher
- Western gull
- Common murre
- Pigeon guillemot
- Cassin's auklet
- Rhinoceros auklet
- Tufted puffin

The seabird populations of the sanctuary are not only significant, but fascinating because of their history and long record of exploitation, observation, and study. In a review of the history

of the Farallon Islands community, Ainley and Lewis (1974) were able to refer to ornithological observations dating back to the 1850s. The 120 years of records and the ongoing monitoring undertaken by the Point Reyes Bird Observatory since 1972 have allowed scientists to

examine the relationship between birds and the ocean with a historical perspective not available in other places along the Pacific coast. The records also indicate the dramatic effects of human-related disturbances on seabirds such as the effects of egg harvesting, the introduction of domestic animals, and oil discharges in nearshore waters (Ainley and Lewis 1974). But the data also indicate the possibility of rapid recovery of seabird populations once disturbances are curtailed. More recently, a sudden decline in the common murre population associated with El Nino has once again shown that seabirds are sensitive to oceanographic events and therefore are good indicators of the dynamics of the ocean ecosystem (Page et al. 1984).

Mainland coastal areas along the edges of the sanctuary support several additional seabird colonies, all considerably smaller than the colonies at the Farallon Islands. Important nesting locations and prominent breeding species are shown in figure 4 (National Oceanic and Atmospheric Administration 1980). Large foraging concentrations of birds occur in the sanctuary in the vicinity of these colonies (see figure 5).

Several current management concerns have been identified that could affect the status of seabird colonies

at the Farallon Islands and along the mainland in the next decade. These include conflicts with fishing techniques such as gill-netting (birds diving for prey are caught in nearshore nets). The problems of accidental and chronic discharges of oil and other hydrocarbons associated with the heavy shipping traffic into San Francisco Bay are other concerns. Some chemicals are known to concentrate in the food of seabirds and can affect reproductive success in some species. Disturbances related to human contact and harassment may continue to be a



threat, particularly at the mainland colonies. In relationship to these problems, there is a need to document and understand seabird foraging habits and areas and their relationship to breeding success (Minerals Management Service 1984).

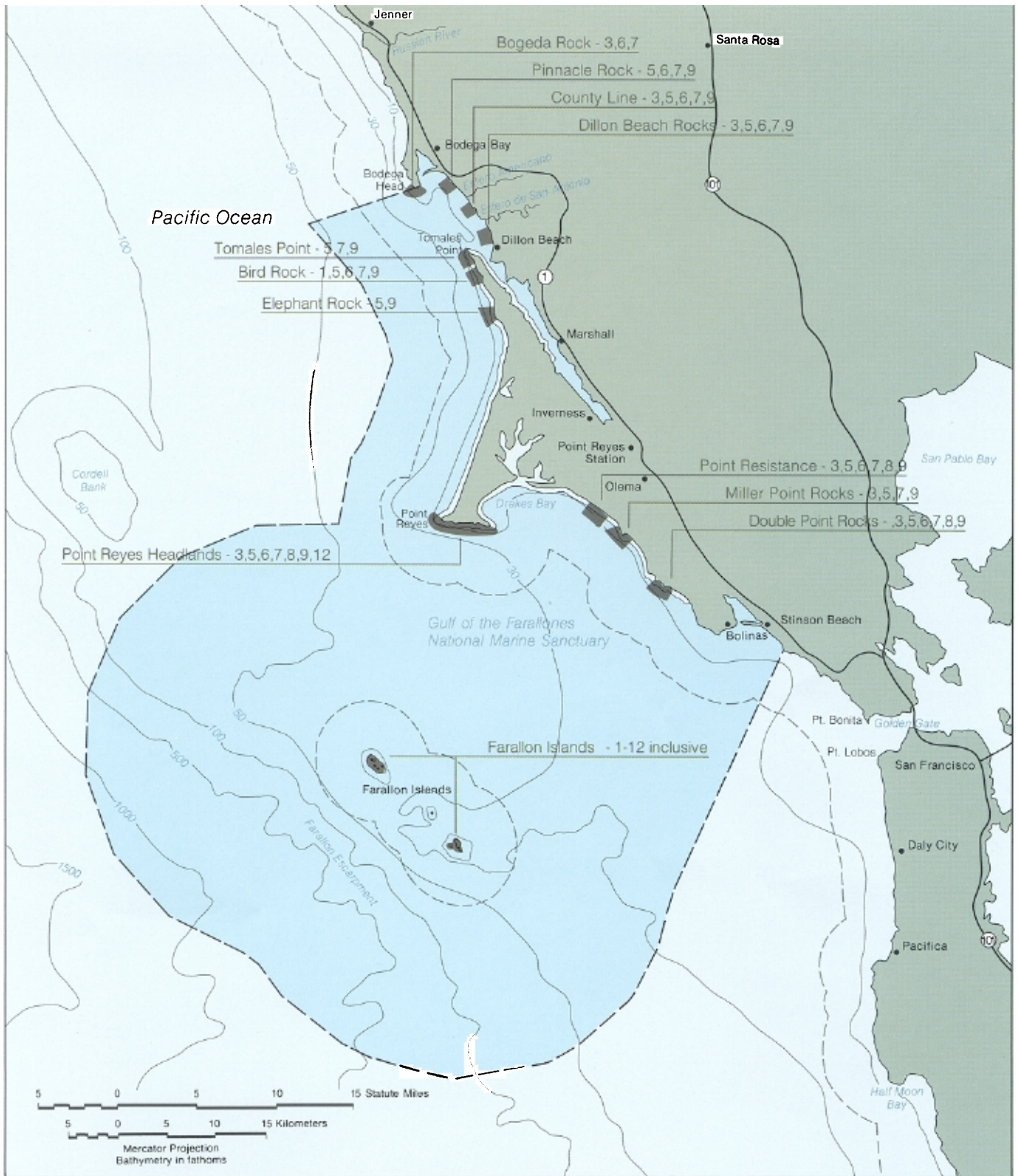
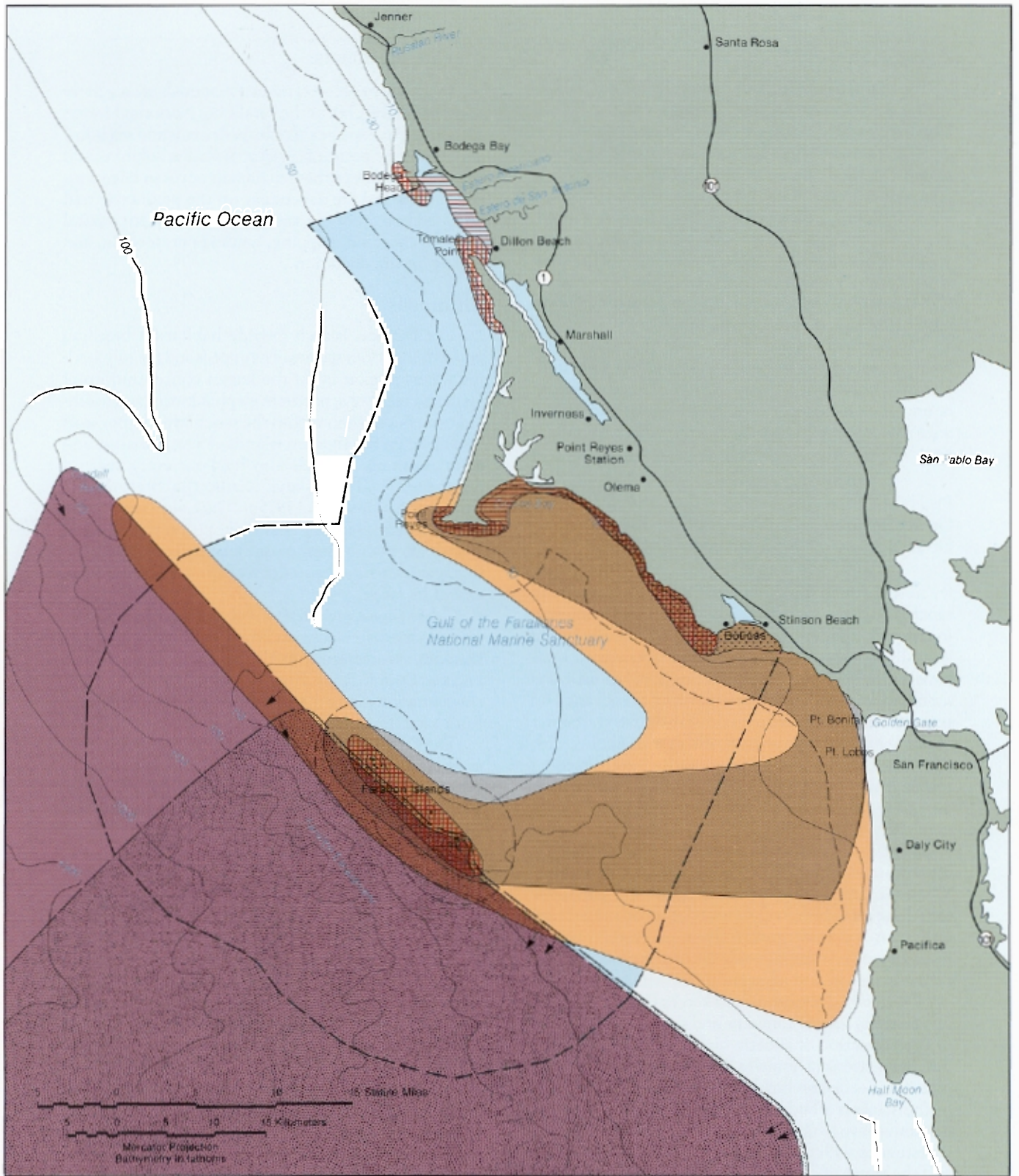


Figure 4
Marine Bird
Nesting Areas

Sources: Sowls et al., 1981; Aunley et al., 1982; Point Reyes Bird Observatory, 1985.



