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MARINE MAMMALS AND SEABIRDS OF CENTRAL AND NORTHERN CALIFORNIA, 1980 " 1983:

SYNTHESIS OF FINDINGS

Center for Marine Studies
University of California, Santa Cruz

Prepared for
Pacific OCS Region
Minerals Management Service
U.S. Department of the Interior

Contract #14-12-0001-29090

August 1983

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Prepared by

Center for Marine Studies
University of California, Santa Cruz

Principal Investigator:
Thomas P. Dohl

Lead Scientists:
Michael L. Bonnell – Pinnipeds & Sea Otters
Robert C. Guess – Cetaceans
Kenneth T. Briggs – Seabirds

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ABSTRACT

This volume summarizes the findings of a three-year study of marine mammal and seabird distribution, abundance, and seasonality.

Data were collected by means of 72 biweekly aerial surveys over the ocean from the mainland to a distance averaging 175 km offshore. On aerial transects 2,340 sightings of 3,819 seals and sea lions, 4,575 sightings of 116,886 cetaceans, and 70,516 sightings of 1.2 million seabirds were recorded. Approximately 300,000 linear Ian of transect lines were surveyed in about 2,200 hours in the air. In addition. quarterly coastal aerial photographic censuses were made of seabird and pinniped populations on land.

The marine fauna of central and northern California includes at least 102 species of seabirds, 21 species of cetaceans, 5 species of pinnipeds, and the sea otter. Seabird density in central and northern California is seasonally very great, and more similar in magnitude to the Gulf of Alaska and the Bering Sea than to the Southern California Bight. We estimate that seabirds number almost 6.5 million when maximally abundant. Autumn is the season of greatest marine mammal abundance, with an estimated population of more than 200,000 animals. Numbers progressively decrease, on a seasonal basis, until an annual minimum of approximately 210,009 animals is reached in summer.

Within this study area, the locations on land of greatest importance to seabirds are the colonies at the Farallon Islands, Point Reyes, Trinidad Head, and Klamath River to Castle Rock. The most important sites used by pinnipeds are Año Nuevo Island and the nearby mainland point, the Farallon Islands, the beaches and esteros near Point Reyes, Mistake Point and Sugarloaf Rock near Cape Mendocino, and the rocks of the St. George Reef.

At sea, most seabirds, the sea lions, harbor seals, sea otters, and harbor porpoises were found predominantly in waters overlying the continental shelf (to the 200 m isobath). The greatest numbers of cetaceans were found over the continental slope (‹2,000 m) in the southern half of the survey area. Two species of marine mammals, the sperm whale and the northern fur seal, preferred offshore waters (›2,000 m).

Endangered or threatened species of seabirds *and* marine mammals with sizable populations in central and northern California include the Brown Pelican (over 30,000), the California sea Otter (about 1,300 adult animals), and several species of baleen whales (gray, fin, blue, and humpback whales).

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1. INTRODUCTION

1. INTRODUCTION

This volume summarizes major findings of a three-year study of marine mammals and seabirds of central and northern California. As part of the Minerals Management Service (MMS) Environmental Studies Program, this study was conducted to gather baseline information on the marine mammal and seabird populations of central and northern California to help predict, assess, and manage potential impacts of offshore oil and gas development in the area. A similar study conducted in 1975 through 1978 described marine mammal and seabird use of the waters and islands of the neighboring Southern California Bight (Center for Coastal Marine Studies, University of California, Santa Cruz; Contract No. AA550-CT7-36).

A contract between the MMS and the Center for Coastal Marine Studies of the University of California at Santa Cruz (Contract No. 14-12-0001-29090) set forth the objectives of the study: determine species composition, distribution, abundance, and seasonal variation for marine mammal and seabird populations, provide a description of habitat use, and identify axeas of special biological importance to these populations in the central and northern California study area. The general methodology for this study, also specified in the Statement of Work, was a series of aerial surveys of the area extending from Point Conception north to the Oregon/California border and seaward from the mainland shore a distance of about 85 km (about 100 nautical miles), with emphasis on waters inshore of the proposed lease areas. The study area surveyed included 140,685 km^2 of ocean, 1,000 km (about 550 nm) of coastline, and numerous offshore rocks and islands (Fig. 1).

Local marine mammals and seabirds have been commercially exploited, disturbed, and scientifically studied for the last 250 years, and several cities have developed along the coast near

breeding colonies, migration routes, and feeding sites. Nevertheless, many basic aspects of these animals" occurrence and ecology have been inadequately described. The seabirds, sea otters, and pinnipeds (seals and sea lions) were considerably better known than the whales, dolphins, and porpoises, primarily because of studies done on central California colonies. The tremendously important colonies on the Farallon Islands and Ano Nuevo Island -had been intensively studied since the early 1900's, and a series of general reconnaissance surveys had identified most seabird colony sites to the north and south (Orr and Poulter 1965, Gentry 1968, Ainley and Lewis 1974, Wild and Ames 1974, Ainley et al. 1977, LeBoeuf and Bonnell 1980, Sowls et al. 1980, LeBoeuf 1981, Estes and Jameson 1983), Ainley (1976), Stallcup (1976), and Page et al. (1977) reviewed the occurrence of certain bird species in open waters off central and northern California; the pelagic fur seai surveys (Bureau of Commercial Fisheries) documented occurrence of the most numerous pelagic pinniped. In contrast, aside from a limited number of geographically restricted studies, only Morejohn's review (1977) was of much use in assessing cetacean seasonality and abundance. Morejohn's review outlines the general composition of the cetacean fauna and draws together many life history features for the better-known species—generally those that had been commercially harvested.

Our results constitute the most comprehensive quantitative data base ever gathered concerning seasonal abundance and distribution of these animals in central and northern California. Working primarily from an airplane, we surveyed open waters of the area to a distance averaging 175 km off the coast along a set of 92 fixed, east-west transect lines (Appendix 1), About half these transects were surveyed twice each month, once from high altitude (300 m) where large cetaceans are best seen, and once from low altitude (60 m) for best counts of small marine mammals and birds. Approximately 240,000 linear km of flight lines were covered during the study. Twenty-eight percent (23%) of this effort was expended over neritic waters (0-