Source: Ainley, et al., 1982

- | | |
|-----------------------------------------------------------|--------------------|
| Gulf of the Farallones National Marine Sanctuary Boundary | Western grebe |
| Rhinoceros auklet | Brandt's cormorant |
| Cassin's auklet | Pelagic cormorant |
| Pigeon guillemot | Common murre |

Figure 5
Marine Bird Concentrations

Aquatic Birds

Four estuaries, a lagoon, and one large coastal bay within the sanctuary provide foraging habitat for species broadly referred to as aquatic birds (waterfowl, shorebirds, gulls, and terns). These habitats are pristine compared to most coastal wetlands in California and provide relatively remote habitat for thousands of migrant and wintering loons, grebes, pelicans, cormorants, waterfowl, shorebirds, and gulls. There is a large (though incomplete) volume of historical data on the aquatic birds of the sanctuary. An analysis of historical census data by Page et al. (1984) describes the seasonal and temporal distribution patterns of aquatic birds in the sanctuary.

One hundred and twenty-three species of aquatic birds have been recorded in wetland areas of the sanctuary. However, only eight of the species considered abundant or uncommon are reported to breed regularly in coastal areas adjacent to the sanctuary and one additional species breeds irregularly. The breeding species include:

Pied-billed grebe	Mallard	Snowy plover
Great blue heron	Cinnamon teal	Killdeer
Great egret	American coot	Gadwall

In addition to the species that breed and nest in the sanctuary, there are at least twenty species summering in the area, and seven species that are primarily spring and fall migrants. The remaining common aquatic birds have both migratory and/or wintering populations in the sanctuary (Appendix 3). The make-up of the aquatic bird population therefore changes constantly over the course of the year, with new arrivals always overlapping with departures of migratory, overwintering, and breeding species (Page et al. 1984). In addition to the seasonal turnover pattern, Page et al. (1984) report a considerable variability in abundance at a wetland from year to year and a different composition of species at each of the four estuaries studied, making each site a unique community. While the implications of these temporal and spatial patterns have yet to be fully understood, they do suggest how difficult it is to understand fully annual variations and what is involved in monitoring the health of aquatic bird communities in and adjacent to the sanctuary.

The detailed review undertaken by Page et al. (1984) also suggests several concerns and study needs relevant to the protection of aquatic birds. Information on the bird populations of Tomales Bay is lacking. More information is needed on how birds actually use the Bay, and on the numbers of birds present during each season. Other concerns have to do with effects of human disturbance on estuaries such as Bolinas Lagoon and Tomales Bay, and the status of certain species such as the American white pelican, brown pelican, and double-crested cormorant.

Marine Mammals

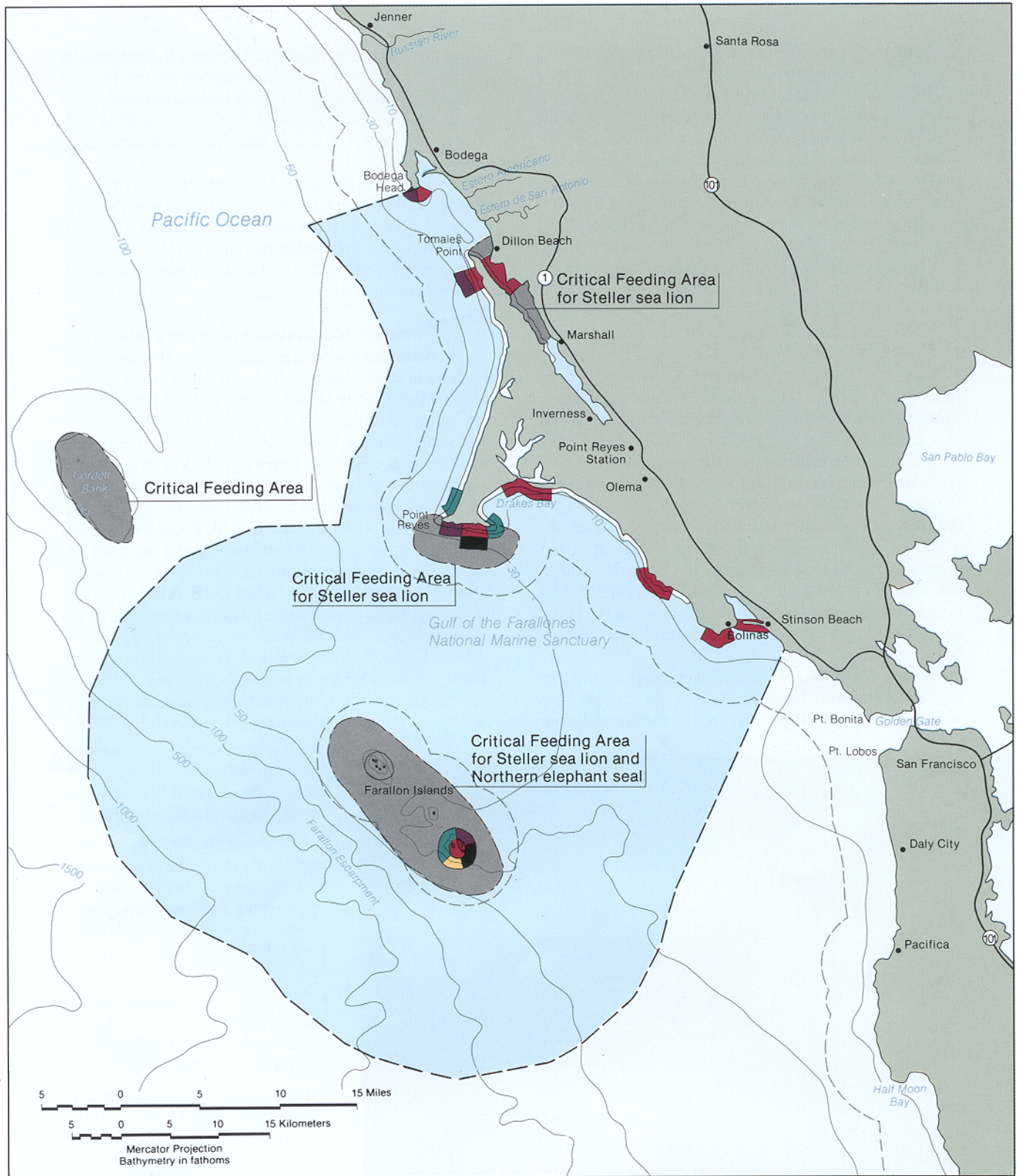
Twenty-two species of marine mammals are regularly observed in the Gulf of the Farallones National Marine Sanctuary: five species of pinnipeds (seals and sea lions) and seventeen species of cetaceans (whales, dolphins, and porpoises). Many of these mammals occur in large concentrations and are dependent on the productive and secluded habitat of the sanctuary and adjacent coastal areas for breeding, pupping, hauling-out, feeding, and resting during migration.

Pinnipeds

The Farallon Islands provide habitat for breeding populations of four species of pinnipeds and the surrounding waters support by far the largest concentrations of California sea lions, northern elephant seals, and northern or steller sea lion within the sanctuary. Harbor seals also breed on the Farallon Islands. A few immature and adult northern fur seals also haul-out every year on Southeast Farallon Island (California State Water Resources Control Board 1979c). The California sea lion and northern elephant seal colonies on the Farallon Islands are the northernmost breeding populations for this species, while the steller sea lion is at the southern end of its range.

Other large concentrations of seals and sea lions are found in the waters surrounding the main rookeries and haul-out sites adjacent to the sanctuary (i.e., Bolinas Lagoon, Double Point, Point Reyes Headlands). Smaller concentrations occur in the vicinity of Bodega Rock, Bird Rock, and Tomales Point (see figure 6).

The California sea lion (*Zalophus californianus*) is the most abundant and widely distributed pinniped of the sanctuary. It is found year-round in the Gulf with approximately 3,000 individuals hauling-out on the Farallon Islands and 300 individuals at the Point Reyes Headlands in August (Ainley et al. 1981). The population in the sanctuary appears to be increasing, a trend also observed in the major breeding range south of Point Conception. Since 1974, one or two pups have also been born on the islands, the northernmost breeding record for this species. About 5,000 to 10,000 animals pass through the Gulf of the Farallones during the spring and fall migrations. A change in migration pattern was first noted at the Farallon Islands in 1978 when large numbers of immature sea lions hauled-out in the fall. Since then the population has tripled, possibly because of the increased availability of Pacific whiting (Allen and Huber 1983; Ainley et al. 1981). California sea lions may also be concentrating along the mainland in December and January to take advantage of seasonally abundant herring spawning in Tomales Bay. Changes in feeding patterns brought on by the El Nino conditions are also expected (Allen and Huber 1983).



Sources: Ainley, et al., 1982; Allen and Huber, 1983.

--- Gulf of the Farallones National Marine Sanctuary Boundary

Haul-out Areas
 ■ Northern fur seal
 ■ Known Critical Feeding Areas

Breeding and Haul-out Areas
 ■ Northern elephant seal
 ■ California sea lion
 ■ Steller sea lion
 ■ Harbor seal

Figure 6

Pinnipeds

Steller sea lions (*Eumetopias jubatus*) occur year-round throughout the sanctuary, especially in the coastal waters of the Farallon Islands. Unlike the California sea lion, the steller sea lion population has decreased dramatically in the southern part of its range which includes the Farallon Islands. The reasons for this decline are not understood and may involve a combination of factors such as increased competition from other pinnipeds, a general warming trend in water temperature resulting in decreased prey availability, and a depressed reproductive rate (Allen and Huber 1983). The breeding population at the Farallon Islands has remained constant at about 130 to 190 animals, and 12 pups were born in 1982. Much smaller numbers (less than 20) have been recently recorded hauling-out along the mainland. The population appears to have a very low birth rate and a very high rate of premature pupping. This could be caused by disease, increased levels of chlorinated hydrocarbons in tissues, or a combination of factors (Huber 1984).

The northern elephant seal (*Mirounga angustirostris*) is the largest and second most abundant pinniped in the sanctuary. The total breeding population in the sanctuary (primarily at the Farallon Islands) is about 900 individuals, a dramatic increase since the early 1970s when the population numbered less than 200 individuals (California State Water Resources Control Board 1979c). The population may also be expanding its range to the Point Reyes Headlands area, where several individuals have been sighted.