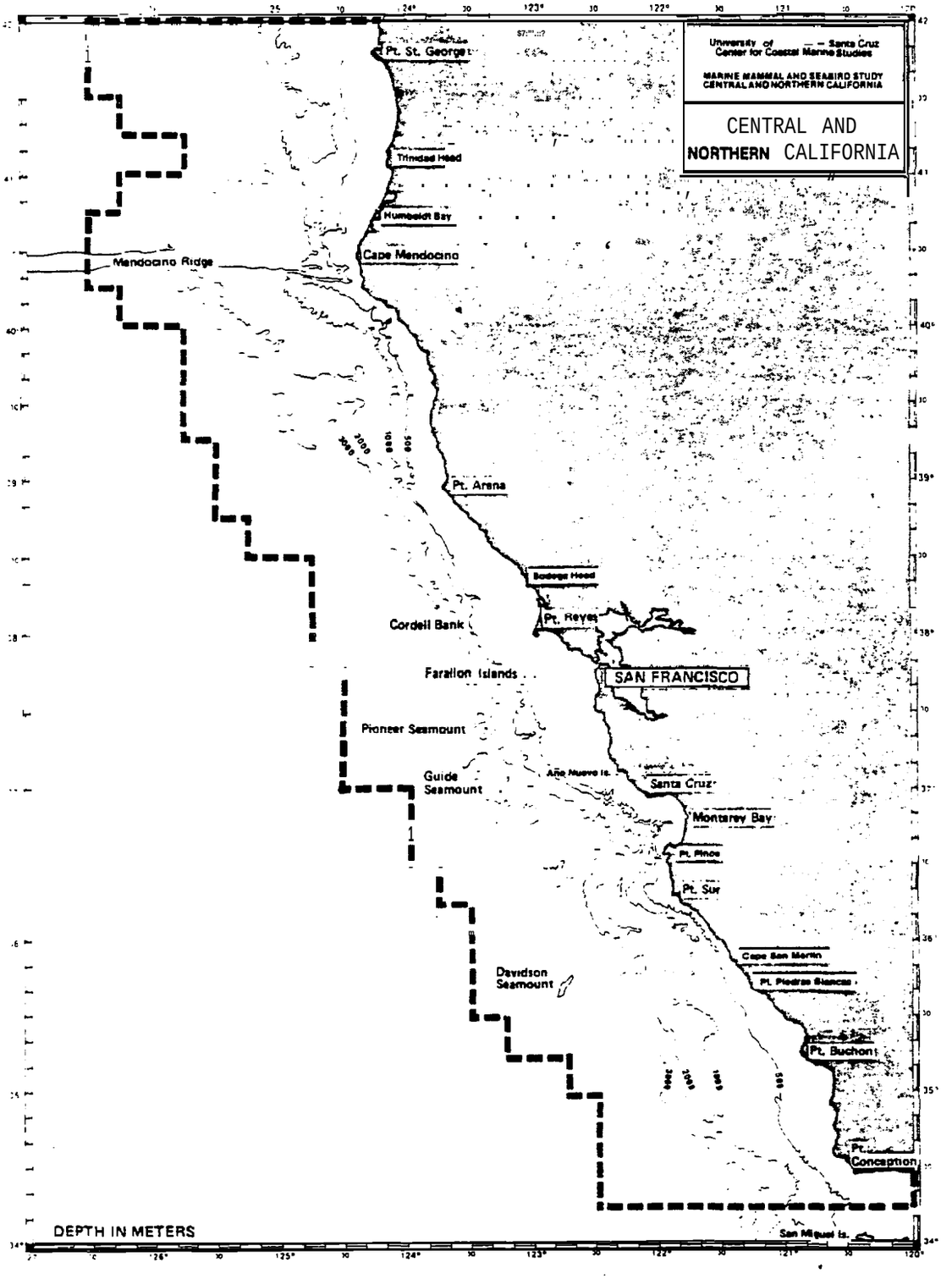

Figure 1. Map of the central and northern California study area showing major coastal features, general bathymetry, and seaward extent of survey.

199 m) and 45% was devoted to waters over the continental slope (200-1,999 m); the remainder sampled waters farther offshore.

From discrete sightings of animals we estimated density per unit area: bird density was calculated from a narrow (50 m) fixed corridor; mammal densities were estimated using unbounded corridors, employing a Fourier-series transformation from inclinometer-measured sighting angles. Additional information was obtained from five vessel surveys made in the central coast region and from twelve aerial visual and photographic surveys along the entire central and northern California coastline and adjacent rocks and islands. Sixteen aerial surveys were also done to describe the distribution of sea otters within their central California range.

The data base is enormous: open ocean aerial surveys accounted for 2,340 sightings of 3,819 seals and sea lions; 4,575 sightings of 115,886 whales, dolphins, and porpoises?; and 70,516 sightings of mere than 1.2 million seabirds. Vessel surveys added 4,947 sightings of 20,654 seabirds, and coastal surveys resulted in more than 16,000 photographs and tens of thousands of visual sightings totaling more than 224,000 pinnipeds and 2,9 million seabirds. Further, over 25,000 records of sea surface temperature were takenon open-water aerial surveys using a precision radiation thermometer. Our data analysis focused on detecting, mapping, and describing the seasonal and regional changes in the abundance, distribution, and movement of the seabirds and marine mammals in central and northern California.

2. SUMMARY OF MAJOR FINDINGS

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The marine vertebrate fauna of central and northern California includes at least 102 species of seabirds, 21 of whales, dolphins, and porpoises (the cetaceans), together with 5 species of seals and sea lions (the pinnipeds) and the southern sea otter. The waters of central and northern California are a meeting ground where populations of animals having different biogeographic affinities intermingle. Among each group of animals may be found species representative of widespread communities found in the cooler waters of the North Pacific. Off California, these boreal species occur primarily during winter through early summer in areas of coastal upwelling and in the coolest waters of the California Current. Included among them are Dan's and harbor porpoises, northern fur seals, fulmars, auklets, murres, and several species of gulls; among the birds, species having preferences for cool waters numerically predominate at all times of the year. Also present off central California in late summer and autumn are representatives of communities found in warmer waters to the south. These include California sea lions and northern elephant seals among the pinnipeds, several species of petrels, shearwaters, and terns, the Brown Pelican, as well as bottlenose dolphins and pilot whales . Many species of cetaceans are widespread in occurrence throughout the North Pacific.

Two species we studied have populations endemic to California; these are the Ashy Storm-Petrel, whose small world population is centered on the Farallon Islands, and the southern sea otter. Several other species are wholly or largely restricted to the waters of the California Current and attain high population levels off central and northern California: Brandt's Cormorant, Western Gull, California sea lion, northern elephant seal and, during its annual migration, the California gray whale.

Seabird density in waters of central and northern California is seasonally quite high, and more similar to that attained in the rich waters of the Gulf of Alaska and the Bering Sea than to that we found previously in the waters of the Southern California Bight. We estimate that seabirds may number as many as 6.5 million at once in autumn and early winter, and that they may consume up to 200,000 metric tons of fish, squid, and plankton in a single year. Like seabirds, marine mammals are found in great abundance in all seasons, though most species exhibit distinct patterns of seasonality. In autumn, the season of maximal abundance, mre than 200,000 marine mammals are estimated to be present offshore and along the coast. At this time populations of Pacific white-sided dolphins, California sea lions, and northern right whale dolphins are numerically predominant. In winter total numbers of marine mammals in central and northern California decline. 'Those populations that remain large or actually increase in winter consist mainly of Risso's dolphins, northern fur seals. Dan's porpoises, and northern right whale dolphins; annual combined population lows for marine mammals are found in spring and summer.

From 1980 through early 19S3 seabird biomass density varied seasonally as a result of migrations, nesting events, and appearance of winter and summer (nonbreeding) residents (Figure 2). Spring migration in March, April, and May generally coincided with increased biomass, particularly of gulls, phalaropes, and shearwaters. This was followed by early or midsummer lows, when nesting residents represented most of the biomass and migrants were absent, and then by surges of migration in late summer (August or September). Events in 1981 appeared to occur about a month earlier than in the other years. Biomass increased to autumn-winter maxima in 1980 and 1981, but with the onset of El Niño conditions in autumn 1982, biomass underwent an oscillating decline. Low values in December 1982–January 1983 reflect general absence of the usually predominant Alaskan and Pacific Northwest nesting species.