A few northern fur seals (*Callorhinus ursinus*) are regularly sighted on the north Farallon Islands from June to September. Fur seals probably bred on the islands before

the fur seal harvesting of the nineteenth century. The species now breeds almost exclusively on the Pribilof Islands in Alaska, although a small colony has established itself on San Miguel Island in the Channel Islands (DeMaster 1984; California State Water Resources Control Board 1979c).

Thousands of female and immature fur seals migrate through the western edge of the sanctuary along the continental shelf from November through June (Ainley et al. 1981). Of all the marine mammals in the sanctuary, northern fur seals are the most sensitive to an accidental oil spill because they depend largely on their fur for insulation.

Harbor seals (*Phoca vitulina*) haul-out and breed at the Farallon Islands and at sites adjacent to the sanctuary such as Double Point, Tomales Point, Drakes Estero. Double Point is the largest harbor seal pupping ground in California (Allen and Huber 1983). Combined with the seals utilizing Drakes Estero, Tomales Point, and Tomales Bay, the Point Reyes population represents a significant proportion (17 percent) of the state harbor seal population estimated to be 19,000 in 1982 (Allen and Huber 1983). Observations at Double Point and Bolinas Lagoon suggest that on a local level, there has been an expansion in harbor seal use of these areas during the breeding season (Allen and Huber 1983). A large number of seals appear to migrate from unknown areas to the sanctuary to breed. Seals are possibly attracted by suitable habitat, food availability, and lack of human disturbances. There is a need for information about movements outside the sanctuary to understand where breeding animals disperse in summer and winter (Allen and Huber 1983).

In summary, the significance of the pinniped resources of the sanctuary is determined primarily by the following characteristics:

- It is one of the few areas of the world with an overlap in distribution of species characteristic of warm-temperate waters (i.e., California sea lion) and cold temperate waters (northern fur seal; steller sea lion).
- The rookeries for several species have been expanding in recent years and further growth is expected.
- For some species, the sanctuary population represents a high percentage of either the central California population or the state's total population.



- Sanctuary waters are highly productive to support such a large and rapidly growing mammal population.
- The populations are relatively accessible to major urban centers, providing opportunities for research and interpretation as well as creating potential conflicts with visitors.

While the status of pinnipeds is well documented, several questions remain with respect to their ecology and behavior. These questions may affect how pinnipeds can be protected in the sanctuary. Several management and research concerns are being jointly addressed by organizations such as the Marine Estuarine Management Division, the National Marine Fisheries Service, and the California Department of Fish and Game. These include: (1) the nature and extent of interactions between pinnipeds and several net fisheries; (2) the effects of oil spills and chronic pollution on individuals and populations; (3) food requirements of pinniped populations and their implications for fisheries management; (4) the need to minimize existing and future levels of human disturbance; and (5) the spatial/geographic distribution of various life history functions of the pinniped populations (e.g., breeding, hauling-out, feeding, foraging, pupping.)

Cetaceans

Seventeen species of whales and dolphins have been sighted in the sanctuary. Ten species are seen regularly and of these, the killer whale, minke whale, harbor porpoise, Dall's porpoise, and white-sided dolphin are considered year-round "residents." The harbor porpoise is the most abundant small cetacean in the Gulf of the Farallones, but the size of the population is not precisely known. Very little is known concerning the areas of concentration, life history, or behavior of the other resident populations within the sanctuary.

The status of the sanctuary's harbor porpoise population is a complex issue of regional and national concern (DeMaster, pers. comm.; Marine Mammal Commission 1985). Although precise estimates of the number of harbor porpoises taken in gill nets in central California are not available, observations in the sanctuary indicate that at least 100 animals were taken in 1983 (Ainley, pers. comm.). This estimate is conservative, but scientists believe that even this known level of take is considerably above the maximum allowable take the population can withstand (DeMaster, pers. comm.).

The sanctuary also lies on the migratory pathway of the gray whale and other large baleen and toothed whales (see figure 7). Gray whales migrate from Alaska southward through the sanctuary beginning in December with peak migration in January. The northward migration begins at the end of February and peaks in March (Ainley et al. 1978). A small number of gray whales remain near the Farallon Islands during the summer, suggesting that these

may be an over-summering population. Furthermore, an increasing number of humpback whales have been sighted in the Gulf between April and November, indicating the return of a seasonal population that had been eliminated by the whaling industry in the early 1900s. Cetaceans are considered a significant sanctuary resource because of the frequency and diversity of sightings within the site, and the fact that the world's total cetacean populations are so small.

In summary, important management concerns for cetaceans in the sanctuary include

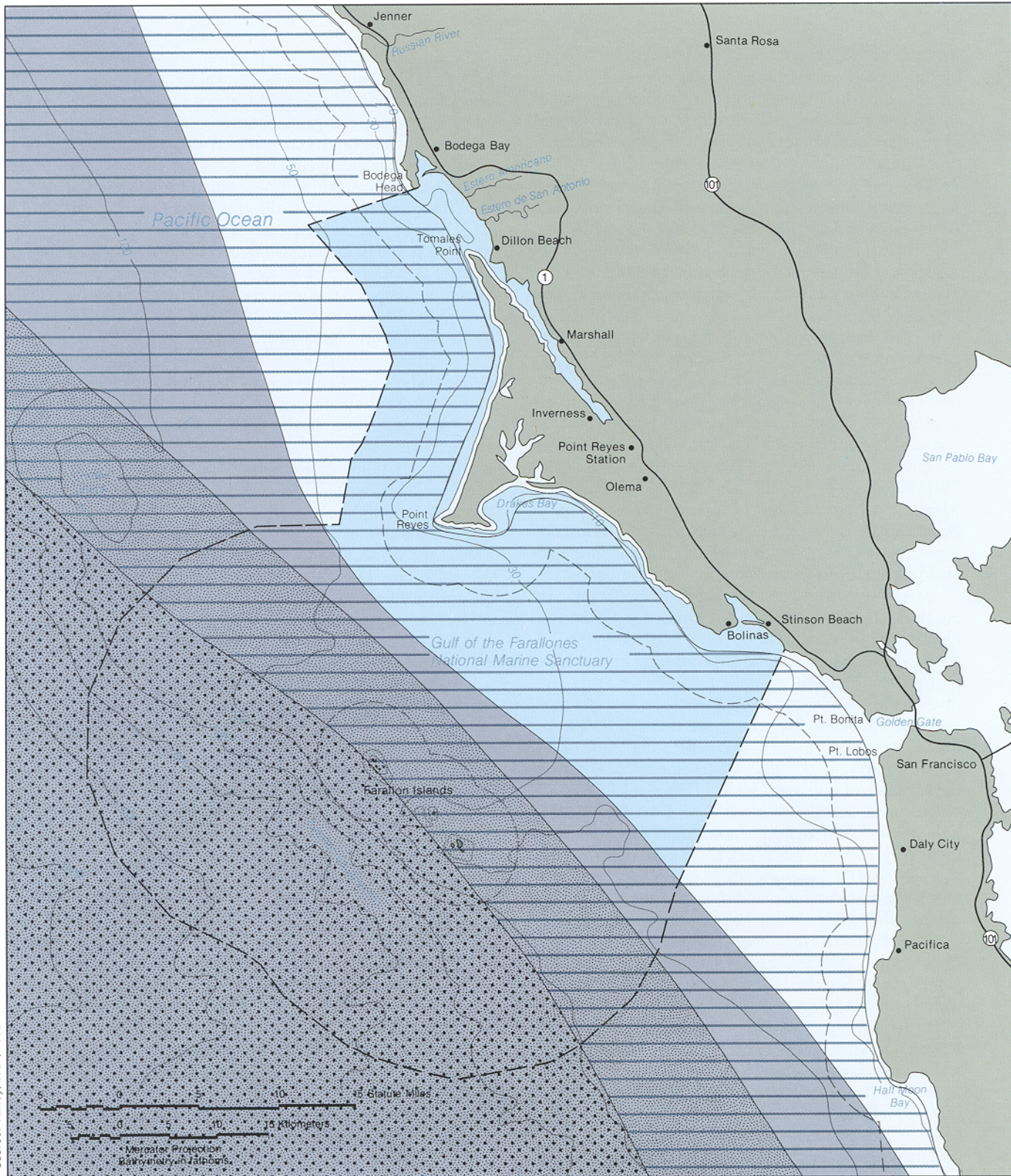
- Lack of baseline data on the status of populations
- Interactions of the smaller species, such as the harbor porpoise, with commercial gill net fisheries
- Humpback whale ecology and factors involved in the return of this population to the sanctuary area

Invertebrates, Fish, and Marine Plants




There is a diversity and abundance of fish and invertebrate species within the sanctuary. This is due largely to the variety of habitats within the sanctuary. According to a recent review by Chan (1984), the sanctuary's marine fauna may in fact be more diverse than in other areas along the Pacific Coast because of the unusual mixture of soft shale (Duxbury Reef) and hard shale (Estero de San Antonio) alternating with both small and large estuaries and lagoons.

Our understanding of the fish and invertebrate communities is far from complete. A few surveys undertaken to date provide an indication of some of the characteristic species (California State Water Resources Control Board 1979a, 1979b, 1979c). The most complete records are available for the intertidal and nearshore zones with only sketchy information on fauna beyond 100-foot depths. This scarcity of information is due in part to the difficulty of sampling at depths and the hazardous diving conditions (Chan 1984). The life histories and seasonal distribution of commercially important species such as the Pacific salmon and Dungeness crab are better documented than those of species with limited or no commercial value.

The protected bays and coastal wetlands of the sanctuary include intertidal mudflats, sand flats, salt marshes, a few submerged rocky terraces, and shallow subtidal areas. The intertidal mudflats support large concentrations of burrowing organisms (clams, snails, crabs) that are a main food source for shorebirds and waders. Some species (such as the littleneck clam) are also collected by recreational fishermen. Eelgrass beds occur on the more extensive flats at Tomales Bay (see figure 8) and they support other assemblages of organisms living on the blades, about the bases, and among the roots of the plants. Eelgrass is also critical for the remnant population of black brant which



Source: Ainley, et al., 1982.