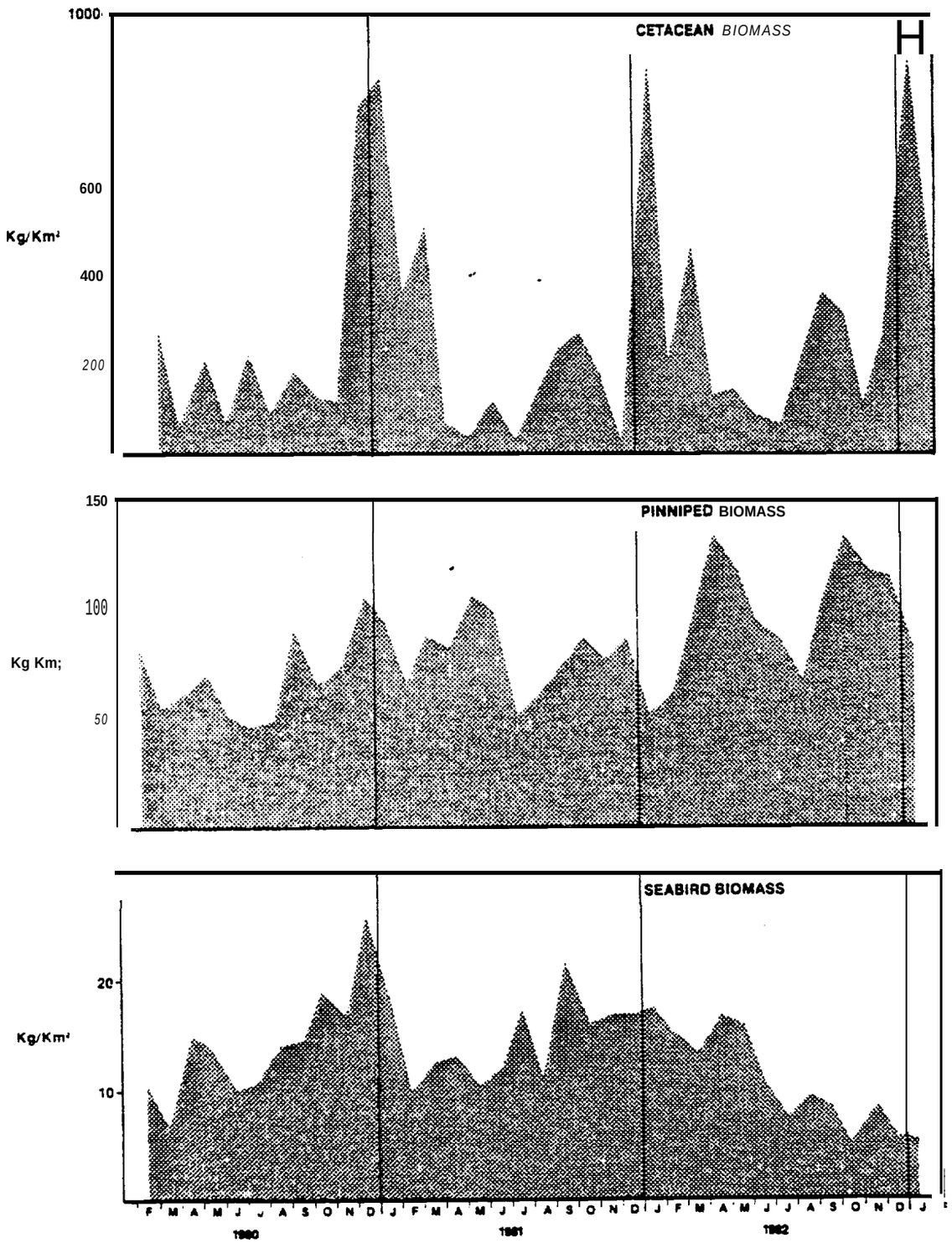


Figure 2. Monthly biomass density (Kg/km²) for cetaceans, pinnipeds, and seabirds in the central and northern California study area, 1980-1983.

The major cetacean biomass peaks were bimodal and occurred in January and March, reflecting the annual gray whale migrations. The return journey north to the feeding grounds developed more slowly, occupying several months in contrast to the more concentrated movement south . A less obvious but very sharply defined peak in the abundance of smaller toothed cetaceans occurred in February; Risso's, northern right whale, and Pacific white-sided dolphins increased 500% over earlier winter counts. In the final months of this survey, accelerating reductions in the abundance of these species were noted in December, January, and February (5%, 29%, and 92%, respectively, of previous peak counts), and probably reflected the cumulative effects of the El Niño phenomenon experienced in 1982-1983. During the warm-water months of autumn the smaller toothed cetaceans again entered the area in sizable numbers. Populations increased five times over the summer lows to reach their annual peek numbers, Also during this period an extraordinary increase in humpback whales was observed, primarily within the Farallon basin. This event and its relative annual increase may be noted in Figure 2, centering in September-October and overshadowing the influx of the smaller animals.

Pinniped biomass in central and northern California fluctuated annually with the arrival and departure of breeding species, as well as nonbreeding California sea lions and northern fur seals. Two peaks were evident (Figure 2), A spring peak resulted from the influx, from Bering Sea rookeries, of thousands of northern fur seals who remained in pelagic waters from February through May. Also contributing to the spring peak were large populations of molting northern elephant seals on land, breeding harbor seals, and California sea lions passing through the area en route to rookery islands in the Southern California 'Sight. With the departure of northern fur seals, northern elephant seals, and adult California sea lions, pinniped biomass dropped to a summer low despite annual peak numbers of harbor seals and Steller sea lions and the arrival of many juvenile California sea lions. The autumn peak in pinniped biomass resulted from the arrival

of male California sea lions, dispersing notihward following their summer breeding season; they accounted for over 80% of the total pinniped population in autumn 1982. In winter, with the departure of many California sea lions, pinniped biomass dropped to a January or February low and consisted primarily of breeding northern elephant seals. In February or March pinniped biomass once again increased with the return of migrant northern fur seals. Especially in the last year of this study there was a trend toward greatly increased use of central and northern California resources by California sea lions.

At sea most seabirds, the sea lions, harbor seals, sea otters, and harbor porpoises were found predominantly in waters overlying the continental shelf (to the 200 m isobath). Seabirds were found in greatest concentrations over the relatively broad shelf areas north of Cape Mendocino, from Monterey Bay to Bodega, and south of Point Buchon. Several species, including shearwaters, phalaropes, and Brown Pelicans, concentrated preferentially for feeding in thermal fronts bordering coastal upwellings. California sea lions were most abundant in coastal waters south of their hauling grounds on Año Nuevo Island and the Farallones, while sea otters were especially concentrated close to shore near Point Buchon, between Point Cayucos and Point Piedras Blancas, from Pfeiffer Point to Monterey, and in Sequel Cove in northern Monterey Bay. Both harbor porpoises and harbor seals tended to be most abundant close to shore in the northern half of the study area. Most cetacean species and the northern elephant seal occurred in greatest numbers in waters overlying the continental slope (200 m to 2,000 m depths). Two species of marine mammals-the sperm whale and the northern fur seal—preferred offshore waters (>2,000 m depth). Among all groups of animals, we found year-round low populations in waters west of Point Arena. In this respect it may be significant that these waters are among the most windy and turbulent in the North Pacific during spring through late summer. While this promotes strong upwelling of nutrient-rich water along the shelf, it apparently precludes spawning activities of schooling fishes like

anchovies, which require development of stable surface layers and less offshore surface flow for successful growth of the young. Lack of significant spawning populations of anchovies and other fishes and squid which predominate elsewhere in the California Current may make waters off Point Arena less than suitable for maintenance of large populations of marine mammals and birds.

Most locally-occurring cetacean species probably give birth to young in waters off central and northern California. we commonly saw newborn Pacific white-sided dolphins in autumn and young Risso's and northern right whale dolphins in winter. Among the pinnipeds, large breeding populations of Steller sea *lions*, northern elephant seals, and harbor seals are found in central and northern California. The most important rookeries and hauling grounds to these pinnipeds and to the thousands of California sea lions which occur here in spring through autumn include Ano Nuevo Island, the Farallon Islands, the beaches and esteros near Point Reyes, Mistake Point, Sugarloaf Rock near Cape Mendocino, and the rocks of the St. *George* Reef.

Seventeen species of seabirds presently nest in central and northern California; prior to 1983 their aggregate numbers had been increasing due to growth of the population of Common Murres. Total nesting numbers in 1982 were on the order of S50,000, most of which were murres (519,000), Brandt's Cormorants (56,000), Cassin's Auklets (109,000), and Western Gulls (40,000). To these and other seabirds the most important coastal sites are the colonies at castle Rock to Trinidad Head, Point Reyes, and the Farallones.

Several populations of seabirds and pinnipeds showed rapid growth during our study. Harbor seal and California sea lion numbers increased 42% and 44%, respectively, from 19S1 to 1982; northern elephant seal numbers increased 2S%. The population of Common Murres

appeared to increase .9% to 10% per year through 1982. Other populations declined: Brandt's Cormorants decreased by 15% through our study period and numbers of Steller sea lions decreased 19%.

For wholly pelagic marine mammal and seabird populations and non-breeding seabird visitors such as wintering waterfowl, changes in population size are difficult to determine due to sampling variance in surveys, the short time-series of this three-year study, and the absence of historical perspective. One change was observed and is worthy of note, A substantial decline in the abundance of northern fur seals in offshore waters of the California Current was recorded from 19S0 through 1982. This decline may reflect the decreasing size of the Bering Sea population, or indicate a change in food availability for these winter visitors to California waters.

During autumn 1982 and early winter 1983, the expression of the Pacific basin's El Niño phenomenon became apparent within the central and northern California study area. This period corresponded to the final six months of our study; the last of our surveys were completed prior to the season when the maximal effects of El Niño were being felt . Some changes were observed in the distribution and abundance of a few of the species being studied, but it is difficult to know whether these alterations were the direct result of this anomalous warm-water period. Two conditions limit the conclusions one may reasonably make, regarding the short-term and long-term effects of El Nine. First, our study of marine mammals and seabirds of central and northern California is the only program of this scale ever undertaken, therefore, little local and no state-wide, historic data base exists with which to compare our findings. Second, populations were already changing in apparent response to El Niño before patterns of abundance and distribution under normal oceanographic conditions could be fully described.

The general changes in marine mammal and seabird populations in central and northern California observed in the last six months of our study varied with species. Warm-water cetacean species, such as the Pacific bottlenose dolphin and the common dolphin, increased in abundance; cold-water species, such as the northern right whale dolphin, declined. Populations Qf California sea lions increased in central and northern California, possibly due to greater availability of food resources relative to southern California. Winter seabird residents, such as gulls, alcids, and fulmars which nest in Alaska and the Pacific Northwest, failed to arrive in normal numbers in 1983, resulting in a 69% decrease in winter seabird biomass. By spring, the Common Murre, after reaching an estimated nesting population of almost 525,000 in central and northern California in 1982, suffered near complete reproductive failure and very poor colony attendance in 1983 and, in summer 1983 high pup mortality was recorded for sea lion and fur seal populations breeding on the southern California islands.

Endangered or threatened species of seabirds and marine mammals with sizable populations in central and northern California include the Brown Pelican (with a September/October population numbering over 30,000), the California sea otter (about 1,300 adult animals), and several species of baleen whales (gray, fin, blue, and humpback]. Most of the estimated world population of 17,COO gray whales migrate along the coast of California in winter and spring, and there now exist resident groups of gray whales at four locations along the northern California coast. Fin and blue whales reach peek abundance in autumn and are seen primarily in shelf and slope waters in the southern half of the study area. Humpback whales are concentrated in the Farallon basin in late summer through autumn.

The most sensitive marine mammal and seabird habitat in central and northern California includes those waters and shoreline areas where we recorded the largest population numbers, and also those areas used by endangered or threatened species. The distributions shown in

Figure 3 encompass all such areas within the central and northern California study area. The quantitative, objective basis for this chart is the average abundance of cetaceans, pinnipeds, sea otters, and seabirds over the three-year term of this study. Though the definitions vary with animal group, the areas shown in Figure 3 are areas of consistently great use from year to year resulting in high average density (pinnipeds: $> 1/km^2$; cetaceans: $> 2.5/km^2$; seabirds: $> 30/km^2$). For certain species, some of this habitat use may be limited to a single season each year; other areas may be occupied year-round, Accompanying this figure is a list of the specific areas and the species or seasons involved (Table 1).

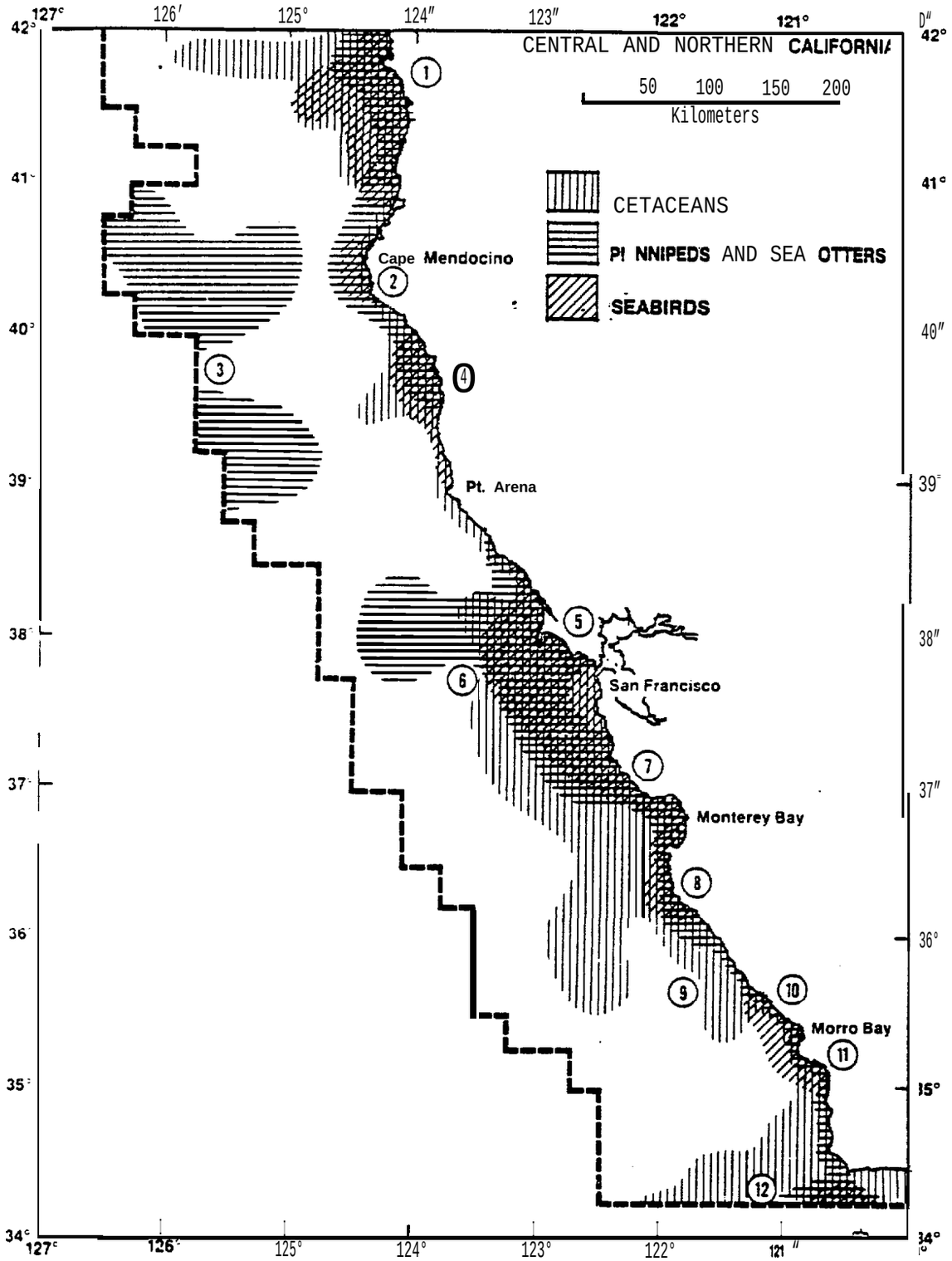


Figure 3. Areas of special importance to cetaceans, pinnipeds, sea otters, and seabirds in central and northern California.

TABLE 1. Areas of special importance to cetaceans, pinnipeds, sea otters, and seabirds in central and northern California (see Figure 3) .

(1) Gray whales occur year-round near St.George Reef, the Klamath River mouth, and Big Lagoon near Trinidad Head. Sea lions and harbor seals haul out on the rocks of St. George Reef and Trinidad Head; a S teller sea lion rookery 1s located at SW Seal Rock. A major harbor seal hauling/pupping ground is located in Humboldt Bay and the mouth of the Eel River. Murre colonies at Castle Rock, Trinidad, and Klamath River represent 40% of the state's total; colonies of Fork-tailed and Leach's Storm-Petrels, primarily at Little River Rock near Trinidad, represent 90% of the state's total. Consistently high densities of foraging birds are found in shelf waters. In autumn 90% of the state's scoter population occurs here.

(2) A large S teller sea lion rookery is located at Sugarloaf Rock (Cape Mendocino) . Over the shelf , foraging murres from Cape Mendocino colonies are found in spring and summer. Thousands of scoters occur here, intheir autumn southward migration; thousands of wintering gulls are found in November through larch.

(3) The slope and offshore waters over Mendocino Ridge and the fan of Vizcaino Canyon receive heavy uae by migrant northern fur seals in January through May.

(4) Seasonal concentrations of Pacific white-sided dolphins, northern right-vhale dolphins, and harbor porpoises occur in autumn, Risso's dolphins and Dan's porpoises in summer. A very large harbor seal hauling ground is located at Mistake Point. Almost 25% of the state's 16,000 nesting Pelagic Cormorants occur along Mendoc ino coast and nearshore waters; Cena of thousands of auklets and murres feed here in July through Occober.