-  Gulf of the Farallones National Marine Sanctuary Boundary
-  Areas of Concentration
-  Dall's porpoise




- Areas of Occurrence**
-  Humpback whale
-  Blue, Fin, Sperm whales
-  Gray whale and Harbor porpoise

Figure 7
Cetaceans

winters within the sanctuary and the adjacent Point Reyes National Seashore. Pacific herring also use eelgrass beds for spawning in Tomales Bay. The shallow protected waters of the bays and estuaries are also critical habitat for anadromous fish, several species of surfperches, and flatfish (California Department of Fish and Game 1980).

Very different species are found along the exposed rocky coasts of the sanctuary, such as Duxbury Reef. Chan (1984) provides a detailed description of the zonation of rocky benthic communities. In a typical transect, barnacles and limpets in the high tide zone (Zone 1) are gradually replaced by black turban snails (Zone 2), sea mussels (Zone 3), and the sea anemones and urchins that mark the transition (Zone 4) toward subtidal rocky communities.

Over shallow rocky reefs where light, temperature, and other sea conditions are suitable, dense kelp beds occur (see figure 8). These beds are dominated by bull kelp and to a lesser extent by giant kelp. Kelp beds extend along the mainland coast between Point Reyes Headlands and Bolinas Lagoon and on the leeward side of the Farallon Islands. Many other species of algae (*Pterygophora*, *Botryoglossum*) grow under the kelp canopy. The fronds, stipes, and holdfasts provide accessible habitat for pelagic and demersal finfish and protection for juvenile finfish.

Sandy shores and shallow sandy bottoms provide another habitat prevalent in the sanctuary (California Department of Fish and Game 1979). Except in very calm shallow coves, sandy substrates do not support extensive algal growth. Fish and invertebrate species tend to be less diverse and abundant in this habitat than in rocky bottom areas. Common species include Dungeness crab, ocean shrimp, surfperch, starry flounder, sand sole, smoothhound shark, and white croaker (California Department of Fish and Game 1979).

Accurate characterizations of the deeper subtidal habitats of the sanctuary are limited (California Department of Fish and Game 1979). Deep rocky reefs are not as easily observed as the shallow reefs which are more accessible to scuba divers and therefore have been more extensively studied. At depths of about 10 or 13 fathoms, the lack of adequate light penetration limits kelp growth. Encrusting coralline algae, brittle stars, and serpulid worms are among the life forms found. Rocky banks in water over 30 fathoms are inhabited mostly by rockfishes, often in large populations. Chilipepper, bocaccio, stripetail rockfish, squarespot rockfish, speckled rockfish, widow rockfish, greenstriped rockfish, greenspotted rockfish, yellowtail rockfish, and several others are found here as well as an occasional lingcod, sablefish, or cabezon. Rock sole, Dover sole, English sole, Pacific sanddab, petrale sole, and sablefish are found in offshore soft bottoms. Over 20 species of fish are also common to the pelagic environment of the sanctuary, including several

large predators such as King salmon, numerous shark species, silver salmon, albacore, Pacific bonito, jack mackerel, Pacific mackerel, and others. Concentrations of pelagic schooling species such as northern anchovy and Pacific herring are a critical food source for predator species such as pinnipeds and the brown pelican.

Current knowledge and understanding of fish in the sanctuary come from the California Department of Fish and Game's management of commercial and sport species. Immediate management concerns center on depleted stocks, particularly for species with slow recruitment rates, and on the protection of critical spawning and nursery habitats. Vulnerable habitats in the sanctuary also need to be identified.

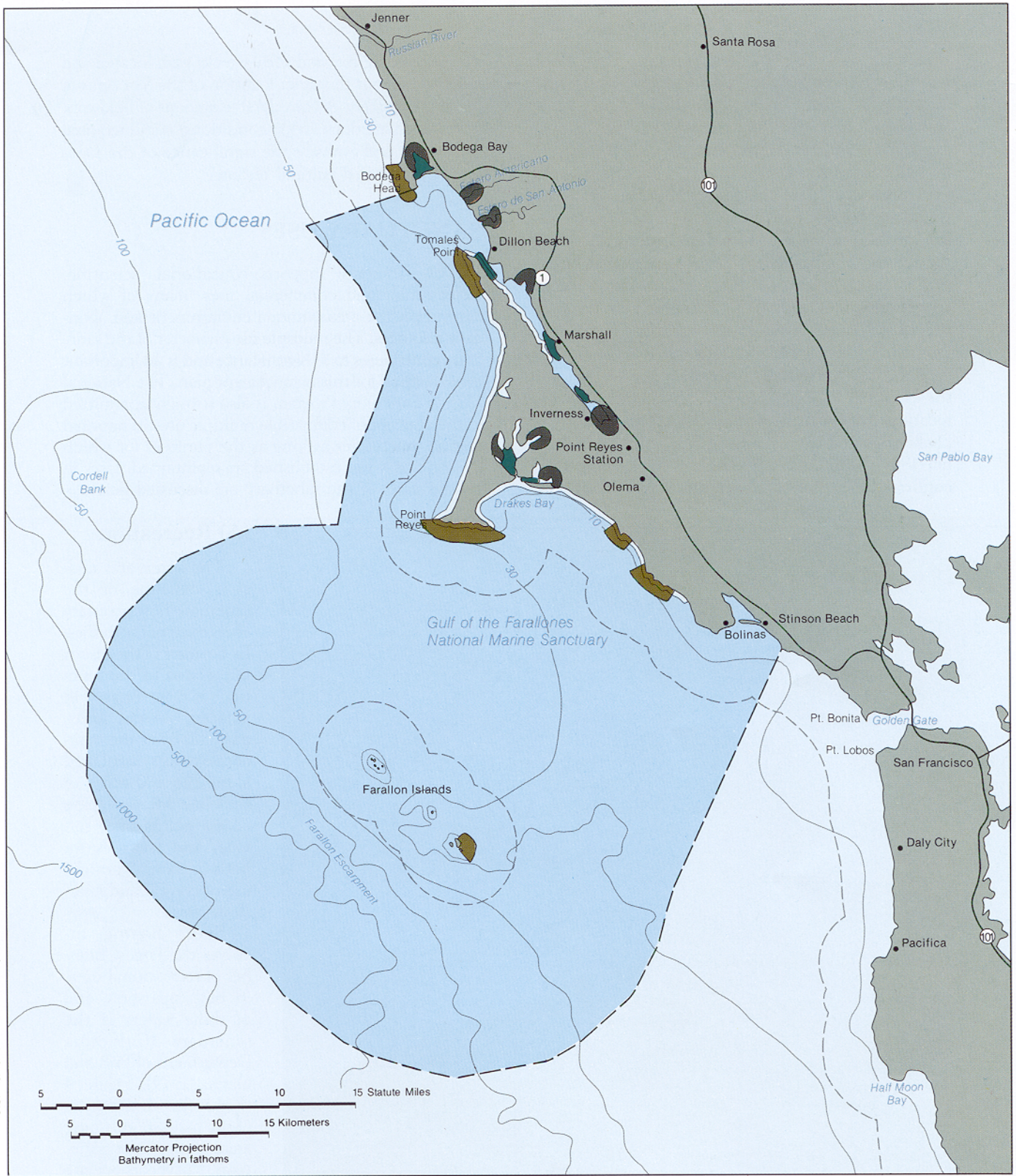
Intertidal areas have been relatively well documented periodically over the past two decades. However, because of the lack of a long-term data base, the dynamics of these areas are not easily understood. Chan (1984) points out the need for continuous monitoring of benthic invertebrates as a baseline against which to evaluate impacts of events like oil spills. There is also a need to understand natural factors of change (such as El Niño effects) separate from human-induced disturbances. Some intertidal species such as abalone are still illegally harvested at certain locations. The effects of illegal take and trampling of intertidal habitats need further investigation. Intertidal areas within the sanctuary have also been quarantined, and there is a need to monitor the level of contamination and its effects through the food chain.

So little is known about the status of subtidal invertebrates in the sanctuary that it is not possible to determine immediate management issues. The most immediate need may be to assess that status of knowledge of various subtidal communities within the sanctuary in collaboration with the California Department of Fish and Game and local research organizations. There may also be an opportunity to set aside certain rocky, subtidal areas that can be isolated for study purposes with no human disturbance.

(C) Cultural and Historic Resources

Archaeological and historical investigations in areas outside the sanctuary have uncovered evidence that significant submerged cultural resources may be present within the sanctuary (Murphy 1984). Over 100 onshore archaeological sites have been recorded adjacent to the sanctuary in locations such as Tomales Point, Double Point, and Drakes Estero. These sites illustrate the complete story of northern California Indians from prehistory, through European contact, to recent times. They provide clues to how native communities such as the Coast Miwok people depended on a wide range of marine resources for subsistence and trade. Onshore historic

Sources: California Department of Fish and Game, 1980;
 U.S. Fish and Wildlife Service, 1981.







-  Gulf of the Farallones National Marine Sanctuary Boundary
-  Eelgrass Beds
-  Kelp (*Macrocystis* sp. and *Nereocystis*)
-  Salt Marshes

Figure 8

Marine and Coastal Plants

sites adjacent to the sanctuary (e.g., the Point Reyes and Point Bonita Lighthouses) document the strategic importance of San Francisco Bay, the Farallon Islands, and the Gulf of the Farallones during the Spanish exploration and fur trading eras.

Point Reyes and Drakes Bay were important in the early historical development of the San Francisco region and consequently were the location of numerous shipwrecks. The earliest wreck dates back to 1595 when the Spanish Manila Galleon *San Agustin* sank in Drakes Bay. There are at least 72 other marine disasters recorded between 1840 and 1940, resulting in at least 30 wrecks in the area, with 15 in Drakes Bay or near the Point Reyes Headlands (Murphy 1984).

Recent investigations undertaken by NOAA and the National Park Service in 1982-83 were aimed at locating shipwreck sites in pre-selected portions of Drakes Bay and the remains of the *San Agustin* (Carrell 1984; Murphy 1984). The on-site investigations confirmed the extent and location of potential wreck

sites within the Bay and a few wrecks were located and inventoried, but the exact location of the *San Agustin* remains a mystery. A considerable amount of fieldwork (involving hazardous diving conditions) is still required to identify and evaluate the significance of the sanctuary's submerged cultural resource.