(5) Ma j or harbor seal hauling/pupping grounds found at Double Point and in esteros of Point Reyes. Many hundreds of California sea lions haul out on Bodega Rock in autumn and winter. Northern elephant seals breed on SE Farallon Island in wincer and autumn. Steller sea lions in summer. Thousands of California sea lions haul out here in spring through autumn. Seabird colonies on the Farallones are che largest in the U.S. couch of Alaska; world's largest nesting concentrations of Western Gulls, Brandt's Cormorants, and Ashy Storm-Petrels. In autumn up to 4,000 Brown Pelicans roost from Bodega Bay co SE Farallon Island.

(6) Major concentrations of humpback whales occur in the Farallon Basin during summer and autumn. Seasonally high densities of Pacific white-sided dolphins, northern right whale dolphins, Risso's dolphins. and Dall's porpoises are found from late summer through early winter. Some gray whales occur here year-round. Migrating blue and fin whales are seen farther offshore. California sea lions iced over Cordell Bank in autumn; northern fur seals are found in high densities farther to the west in winter and early spring. Major seabird feeding ground in the Gulf of the Farallones; thousands of grebes and scoters occur here in autumn and wincer.

(7) The largest pinniped populations in central and northern California are found on Año Nuevo Island and mainland point. Breeding populations of northern elephant seals occur in winter; of Steller sea lions in summer. Thousands of California sea lions haul out here in lace spring through late autumn. Important foraging areas for California sea lions are located over tne Pioneer Canyon between Año Nuevo and Farallon Islands. tip to 2,300 Brown Pelicans roost on Año Nuevo Island in July. Th e northern end of the California sea Otter range is at Point Año Nuevo. In Monterey Bay thousands of storm-oecrels-including a signif icant portion of the world's Ashy Storm-Petrel population, nearly 6,000 Brown Pelicans, and hundreds of California sea lions occur in autumn. Over one-half million shearwaters, murres, and phalaropes feed in Monterey Bay in May and June.

(8) Approximately 24% Of the California sea otter population is found from Monterey to Point Sur. Many California sea lions are found on rocks and in shelf waters during lace summer and autumn.

(9) In lope waters west of the Big Sur coast, Risso's dolphins are present year-round, with increased numbers present during warm-water periods. Large numbers of northern right whale dolphins and moderate numbers of Dan's porpoises are present in winter. Offshore waters along the 2,000 m isobath are heavily utilized by migrating blue and fin whales.

(10) Approximately 62% Of the California sea otter population is found from Point Sur co Morro Bay; large concentrations are located from Piedras Blancas to Cayucos. Large numbers of California sea lions haul-out in summer and autumn on the rocks of Point Piedras Blancas. Thousands of grebes, murres, and scoters are found in autumn through winter in the shelf waters from Point Piedras Blancas to Point Sal; about 6,000 of the 30,000 Brown Pelicans chat migrate northward along the coast are found on coastal roosts here in July through October.

(11) Approximately 10Z of the California sea otter population is found in the vicinity of Point Buchon and Shell Beach. Large numbers of California sea lions haul-out in spring through autumn on Lion and Pup Rocks near Point Buchon and at Point Sal Rock.

(12) Pacific white-sided dolphins, northern right whale dolphins, and Risso's dolphins are found in large numbers from nearshore to 160 km (about 90 nm) offshore in summer, autumn, and winter. During warm-water periods associated with El Niño, pilot whales, common dolphins, and bottlenose dolphins also became abundant in the waters west of Point Conception and Point Arguello. High densities of seabirds and California sea lions occur within 25 km of their colonies on San Miguel Island. Large numbers of migrating shearwaters, loons, grebes, and scoters are found here in spring through autumn.

The most significant findings relative to each group of animals are summarized in the sections that follow, Readers interested in detailed descriptions of historical information, field survey methodology, and population dynamics of each species are referred to the following three books which together constitute the scientific results of the study:

Michael L. Bonnell, Mark O. Pierson, and Gary D. Farrens, *PINNIPEDS and SEA OTTERS of Central* and *Northern California, 1980-1983 Status, Abundance, and Distribution.*

Thomas P. Dohl, Robert C. Guess, Marilyn L. Duman, Roger C. Helm, *CETACEANS of* Central *and Northern California, 7980-7983 Status, Abundance, and Distribution .*

Kenneth T. Briggs, W. Breck Tyler, David B. Lewis, Kathleen F. Dettman, *SEABIRDS of Central and Northern California, 1980-7982 Status, Abundance,* and *Distribution .*

PINNIPEDS

Faunal composition and annual cycle. The pinniped fauna of central and northern California consists of five species totaling nearly 50,000 animals in spring and autumn: California sea lions, Steller (northern) sea lions, northern fur seals, northern elephant seals, and harbor seals. The greatest population on land occurs in September and October during the postbreeding dispersal of California sea lions northward from the rookery islands of San Miguel and San Nicolas in the Southern California Bight. The greatest population at sea occurs in February and March, when migrant northern fur seals from the Bering Sea arrive to overwinter off California.

Breeding species. Three pinniped species (Steller sea lion, northern elephant seal, and harbor seal) maintain large breeding populations in central and northern California. The Steller (northern) sea lion has a summer breeding population of over 3,000 animals, including nearly 500 pups, at four locations: Año Nuevo Island (67% of the total), Sugarloaf at Cape Mendocino (26% of the total), the Farallon Islands (3% of the total), and Southwest Seal Rock at Point St. George (5% of the total). The Steller sea lion population seems to be stable at present, although fewer juvenile and subadult animals were seen in the area relative to past years. The northern elephant seal has a winter breeding population of over 3,400 animals, including about 1,800 pups born primarily at two locations: Año Nuevo Island and the nearby mainland point (S1% of the total), and Southeast Farallon Island (18% of the total). A small rookery has become established at cape San Martin on the Big Sur Coast, and at least one pup has been born on Castle Rock at Point St. George. The northern elephant seal population on Año Nuevo and Southeast Farallon islands is growing rapidly, showing an increase of 28% from 1981 to 1982. The central and northern California population

of harbor seals is also rapidly growing, with intrinsic growth apparently augmented by immigration. The present population of more than 12,000 harbor seals, representing about 70% of the California total, produced over 2,000 pups in 1982 and is found in sizable numbers at more than 100 locations along the open coast and in bays and estuaries. California sea lions are known to occasionally give birth to a few pups on Lion Rock at Point Buchon and on Southeast Farallon Island. California sea lions, northern fur seals, northern elephant seals, and harbor seals have large breeding populations on San Miguel Island, located 25 nm south of Point Conception.

Abundance and distribution. In winter, when the pinniped population on land is at a yearly low of about 12,000 animals, the population at sea within the surveyed area is about 23,000 animals—80% are northern fur seals which are found in a broad band over the Monterey Seavalley, Guide and Pioneer seamounts, Cordell Bank, and the waters west of Point Arena and Cape Mendocino. These migrants from the Bering Sea (and a few from San Miguel Island) rarely haul out on land in winter and are uncommon within 50 km (27 nm) of the mainland. In spring the population of pinnipeds at sea remains constant at about 23,000 animals,' but the population on land doubles to about 24,000 animals, with the breeding season of harbor seals and the arrival of a migrant wave of California sea lions. By summer, with the departure of northern fur seals to the north and adult California sea liens to the south, the at-sea population in central and northern California waters reaches a yearly low of about 5,000 animals. However, the numbers on land remain at spring levels of about 25,000 animals, due primarily to the peak haul-out of molting harbor seals and the arrival of many thousand yearling and juvenile California sea lions. In autumn pinniped populations on land reach an annual peak of over 31,000 during the post-breeding season dispersal of California sea lions from the Southern California Bight. The population at sea in autumn is about 14,000 animals, with the highest densities occurring

over the continental shelf from Point Conception to Monterey Bay. Important feeding areas were indicated for the waters over Pioneer Canyon near Año Nuevo Island, and Cordell Bank near the Farallon Islands.

SEA OTTERS

Status and distribution. Counts of sea otters, representing 56% to 77% of the estimated total population, (1,300 independent animals; Estes and Jameson 1983) were used to describe the present distribution and the changes that occurred from 1980 to 1983. In June 19S3, 6.7% of the population was found south of Point Buchon, with the large southernmost raft located off Shell Beach; 35,9% was found from Point Buchon to Point Piedras Blancas; 30.1% was found from Point Piedras Blancas to Point Sur; 17.3% was found from Point Sur to Cypress Point; 10% was found in, or north of, Monterey Bay. The numbers found in the Point Sur to Cypress Point area increased substantially from 1980 to 1983, while numbers in Monterey Bay and the southern Big Sur coast declined. There is no evidence of population growth.