SANCTUARY USES

The sanctuary supports educational, scientific, recreational, and commercial uses, many of which depend on the area's unique environment and abundant resources. The multiple use character of the sanctuary contributes to its significance and is an important consideration for this management plan. The National Marine Sanctuary Program is also strongly committed to the concept of compatible multiple uses in national marine sanctuaries as long as the purposes for which the sanctuary was established are maintained. Uses in various parts of the sanctuary are discussed below.

(A) Recreation

The waters and adjacent shoreline of the sanctuary host a variety of recreational activities. By far, most of the visitor use related to the sanctuary is concentrated in adjacent coastal areas, particularly at the main access points distributed along the 100 miles of shoreline. Many of these access points offer services and facilities for both day and overnight use of coastal and near-shore areas.

Sport fishing involves the largest number of recreational users in both nearshore and off-shore waters of the sanctuary (California Department of Fish and Game (1979). Figure 9 shows the distribution of the main sport fishing areas within the sanctuary. Partyboats operate



from San Francisco, Oakland, Alameda, Berkeley, Richmond, Bodega Bay, Half Moon Bay, and Sausalito. King salmon, rockfish, and striped bass are the major species taken by trawlers. The sanctuary may account for the state's largest salmon partyboat fishery (out of San Francisco Bay). Bodega Bay and Duxbury Reef are among the most popular areas for rockfishing in the sanctuary. Waters around the Farallon Islands are also used for rockfishing.

Whale watching, Farallon Island trips, and pelagic birding excursions organized by Oceanic Society Expeditions, the Whale Center, and other environmental education groups account for several thousands of visitors venturing offshore. The popularity of such cruises in the Gulf of the Farallones has been increasing since 1980. Sailing and power boat clubs in San Francisco Bay sponsor ocean races at various times throughout the year which often utilize the Farallon Islands as a turning point (NOAA 1980; NOAA 1984c).

The predominant on-shore recreational uses (most of which occur along the shore adjacent to the sanctuary) are: beach-related activities; coastal hiking; nature observation; tidepooling; surfing and windsurfing; clamming and abalone diving; surf fishing; and duck hunting (California Department of Fish and Game 1979; NOAA 1984c).

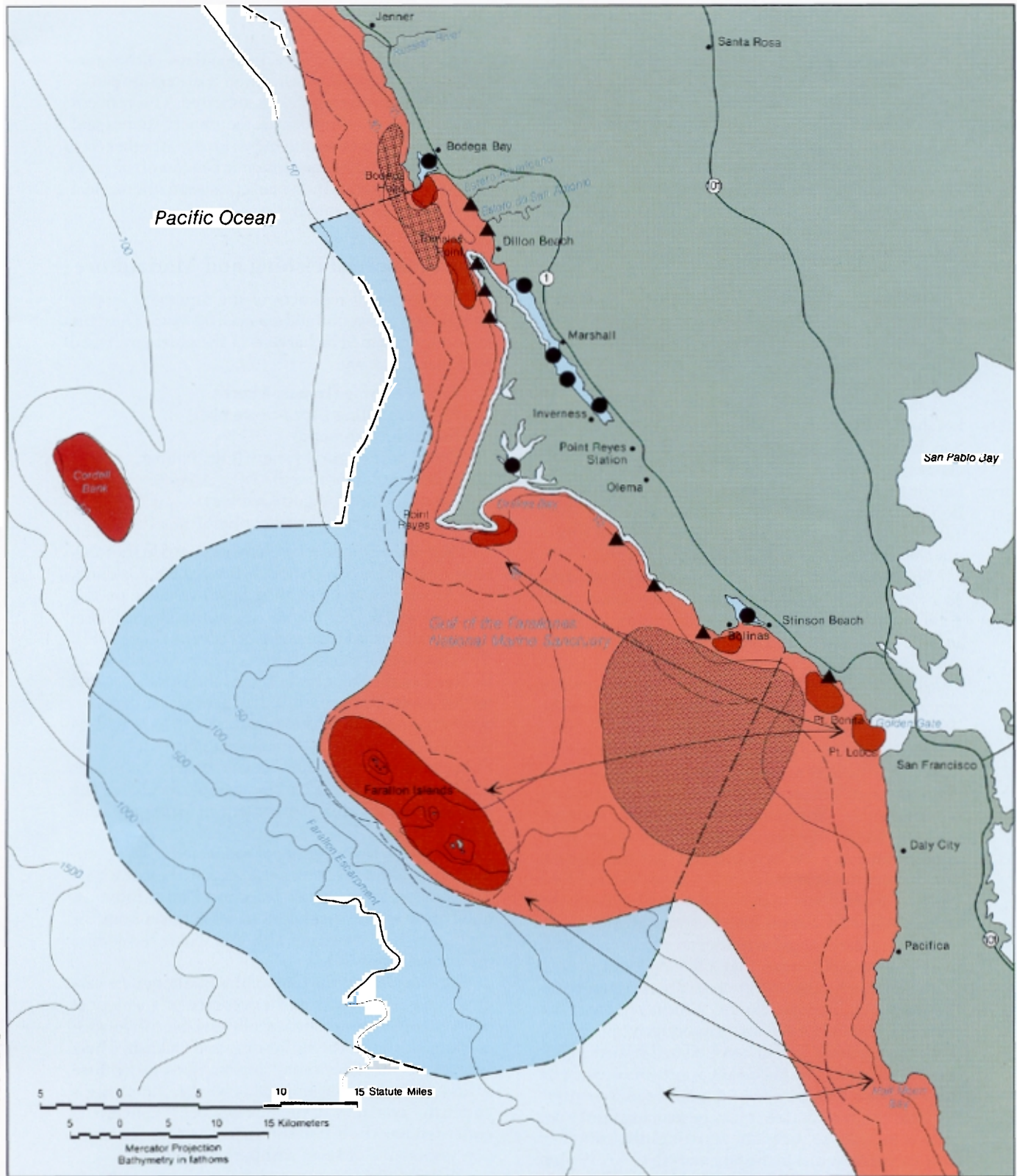
Beach-related activities account for the largest numbers of visitors to the adjacent shore. Over 1.8 million visitors were reported in 1983 at the most popular beaches including Stinson Beach (GGNRA), Muir Beach (GGNRA), Drakes Beach (PRNS), Limantour Beach (PRNS), and McClures Beach (PRNS) (NOAA 1984c). The high levels of attendance each year, particularly at

the height of season, make these areas appropriate places for visitor contact programs. There is an opportunity to make the general public aware of the sanctuary, its resources, uses, and management objectives.

Several onshore locations adjacent to the sanctuary have become popular in recent years for both whale-watching and birding. As many as 145,000 visitors were reported at the Point Reyes Lighthouse observing whales from shore during their northward and southward migrations between December 1984 and March 1985 (Pugh, pers. comm.). Large numbers of bird-watchers spend time along the sanctuary's coastal wetlands observing shorebirds, waders, and waterfowl. Popular locations are Bolinas Lagoon and Tomales Bay salt marshes in the sanctuary, and Limantour Estero and Abbotts Lagoon in adjacent areas. Birding excursions and field seminars organized by the Point Reyes Bird Observatory, the Oceanic Society, the Point Reyes Field Seminars and others initiate visitors and school groups to the bird resources of the sanctuary.



Sources: California Department of Fish and Game, 1980; Minerals Management Service, 1981.



- | | |
|-----------------------------------------------------------|------------------------------------|
| Gulf of the Farallones National Marine Sanctuary Boundary | Prime Salmon Trolling Area |
| Rockfishing | Clam Digging |
| Abalone and Tidepooling | Bird and Whale Watching Excursions |
| General Salmon Trolling Area | Island Excursions |

Figure 9

Sportfishing and Marine Recreation

A recent survey of intertidal users within the sanctuary indicate that in excess of 2,000 tidepoolers use Duxbury Reef every year (Chan 1984). A certain percentage of these users are illegally taking mussels, black turban snails, and limpets and some parts of the reef have been seriously depleted of these species. Abalone diving occurs mainly along Tomales Point where the granitic rocks provide good visibility for divers and sufficient legal-sized specimens are available for lowtide rockpickers (Chan 1984). Based on the most recent surveys, an increasing number of hunters were crossing over to the Tomales Point on a single weekend to collect abalone in the rocky reefs during spring and summer low tides. The effect of the heavy harvest on the abalone population, the impact on the overall nearshore community, and the extent of illegal take are not known.

Clams are harvested in the estuaries and along some beaches within the sanctuary and are the object of a popular sport fishery. Gaper, Washington, and littleneck clams are commonly taken from Tomales Bay at Lawson's Landing and Tomales Bay State Park, Bodega Bay, and Bolinas Beach (see figure 9). There may be more than 1,000 clam diggers in these areas on weekends (California Department of Fish and Game 1979, 1980).

The shoreline adjacent to the sanctuary lends itself to a variety of shore-fishing methods such as surf (line) fishing, surf-netting, and poke poling. Popular locations include the area between Dillon Beach and Estero de San Antonio (California Department of Fish and Game 1979). Duck hunting is another recreational activity that attracts more than 1,000 sportsmen each year to the Tomales Bay saltmarshes and ponds.

Total estimates of onshore visitor use are difficult to make given the large number of coastal access points and the wide variety of recreational activities that occur along the edges of the sanctuary. Available data do, however, indicate that a large percentage of the onshore use is concentrated in a few locations and that the seasonal distribution of people and activities varies widely. These patterns, when better understood, should indicate the best locations for coastal interpretive activities.

Existing recreational activities are relevant to sanctuary management since they offer opportunities to inform relatively large and interested user groups about the sanctuary. To some extent, visitors represent the potential demand for sanctuary interpretive programs. With the apparent lack of consolidated statistics concerning visitor use, an important priority recognized by the Sanctuary Programs Division has been to contact the large organizations that may be keeping visitor use records in order to ascertain current participation in recreational activities in the sanctuary (NOAA 1984c).

Other issues related to recreational use of the sanctuary include the visitor use/resource relationships particularly where an adverse effect is suspected. This concern has led to the funding of selected impact studies and monitoring programs within the sanctuary. Another concern is understanding the economic benefits of the sanctuary (both market and non-market values) to the regional and national economies.

(B) Commercial Fishing and Mariculture

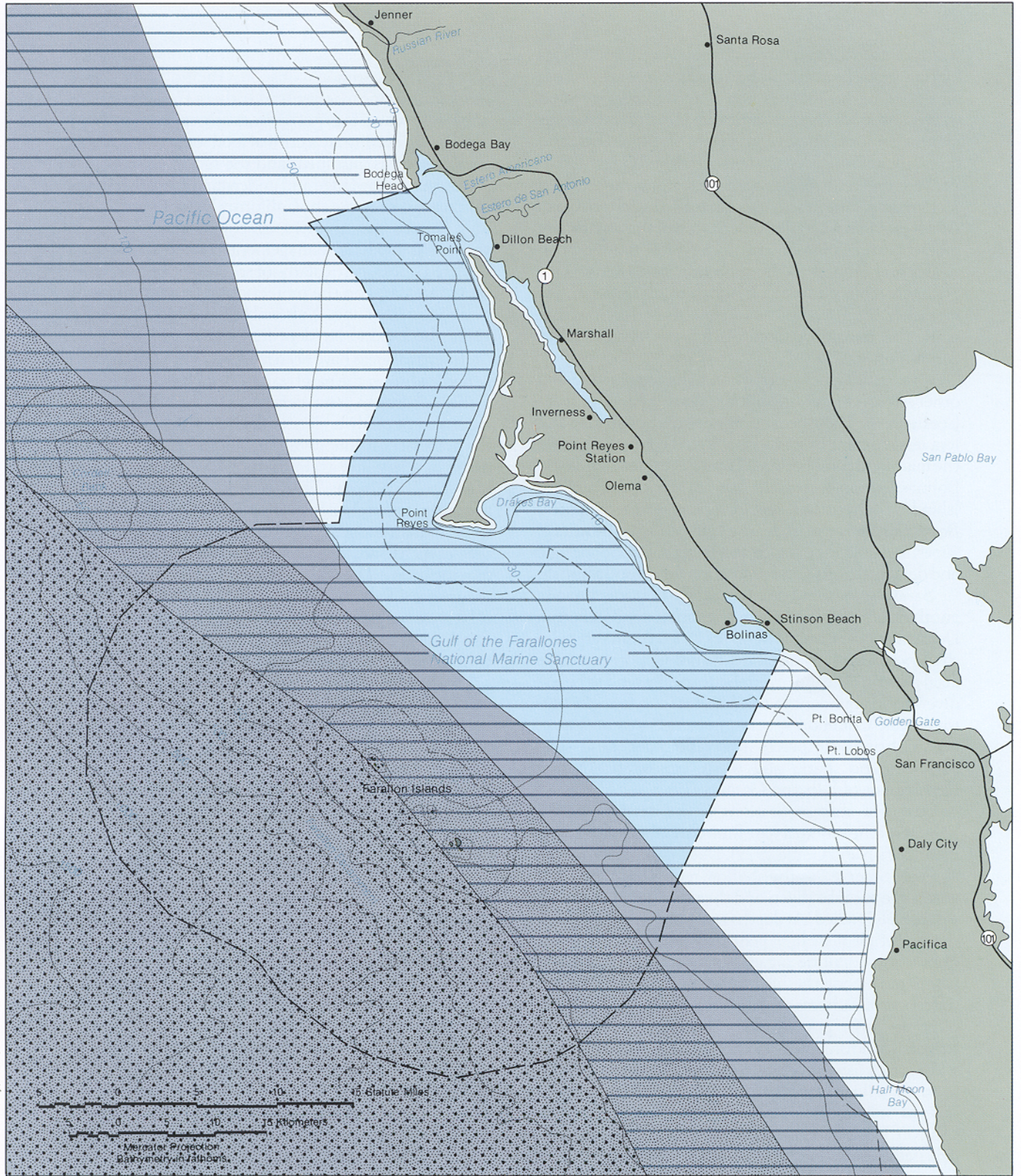
The abundant resources of the sanctuary support several large year-round and seasonal fisheries. The more important commercial harvests of the sanctuary, based on dollar value, are:

- Pacific herring (January-March)
- Salmon trolling (April-September)
- Rockfish (year-round)
- Other bottom trawl fishery (sole, halibut, flounder) (year-round)
- Albacore tuna (August-October)
- Dungeness crab (November-June)

Most of the commercial catch harvested in the sanctuary is landed at San Francisco, Bodega Bay, Oakland, Half Moon Bay, and Sausalito. Small volumes are also landed at Tomales Bay, Point Reyes, Marshall, and Dillon Beach (California Department of Fish and Game 1981). The commercial salmon trolling fishery extends along Bodega Bay, the Point Reyes Peninsula, Drakes Bay, and further south (see figure 10). Dungeness crabs are also taken commercially within nearshore waters in Bodega Bay and Drakes Bay. A commercial gillnet fishery for Pacific herring occurs within Tomales Bay. Several pelagic and bottom fisheries occur throughout the Gulf of the Farallones (California Department of Fish and Game 1980) (see figure 10).

In addition to conventional commercial fishing ventures, mariculture operations also occur in the area within Tomales Bay, Estero Americano, and Drakes Estero. A number of private organizations lease tracts from the California Department of Fish and Game to produce oysters (see figure 10).

Fisheries within the Gulf of the Farallones are very productive due in part to the presence of a variety of habitats important to commercially valuable species such as Dungeness crab, Pacific herring, and rockfish. These habitats provide nurseries and spawning grounds for these species, although only limited knowledge of their use is currently available. One management concern is understanding the role of these areas and how to maintain sustainable harvests within the sanctuary.



Source: Ainley, et al., 1982.

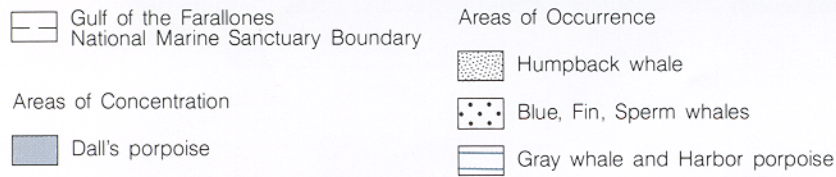


Figure 7
Cetaceans

(C) Shipping and Other Marine Activities

The sanctuary lies immediately westward of the entrance to San Francisco Bay. Three major shipping lanes approaching San Francisco converge near the sanctuary in a circular precautionary zone 11.9 nautical miles in diameter, lying outside the Golden Gate entrance (see figure 11).

The total volume of traffic in and out of San Francisco Bay is large. A total of 3,781 vessels arrived at the Bay in calendar year 1981. This represents an average of three tankers and seven other types of vessels (i.e., cargo, passenger) per day that entered the Bay during 1981. The total number of vessels arriving in the Bay has declined about 28 percent since 1968, when there were 5,218 vessel arrivals (Minerals Management Service 1983).

The U.S. Coast Guard (Twelfth and Eleventh Districts) has recently completed studies of the potential traffic density and the need for safe access routes offshore California. Based on the most recent recommendations, the San Francisco Traffic Separation System would be retained with northern, western, and southern approaches. The northern and southern lanes would be realigned and the southern lanes lengthened. A shipping safety fairway would lie over the Precautionary Area and each of the traffic lanes.

Other offshore commercial and industrial activities within the sanctuary are limited. No oil and gas development activities occur within the sanctuary. In 1963, 57 tracts were leased in the area between Russian River and Bolinas. After unsuccessful exploratory drilling, these tracts were later abandoned (Minerals Management Service 1982).

In 1970, the California state legislature established oil and gas sanctuaries which prohibited hydrocarbon development in state waters along Sonoma, Marin, and San Francisco counties. These prohibitions expired in 1975, and leasing could now occur in state waters, although this appears unlikely. Within Federal waters, the 1978 Outer Continental Shelf (OCS) Lands Act Amendments prohibit any exploration or development within 15 miles of the boundaries of the Point Reyes Wilderness Area unless California issues a permit for such activities in state waters (Minerals Management Service 1983) (see figure 11).

The draft Five-Year OCS Oil and Gas Leasing Program proposed by the Department of the Interior (MMS 1986) estimates that a lease sale will take place in the central California offshore area outside the sanctuary in May of 1989. It is estimated that from this proposed sale, 11 exploration wells will be drilled and that resources totalling 207 million barrels of oil and 292 billion cubic feet of gas will be produced from 30 production wells from 1 platform (Minerals Management Service 1986).