CETACEANS

Estimated mean seasonal population of
all cetaceans
from Point Conception to the Oregon border:

Spring:	76,000
Summer:	78,000
Autumn :	152,000
Winier:	133,500

Cetaceans are found in every season in the waters off central and northern California, The numbers and species vary from season to season and year to year, but there are always animals utilizing these waters . Mean cetacean populations vary from an annual low in spring of 76,000+ animals to double that number in autumn, the season of maximum occupancy.

Five species of small porpoises, detailed below, represent the major elements of the cetacean fauna found within the study area. Together they numerically account for better than 95% of all cetaceans recorded.

Pacific white-sided Dolphins

Estimated mean seasonal population of
Pacific white-sided dolphins
from Point Conception to the Oregon border:

Spring:	26,000
Summer:	32,000
Autumn :	86,000
Winter:	33,500

Pacific white-sided dolphins were the most numerous cetaceans recorded within the study area. They represent almost 40% of all animals seen. Their peak abundance occurred during the warmest water periods of early autumn (September and October), when observed numbers reached three times the levels noted during the remainder of the year. Average school size of Pacific white-sided dolphins (178) more than

doubled during this peak period when compared to spring and summer values . We feel that this influx of animals represents an inshore seasonal migration and mixing of populations from offshore waters well beyond the boundaries of the surveyed area. The function of this movement might well be reproductive, since the majority of newborn animals and most examples of sexual interaction of this species were seen at this time.

Distribution of Pacific white-sided dolphins was strongly biased toward the southern half of the study area in all seasons except spring, at which time sightings were fairly evenly scattered along the entire coast from south to north. Spring school size *(72)* was the lowest of the year, with schools clustered nearer shore and in shallower water (2s0 fm or 510 m) than during the rest of the year.

Northern Right Whale Dolphins

Estimated mean seasonal population of
northern right whale dolphins
from Point Conception to the Oregon border:

Spring:	29,000
Summer:	27,000
Autumn :	37,500
Winter:	61,500

The northern right whale dolphin was the second most abundant cetacean found in the study area, equaling approximately 35% of all the cetaceans recorded. Winter was the season of their peak occurrence.

Distribution of northern right whale dolphins, from north to south, favored the southern half of the study area on an annual basis. Eighty-five percent *(S5%)* of all sightings occurred south of Point Arena; in winter their range contracted even further, concentrating from Point Sur south to Point Conception. This species was generally

found in deeper water than any other small cetacean. Spring sightings clustered about the 280 fm (510 m) isobath, with a few large schools seen in 500 fm (911 m) waters. In autumn the majority of sightings were beyond the 1,000 fm (1,822 m) isobath.

The majority of newborn northern right whale dolphins were observed during late winter and early spring. Over 900 newborn animals of this species were recorded during the three-year study, with 750 of those occurring along the Big Sur coast from Point Piedras Blancas to Point Pines. The northern right whale dolphin was the only species which demonstrated-such sharply defined geographical and seasonal calving boundaries.

Risso's Dolphins

Estimated mean seasonal population of Risso's dolphins from Point Conception to the Oregon border:

Spring:	15,000
Summer:	13,000
Autumn :	20,000
Winter:	30,000

Risso's dolphin (grampus) was the third most commonly seen cetacean species, accounting for approximately 18% of the cetacean fauna on an annual basis, Overall periods of peak abundance of this species tended to occur during autumn and winter, with 63% of the animals recorded during these periods. July or August represented the times of lowest occupancy within the study area.

Grampus distribution and density was biased toward the southern half of the study area from Point Reyes to Point Conception. During spring and summer a more even distribution occurred from north to south, but even then 60% of the animals were seen in the south. A few pockets of high density (>1.5 animals/km^2) occurred along the

Mendocino coastline in summer, which accounted for the major grampus concentrations north of Point Reyes. Even greater densities to the south were seen during autumn and winter, with 75% of all grampus recorded from Monterey Bay to Point Conception.

The majority (60%) of grampus young identified as newborns were recorded during the winter season. 'The remainder were seen throughout the year, although primarily from August through March. These newborn sightings (140) were not concentrated in any particular geographic area or water depth. We feel that grampus newborns may be encountered anywhere within the study area at almost any month of the year.

Dan's Porpoises

Estimated mean seasonal population of
Dan's porpoises
from Point Conception to the Oregon border:

Spring:	3,600
Summer:	3,700
Autumn :	8,750
Winter:	3,400

Dan's porpoises were the fourth most numerous of the small cetacean species (toothed whales) recorded within the study area, and ranked fifth overall. Although they numerically represent only 2.2% of the total cetacean population, they were the most frequently sighted species (27.53). Dan's porpoises *were* the most ubiquitous animals encountered; they were recorded in widely scattered locations throughout the study axea in every season.

Peak occupancy *of* Dan's porpoises occurred from July through October, with lesser peeks found in June and November in some years. Distribution was generalized throughout the study area, with increased densities found from Monterey Bay to Cape Mendocino from midsummer through autumn. However, this population shift is largely explained

by the influx of new animals into the area rather than by a contraction of their usual range.

Due to sampling bias, we feel that population estimates of Dall's porpoises are significantly lower than they should be. Several factors lead to this under-representation: the dorsal aspect of these animals is universally dark in color; they habitually swim just below the water surface; their average 'pod size (3.3) is extremely small; individual animals are widely separated within a pod, often by 30 m or more. These factors contribute to the undersampling bias by making the animal most difficult to see initially and, once noted, accurate counts are highly problematical.

Harbor Porpoises

Estimated mean seasonal population of harbor porpoises from Point Conception to the Oregon border:

Spring:	1,900
Summer:	1,600
Autumn :	3,000
Winter:	1,700

The harbor porpoise ranked fifth among the major small cetacean species, and ranked sixth overall. Autumn was the season of peak abundance for this species, with about 40% of the annual total recorded during this season. The remainder of the year showed only minor variations in numbers between the seasons.

Distribution of harbor porpoises, although statewide, was heavily biased toward the northern coastal sectors. Numbers of these animals increased progressively from Point Pines northward to the Oregon border. A small percentage (usually less than 5%) of the total harbor porpoise population could be found scattered from Piedras Blancas south to Point Conception. The center of this subpopulation varied considerably over the course of this study.

Usually harbor porpoises were found in small pods averaging 2.2 animals, located within 0.25 nm (0.46 km) of the shoreline. open coasts with gently shelving sandy bottoms were the preferred habitat.

Baleen Whales

The baleen whales are numerically a minor element of the cetacean fauna. Most utilize the coastal waters as migratory pathways twice a year, often pausing to feed en route. Because of their large size, each individual represents a significant ecological impact w-hen measured in terms of consuming biomass. As an example, it takes very few humpback whales (at 35,oOO kilograms each) to equal or surpass a large school of Pacific white-sided dolphins or northern right whale dolphins (at 100 or 75 kilograms each).

Passing through the study area twice each year on their annual migration, California gray whales were the most numerous of the baleen whales. Most of the estimated world population of this species (17,000 animals) make the biannual trek along the California coastline, and the majority are found close to shore over shelf . waters. Peak periods of occupancy occur during the winter and spring seasons; however, some gray whales are found year-round in northern California waters. "summering"' populations currently are located off the Farallon Islands, at Patricks Point, at the mouth of the Klamath River, and over the St. George Reef in the Crescent City area. As the overall population of gray whales increases, it appears that somewhat larger numbers are becoming resident in northern California waters.

Humpback whales have become a species of great interest during the course of this study. Known from historical records to occur in some numbers along the central and northern California coast, it was

primarily thought they were only migratory animals. Now we know they not only migrate through these waters, but a high percentage and an Increasing number summer-over within the Farallon basin to feed, prior to a return to their wintering grounds (Baja California). It is probable that these animals shall become a permanent part of the central coast cetacean fauna for at least eight months of each year.