(D) Education and Interpretation

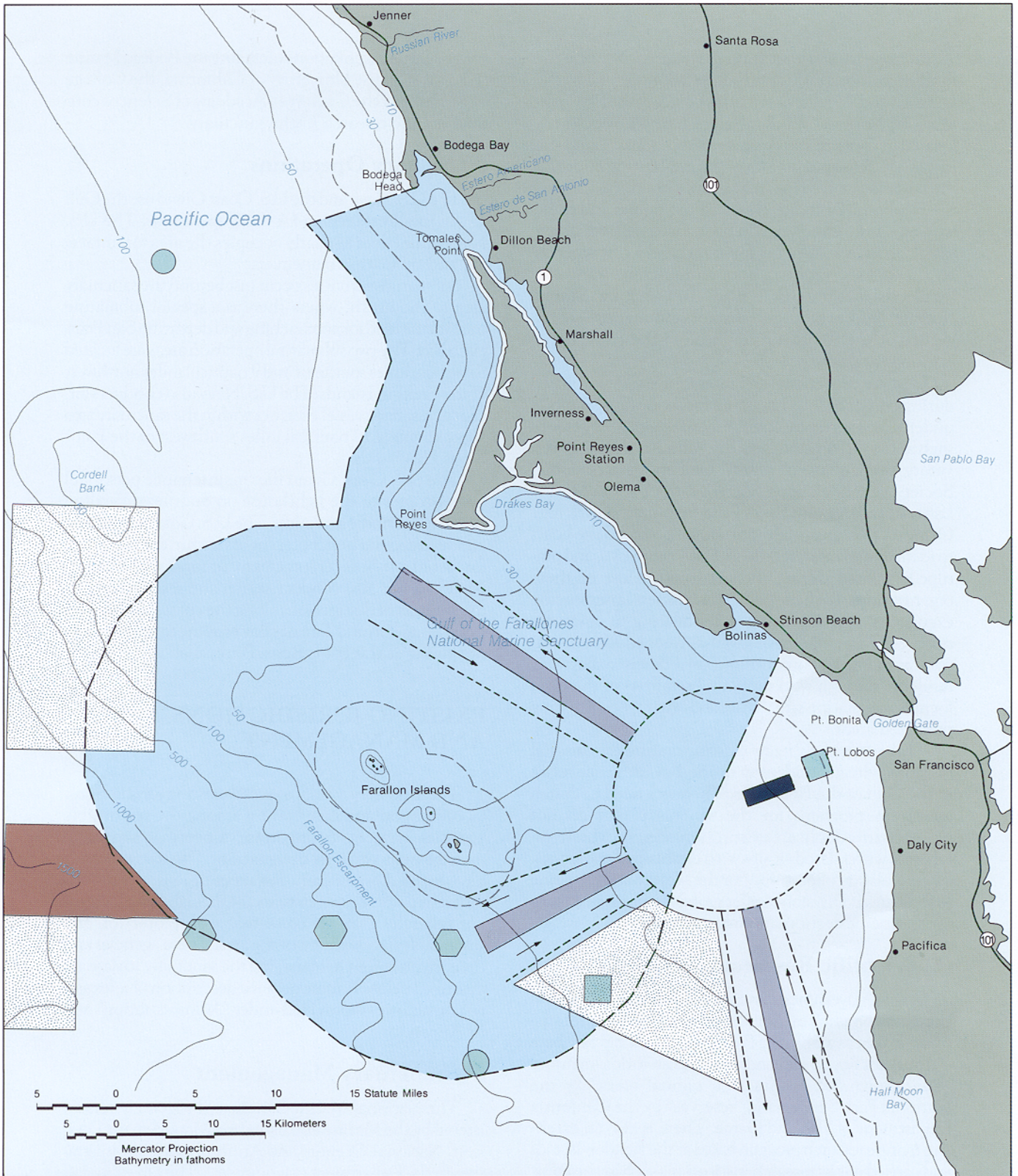
Agencies managing public lands adjacent to the sanctuary have been responsive to visitor needs and have provided a broad range of interpretive and educational services. Many existing programs emphasize the interpretation of coastal resources dependent on sanctuary waters (e.g., waterfowl, marine mammals, lighthouses, and other maritime and coastal defense structures). NOAA (1984c) provides a complete review of the San Francisco Bay organizations that offer educational programs in the sanctuary. The following is a brief summary.

The sites which to date have been the stage for many interpretive programs are the Point Reyes National Seashore and Bolinas Bay and Lagoon. The marine-related resources receiving the most attention at the Seashore are gray whales, marine birds and waterfowl, sea lions and seals, the Lighthouse, and the story of Sir Francis Drake. A variety of media and outdoor facilities are used to convey these themes, including wayside exhibits, brochures, shelters, information kiosks, and a new visitor center at Bear Valley.

The main areas within the Golden Gate National Recreation Area with a coastal orientation are Baker Beach, Ocean Beach, Fort Funston, the Cliff House, Marin Headlands, Tennessee Beach, Muir Beach, and Stinson Beach. Facilities such as trails and overlooks are used to interpret coastal resources. The Marin county naturalist conducts guided tours for schools and groups at Bolinas Lagoon, Duxbury Reef, and other areas in West Marin County. The themes emphasized at Bolinas Lagoon (i.e., at the lagoon proper, and the Audubon Canyon Ranch interpretive center) are the heronry, other waterfowl, harbor seals, and Bolinas history. The reef walks at Duxbury Reef initiate visitors to the intertidal life and processes. The area is also used for frequent school excursions. Facilities at Duxbury Reef and Agate Beach are limited despite fairly heavy use and good access (Chan 1984).

Marine-related interpretation appears to be currently limited in Tomales Bay. Tomales Bay State Park is used regularly for clamming and there are wayside exhibits interpreting estuarine resources. The coast at Marshall and Millerton is presently undeveloped, but there are plans for developing a coastal interpretive program (California Coastal Commission 1981). Interpretation (guided tours, wayside exhibits) of saltmarsh resources also take place at the lands held by the Audubon Canyon Ranch (i.e., Walker Creek, Cypress Grove, Livermore Marsh, Shields Marsh). Some marine-related interpretive programs exist at Doran County Park and Bodega Head State Park, and both sites represent excellent vantage points to view the sanctuary.

Source: Joseph, et al., 1971. Minerals Management Service, 1987. NOAA, 1984c.



- | | |
|-----------------------------------------------------------|---------------------------------|
| Gulf of the Farallones National Marine Sanctuary Boundary | Active Dump Sites |
| Existing Shipping Lanes | Historic or Inactive Dump Sites |
| Submerged Submarine Operating Areas | Inactive Military Dump Site |

Figure 11

Shipping and Other Marine Activities

Interpretive and education programs focusing on the Farallon National Wildlife Refuge (administered by the U.S. Fish and Wildlife Service) take place at the San Francisco Bay National Wildlife Refuge Interpretive Center, located in Fremont (Bitsko, pers. comm.). Because of the extremely dense population of ground-nesting birds and the hazards involved in landing and walking on the site, the Farallon Islands are closed to the public and there is no on-site interpretation. The Point Reyes Bird Observatory, an independent organization conducting research on the islands, provides information concerning the Farallon Islands through its newsletter, a nature seminar program, and exhibits at a small information center located at the Palomarin trailhead in the Point Reyes National Seashore.

Offshore educational and interpretive services offered during cruises in the Gulf of the Farallones are primarily undertaken by private environmental education groups such as the Oceanic Society, the Point Reyes Bird Observatory, the College of Marin, Golden Gate Audubon Society, other Audubon Societies, the Bodega Marine Laboratory, the Point Reyes Field Seminars, and Whale Center. There are usually naturalists on board the boats to identify and interpret the seabirds, cetaceans, and pinnipeds sighted during the excursion. Most of these organizations have periodic newsletters announcing excursions, and discussing issues relating to sanctuary resources. Many also have a well-developed educational program aimed at informing San Francisco Bay area residents through workshops and seminars of the need for national marine sanctuaries and other types of marine protected areas.

There are clearly many existing marine educational programs already underway in the Bay area that relate to the Gulf of the Farallones. There is a need to design education programs for the sanctuary that do not unnecessarily duplicate existing services and which collaborate with related groups with established audiences. There is also an opportunity for the Marine and Estuarine Management Division to offer programs with a new focus on marine protection and management.

(E) Scientific Research

Several government and non-government organizations have ongoing marine research programs in the sanctuary. Two areas within the Point Reyes National Seashore — the Point Reyes headlands and the Estero de Limantour — are designated as “research natural areas” by the National Park Service and “reserves” by the California Department of Fish and Game. There is also an extensive marine research program based at the Farallon Islands and carried out by research institutions such as the Point Reyes Bird Observatory and the University of California in collaboration with the U.S. Fish and Wildlife Service and other Federal agencies such as the Minerals Management Service and the National Marine Fisheries Service.

Several other organizations including the Bodega Marine Laboratory of the University of California, the College of Marin, and the California Academy of Sciences conduct marine research in the sanctuary.

(F) Military Operations

The U.S. Navy and the U.S. Coast Guard use the Gulf of the Farallones region for their operations. The U.S. Navy’s third fleet regularly occupies the area for surface, air, and submarine maneuvers.

Submarine activities occur just beyond the sanctuary area to the north, where there is a special submarine transit lane used for approaching and departing San Francisco Bay. The two submarine operation areas are located 8 nautical miles southeast and 9 nautical miles northwest of the Farallon Islands. The U.S. Navy also conducts aircraft and surface vessel exercises within the sanctuary area approximately 10 nautical miles southwest of the Point Reyes Headlands.

The U.S. Coast Guard flies maintenance personnel by helicopter to the lighthouse on Southeast Farallon Island for periodic servicing. The U.S. Coast Guard also conducts regular helicopter flights within the sanctuary for aerial offshore enforcement around the Farallon Islands. They also conduct search and rescue missions to a number of destinations along the coast, passing over Bolinas Lagoon and Tomales Bay en route to marine areas northwest at the Point Reyes Peninsula.

EXISTING JURISDICTIONS AND MANAGEMENT

The sanctuary overlaps several existing jurisdictions. Coordination and cooperation among the responsible agencies have been important aspects of sanctuary management since its designation. The agencies may have focused on different resources or have designated different parts of the sanctuary for special management, but generally goals are consistent with protection and sustainable development of the area. These agencies and their involvement in managing the sanctuary to date are described below. A more detailed description of roles and responsibilities is provided under “Administration” and in Appendix 5.

(A) Sanctuary Management

The National Marine Sanctuary Program is administered by the Marine and Estuarine Management Division, National Oceanic and Atmospheric Administration in the Department of Commerce. The Division staff based in Washington, D.C. make overall policy decisions and coordinate with on-site staff. In the early years since designation, on-site staff has consisted of a Sanctuary Manager, Deputy Sanctuary Manager, a Research

Coordinator, and a California Department of Fish and Game Sanctuary Warden. The program is implemented through cooperative agreements with the National Park Service Western Region and the California Department of Fish and Game.

Since designation, management of the sanctuary has been aimed at the protection of significant marine resources. The resource protection program has focused on monitoring critical resources through sanctuary-funded programs and augmenting and improving the coordination of surveillance and enforcement activities, in collaboration with the California Department of Fish and Game. The accidental oil spill caused by the T/V *Puerto Rican* in 1984, and incidents in other sanctuaries, have also made emergency response and contingency planning measures a high priority for the resource protection program of all sanctuaries.

Past and ongoing research, undertaken with the National Park Service and the National Marine Fisheries Service, has included studies of pinnipeds, seabirds, shorebirds, and intertidal invertebrates. The interpretive program, undertaken in cooperation with the National Park Service, has led to the design and distribution of a sanctuary brochure, the design and installation of wayside signs, a lecture series, and the provision of interpretive services at selected Point Reyes National Seashore and Golden Gate National Recreation Area locations.

(B) Federal Activities

The National Park Service is involved in the management of the sanctuary through an interagency agreement with the Marine and Estuarine Management Division. The National Park Service manages the Golden Gate National Recreation Area (GGNRA), the most visited national park in the country. The park includes a network of recreational and historic sites along the Pacific Ocean shoreline and in the San Francisco Bay area that are marine-related and therefore can provide orientation to the sanctuary. Areas for coordination with GGNRA include interpretation, and administrative support. The association with the park also offers access to several coastal facilities and the park's cooperating association, the Golden Gate National Park Association.

The National Park Service also administers the Point Reyes National Seashore (PRNS). The Seashore represents the largest stretch of shoreline adjacent to the sanctuary. It also includes certain state tide and submerged lands that have been conveyed to the PRNS for all purposes except exploration and development of minerals. The state, however, has reserved the right to manage the tide and submerged lands conveyed to the National Seashore and therefore controls activities such as oyster culture in Drake's Estero.

National Park Service management policies for the PRNS are designed to protect natural and cultural resources while providing appropriate opportunities for public enjoyment. The NPS Management Plan establishes Natural Zones which are to remain unaltered by human activity. This management scheme complements California Marine Life Reserves designated at Point Reyes Headlands, and Estero de Limantour. Since the PRNS and sanctuary share many living resources, efforts have been made to coordinate activities.

The U.S. Fish and Wildlife Service (FWS) manages the Farallon National Wildlife Refuge. The Refuge is comprised of five islands (North, Middle, and Southeast Farallon Islands, Maintop Island, and Noonday Rock). The Refuge is operated primarily as a migratory bird refuge to protect, among others, murrets, auklets, guillemots, and puffins. The Refuge also protects seals, sea lions, and other marine mammals. Technically, only those portions of the islands which are above the mean high water mark are included in the Refuge; areas which are inundated by the average high tide are not part of the Refuge (Bitsko, pers. comm.).

Southeast Farallon Island is the largest of the islands with an area of 109 acres. The remaining islands in the Farallon chain stretch northwesterly for 4 miles, with some being completely awash on stormy days. The six northerly islands cover less than two acres.

Because of the extremely dense population of ground-nesting birds and the hazards involved in landing, the Farallon Islands are closed to the public and special permits are required for landing. Unauthorized landings on any of the islands are strictly prohibited. Low-flying aircraft, which would disturb the island's wildlife, are also prohibited over the Farallon Islands.

The other Federal agencies with management responsibility in the sanctuary are:

- National Marine Fisheries Service (research)
- U.S. Coast Guard (marine safety, oil spill response, search and rescue)
- Environmental Protection Agency (ocean dumping)

(C) State and Local Activities

The California Department of Fish and Game is responsible for the management of living marine resources in California, including the three-mile state waters' portion of the sanctuary (Fish and Game Code, Title 14 of the California Administrative Code). State management is aimed at the conservation, maintenance, and utilization of living marine resources. The primary management vehicle is the dissemination and enforcement of California commercial and sport fishing regulations which are updated periodically by the Fish and

Game Commission. The California Department of Fish and Game has established ecological reserves, marine reserves, game refuges, and marine life refuges in the ocean waters and submerged lands surrounding the Farallon Islands and the Point Reyes Peninsula (see figure 12). Within these areas, the California Department of Fish and Game has the authority to prohibit or restrict activity (to varying degrees depending on the designation) which may harm the resources, including fishing, collecting, swimming, boating, and public entry. Regulations specific to the ecological and marine reserves within the sanctuary include, for example, prohibitions on the taking of invertebrates, boating closure areas, and restrictions on the use of nets within specified depths (California Department of Fish and Game 1982a). Since designation, the California Department of Fish and Game has augmented surveillance and enforcement in the sanctuary through cooperative agreements with the Marine and Estuarine Management Division.

The California State Water Resources Control Board has designated six Areas of Special Biological Significance (ASBS) in the waters of the sanctuary (see figure 12). ASBS sites are designated to preserve and maintain high water quality in special biological communities by prohibiting discharges of elevated temperature wastes and point source sewage of industrial wastes.

The other state and local agencies with management responsibility in the sanctuary or in coastal areas adjacent to the sanctuary include:

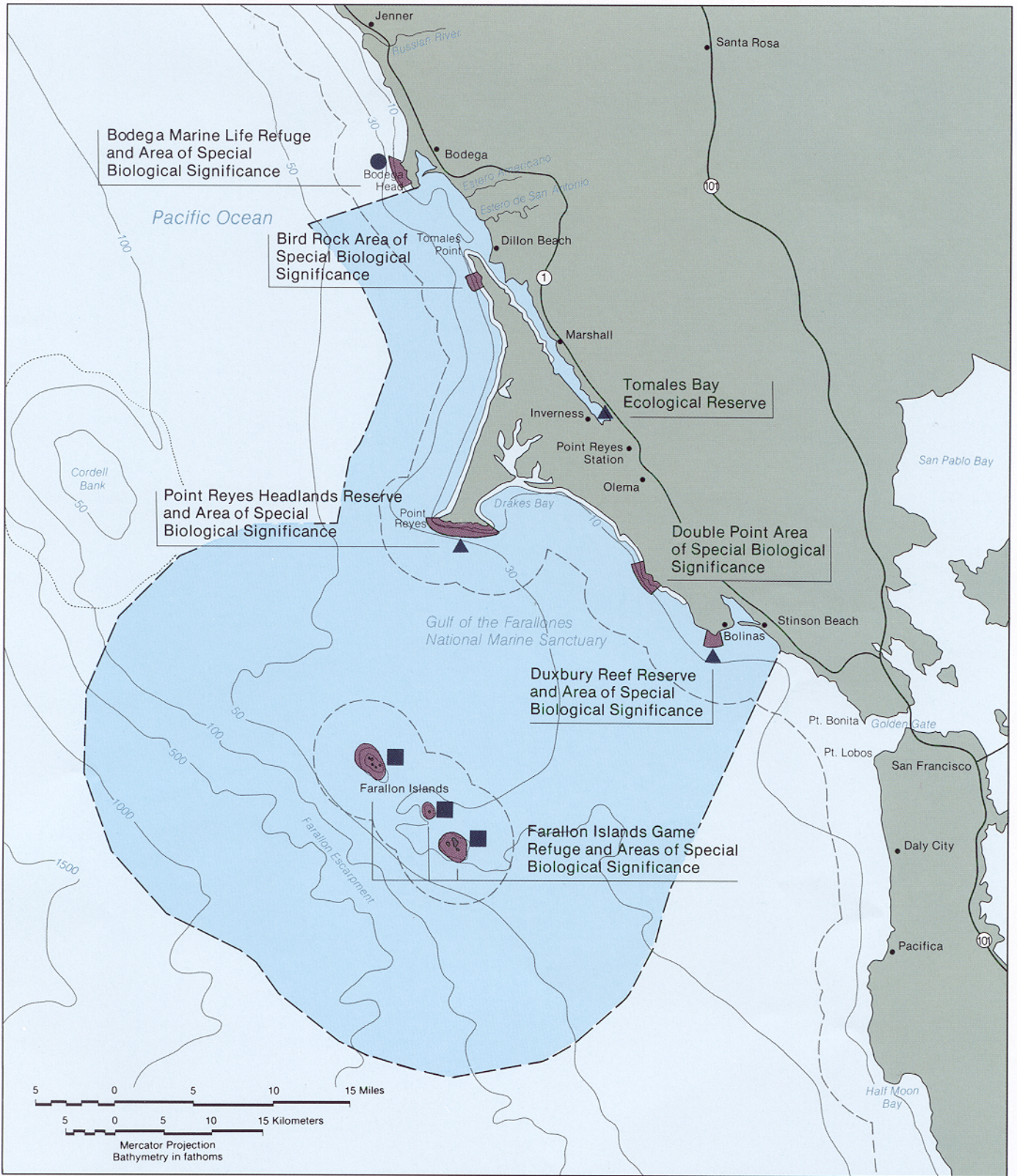
- California Coastal Commission
- California State Lands Commission
- California Department of Parks and Recreation
- Counties of Marin and Sonoma

The counties of Marin and Sonoma both have Local Coastal Plans (LCP) that have been certified by the California Coastal Commission (Marin County Planning Department 1983; Sonoma County Department of Planning 1982). These plans contain policies for coastal development and the protection of coastal habitats. In several instances, these policies relate to and reinforce the objectives of the sanctuary (see Appendix 7). For example, the Marin County LCP (Unit 1) provides policies for the protection of Bolinas Lagoon and Duxbury Reef which are both within the sanctuary. The northern component of the LCP (Unit 11) includes resource protection policies for Tomales Bay, and adjacent wetlands.

The Sonoma County LCP includes policies for the protection of rocky intertidal habitats, the offshore areas at the mouth of Estero Americano, limitations to access to offshore rocks, and protection of marine mammal haul-out areas. Clearly, these policies complement sanctuary objectives. These coastal plans are used by the counties to decide upon and issue coastal permits for a wide variety of land uses including waste treatment facilities, shoreline structures, and boating facilities. The Coastal Commission retains coastal permit jurisdiction over certain aspects of submerged lands and tidelands within state waters.

There are many local public and private non-profit organizations that have been actively involved with the establishment of the sanctuary. These include research organizations such as the Bodega Marine Laboratory (University of California at Davis), the Point Reyes Bird Observatory, and the California Academy of Sciences. Local environmental education groups such as the Oceanic Society, the Whale Center, and many others (NOAA 1984c) have provided assistance to the Marine and Estuarine Management Division in carrying out educational programs.

Source: California Department of Fish and Game, 1979
 California State Water Resources Control Board, 1979b, 1979c, 1980a, 1980b, NOAA, 1987.



- Gulf of the Farallones
- National Marine Sanctuary Boundary
- Proposed Cordell Bank
- National Marine Sanctuary

- State Marine Protected Areas
- Areas of Special Biological Significance
 - ▲ Ecological Reserve
 - Marine Life Refuge
 - Game Refuge

Figure 12
Marine Protected Areas