Blue and fin whales were found in modest numbers (122) over the course of this study. Most sightings of these species occurred from Point Reyes south to near Point Conception. Although the numbers are iow, they appear to be increasing, and sightings are becoming more common outside the usual peak periods of late summer through late autumn. Episodic feeding bouts have been observed, usually in waters between 500 and 750 fm (911 to 1,367 m),

SEA TURTLES

During our three-year study there were 29 sightings of 31 leatherback turtles. Almost 90% of the sightings occurred during periods of maximum seawater temperatures (late summer and autumn). These turtles were seen from 5 to 100 nm (9 to 185 km) offshore; most sightings occurred near the 1,000 fm (1,822 m) isobath. The sightings were too few and infrequent for statistical treatment, but these animals appear to be only occasional visitors to waters off central and northern California during periods of maximum seawater temperatures .

SEABIRDS

Faunal composition. The seabird fauna includes 102 species, of which 30-35 are at least moderately numerous in a given month; 34 species are very rare. The most abundant of the seabirds are several of the nesting residents--about ten species that winter off central and northern California but nest to the north or inland, and three shearwater species that nest in the southern hemisphere and spend their winters (our summers) in the North Pacific. Four species attain estimated "'instantaneous" populations of 1 million or more individuals: the phalaropes (Red and Red-necked combined), Sooty Shearwaters, Cassin's Auklets, and Common Murres. Populations of visitors outnumber those of locally-breeding species at all times at sea, and in autumn and winter along the shoreline. In spring and summer shoreline populations mainly consist of the breeding species.

Population density. The monthly mean density of all seabirds in aggregate varied from 7.8 to 38.2 birds/km^2, while their biomass density ranged from 3.8 to 27.3 kg/km^2. Extrapolated total populations at sea were 1.4 to 6.4 million birds; they consumed about 0.2 million metric tons of prey during 1980 and somewhat less in 1981 and 1982. Total biomass density was more than an order of magnitude higher over the continental shelf than in waters seaward of the continental slope; over the slope itself biomass density was generally one-half to one-third that of contiguous shelf areas. In most open-water areas, bird abundance was lowest in early summer and in midwinter, and highest in spring migration end late autumn.

In early winter 1982-1983 bird populations were lower by 69% than in the preceding years, probably a result of unusual environmental conditions related to onset of a strong El Nino event in the eastern tropical Pacific. This change resulted mainly from low visitation to the area by birds that nest in the Pacific Northwest and Alaska.

Nesting species. The seabird nesting fauna presently includes seventeen species; the Brown Pelican nested successfully in central California as late as about 1959, but most pelicans occurring there now attend nesting colonies in Mexico. It appears that Common Murre populations increased substantially from 1979 to 1902, leading to a concomitant increase in the size of the total nesting fauna from about 0.70 million to 0.85 million birds; other populations of Western Gulls appeared to be stable while Brandt's Cormorant nesting numbers declined 15% from high levels reported in 1979. The predominant nesting species are Common Murres, Cassin's Auklets, Brandt's Cormorants, and Western Gulls. Occurrence of warm-water conditions related to the strong El Niño event of 1982-1983 led to near-total reproductive failure of several nesting species including murres and auklets.

The most important seabird colonies are at Point Reyes, the rocks at Trinidad Head, Castle Rock at Point St. George, and the Farallon Islands . Castle Rock, at Crescent City, harbors nesting populations of eleven species; in 1982 these included an estimated 142,000 murres. This appears to be the largest murre colony in the northeastern Pacific, east of Kodiak Island, Alaska. The Farallon Islands, home to nesting populations of twelve seabird species, are the most important nesting colonies in the U.S. south of Alaska. In addition to harboring California's second largest murre colony, the Farallones support the world's largest colonies of three species essentially endemic to the California Current: Ashy Storm-Petrels, Brandt's Cormorants, and Western Gulls. The 105,000-bird colony of Cassin's AukLets here may also be the species' largest in U.S. waters.

Feeding areas. Most of the numerically predominant seabird species capture their prey by either pursuing it underwater or by seizing it at the surface. Total trophic impact of the fauna probably closely resembles the distribution of biomass, an inference supported

by the geographic distribution of 854 sightings of feeding flocks: the most important feeding areas are neritic waters north of Cape Mendocino, from Monterey to Bodega Head, and south of Point Buchon. Breeding adults, constrained by nest locations and foraging energetic, fed mainly within 40 km of the major colony sites: Point Año Nuevo to Cordell Bank and Cape Mendocino to the Oregon border. Convergence bordering and within upwellings off major promontories were the primary feeding habitat for phalaropes and also appeared to attract shearwaters, storm-petrels, pelicans, and auklets.

BLANK

3. FAUNAL SUMMARIES

3a. FAUNAL SUMMARIES: PINNIPEDS , SEA OTTERS

PINNIPEDS

Pive species of pinnipeds use the land and water resources of central and northern California: California sea lions, Steller sea lions, northern fur seals, northern elephant seals, and harbor seals. The total population for the continental shelf area, including the slope out to the 2,000 m isobath, exceeds 50,000 animals in autumn and reaches nearly 50,000 animals in spring; at least 30,000 pinnipeds are found in the area during summer and winter.

Nest pinniped populations were severely reduced in size by hunting during the last century, Fur seals, which were found by the thousands on the Farallon Islands, were extirpated in California for their pelts, Northern elephant seals were reduced to about 100 animals in the world by seal hunters after oil. Through the 1920's, sea lions were hunted for various products or simply to reduce their impact on commercial fisheries.

Pinniped populations in California were small during the 1930's and 1940's. The Steller sea lion was the most abundant pinniped, with a population in California waters of about 6,000 animals. For unknown reasons, this species' population in California has continued to decline and now numbers about 3,000 animals (1% of the world population). In the last three decades, populations of California sea lions and northern elephant seals have grown rapidly in California, due in part to immigration from Mexican colonies. The California sea lion is the most abundant pinniped on the west coast of North America south of Alaska; about half of the world population of 150,000 animals is found in California. On the southern California Channel Islands, the population of California sea lions has maintained a growth rate of 7% per year since 1950. At present, however, population growth may be

slowing at some locations due to an attenuation of the effect of immigration. The northern elephant seal, with a world population of about 77,000 animals, has a California population of more than 40,000 animals. Though the intrinsic growth rate is probably 7 to 8% per year, the California component of the northern elephant seal population is growing at a faster rate of about 13% per year, due to continued recruitment from Mexican colonies; because of the fixed size of the Mexican colonies, the effect of immigration will diminish with time. The harbor seal, with a world population of about 300,000 animals, has a population in California of at least 17,000 animals; this is a minimum population estimate, based on counts made in May and June 1982 (Miller 1983). While known to be growing, there is insufficient data to calculate a growth rate.

The seasonally most abundant pinniped in California is the northern fur seal. The population size, while not known with certainty because it is entirely pelagic, is conservatively estimated at 25,000 animals (±8,400 SE) for the open-ocean area surveyed in this study; *many* thousand more may be found farther to the west. Northern fur seals reach their peak abundance in February or March, as migrants from the Bering Sea populations overwinter in the California Current. In the early 1960's, a small colony was established on San Miguel Island . With continued but diminishing recruitment from the migrant population, the San Miguel Island colony has been growing at a rate of over 10% per year, and presently numbers about 6,000 animals. The present world population of the northern fur seal is estimated to be 1.8 million animals and is declining due to factors not well understood.

None of the pinniped species in central and northern California are listed as endangered. However, all are protected under the provisions of the Maxine Mammal Protection Act of 1972, and the northern fur seal population is protected under the terms and provisions of the Interim Convention for the Conservation of North Pacific Fur seals.

In central and northern California, the California sea lion is the most abundant pinniped on land and in waters overlying the continental shelf. This species reaches its peak abundance in the autumn, as adult and subadult animals (mostly males) disperse into central and northern California waters, following the breeding season on the rookeries of the Southern California Channel Islands. In winter and early spring, the population in central and northern California falls to its annual low, as animals return to the Southern California Bight to feed upon hake, squid, and anchovy. Another smaller peak of abundance occurs in May prior to the summer breeding season; this peak may be related to the squid spawning season in central California, or may simply reflect the southward passage of animals that overwintered in the Pacific Northwest. Summer populations of yearling and juvenile California sea lions on Año Nuevo and Farallon islands may hint at the founding of new breeding colonies in the years to come. At present, only a very few California sea lions are born in central and northern California – births have been reported for Lion Rock near Point Buchon and Southeast Farallon Island. The largest rookery in the range of the species lies 25 nm south of Point Conception at San Miguel Island.

Steller sea lions, northern elephant seals, and harbor seals all maintain breeding populations in central and northern California. Steller sea lions have rookeries at Año Nuevo Island, Southeast Farallon Island, Sugarloaf Rock near cape Mendocino, and Southwest Seal Rock near Point St. George. The peak count of Steller sea lions on land occurs in late June or early July, during this species" breeding season; the maximum count obtained in this study was slightly more than 3,000 animals, of which 44% were found on Año Nuevo Island.

Northern elephant seals breed in winter, but reach peak abundance on land in spring, when juvenile males join adult females on land for their annual molt, The breeding population (adult males, adult females, and pups of the year) was over 3,400 in 1982, of which 80% of

the central and northern California total was found on Año Nuevo Island and adjacent Año Nuevo Point. Most of the remainder were on the Farallon Islands. A small rookery has recently been established on the mainland at Cape San Martin, and another rookery appears imminent at Point St. George.

Harbor seals reach peak abundance on land in early summer molting season, when about 12,000 animals can be counted on the beaches, rocks, and mudflats of central and northern California. During summer, harbor seals are found at over 100 locations along the open coast and in bays and estuaries. In spring, when pups are born, fewer locations are occupied. The most important appear to be at Double Point, Drake's Estero, and Tomales Bay north of San Francisco, at Mistake Point, in Humboldt Bay, and on St. George Reef and Sisters Rocks Beach near Crescent City.

Hauling-out sites of major importance to pinnipeds in central and northern California are shown in Figure 4. Table 2 identifies these locations and provides annotation.

Two species accounted for 90% of all pinnipeds seen at sea: the California sea lion and the northern fur seal. California sea lions reached their greatest abundance at sea in autumn, concurrent with peak abundance on land in central and northern California. Although an overall mean density of 0.21 animals/km^2 ($\pm$0.12 SE) was obtained, most animals were seen over the shelf where the density averaged 0.45 animals/km^2 ($\pm$0.32 SE). The greatest concentrations of California sea lions at sea were recorded at Cordell Bank west of Point Reyes, over the Pioneer Canyon near Año Nuevo and Farallon islands, and over the continental shelf from Point Sur to the vicinity of Point Conception and San Miguel Island.

Northern fur seals were found predominantly in offshore waters greater than 2,000 m in depth, and 50 km or more from land. Mean densities of 0.19 animals/km^2 were calculated for both winter and spring seasons (December through May). Maximum abundance of about 0.28 animals/km^2 was reached in February and March. During winter and spring the vast majority of northern fur seals seen at sea are migrants from the rookeries in the Bering Sea. A few northern fur seals are found in central and northern California waters in summer and autumn, and may be associated with the colony on San Miguel Island .

The paragraphs which follow provide a seasonal summary of pinniped use of the central and northern California OCS area.

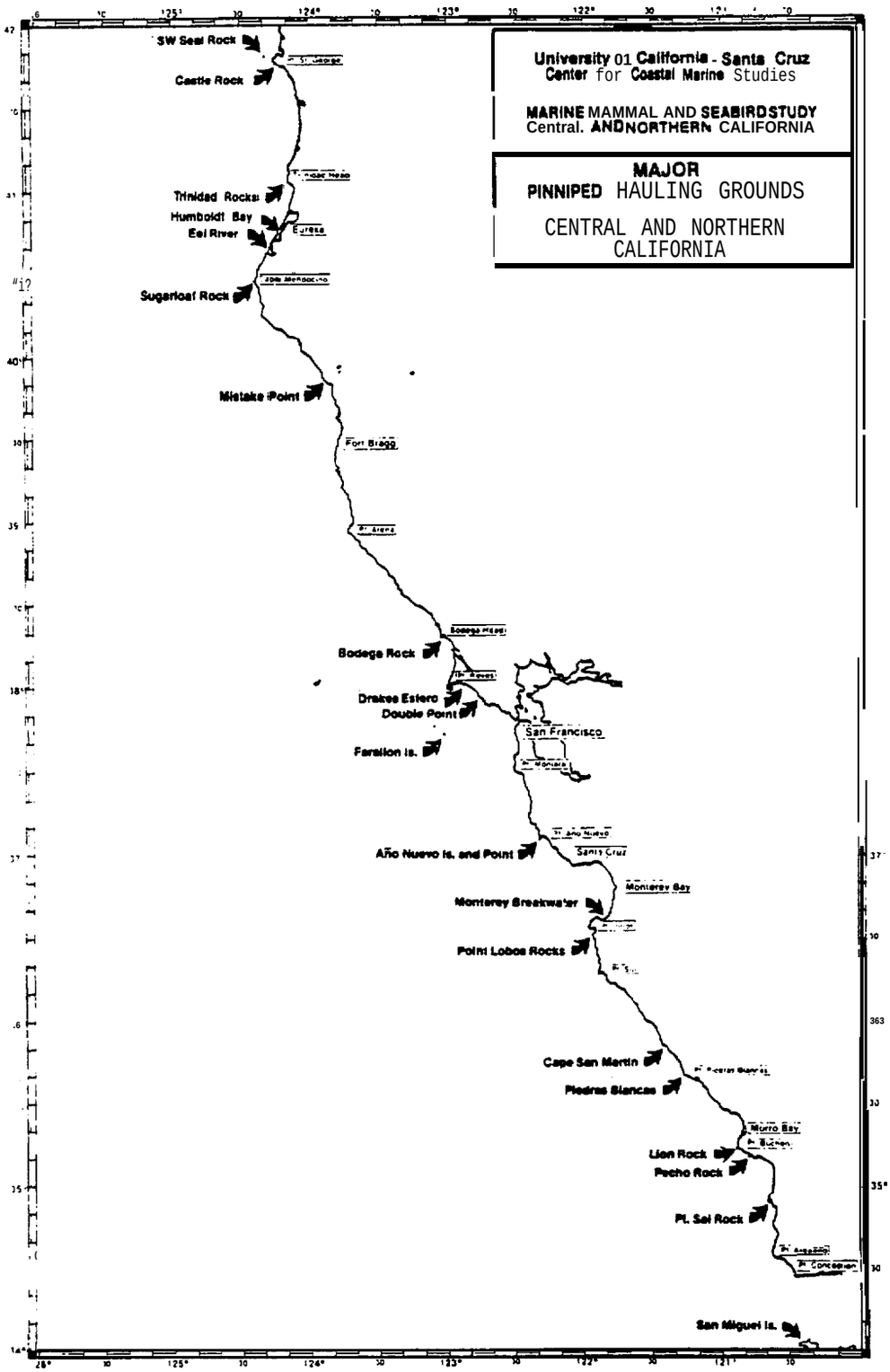

University 01 California - Santa Cruz
Center for Coastal Marine Studies
MARINE MAMMAL AND SEABIRD STUDY
Central. AND NORTHERN CALIFORNIA
MAJOR
PINNIPED HAULING GROUNDS
CENTRAL AND NORTHERN
CALIFORNIA
SW Seal Rock
Castle Rock
Trinidad Rocks
Humboldt Bay
Eel River
Sugarloaf Rock
Mistake Point
Fort Bragg
Bodega Rock
Drakes Estero
Double Point
Farallon Is.
San Francisco
Año Nuevo Is. and Point
Santa Cruz
Monterey Bay
Monterey Breakwater
Point Lobos Rocks
Cape San Martin
Piedras Blancas
Morro Bay
Lion Rock
Pecho Rock
Pt. Sal Rock
San Miguel Is.

Figure 4

Table 2. Major pinniped hauling grounds in central and northern California, north to south. See Figure for locations.

Southwest Seal Rock. Steller sea lion rookery. Maximum population in summer months of about 260 animals; 25 pups born here in 1982.

Castle Rock and Inner-Castle Reef. Major hauling ground of California sea lions. Maximum population of about 2,300 present in the fall; over 1,000 in winter. Population of about 400 harbor seals found on rocks of St. George Reef and Sisters Rocks 5 mi. th the south; 85 pups counted here in May of 1982. Castle Rock also serves as a hauling ground for about 36 northern elephant seals in the winter and spring; one pup born here in the winter of 1982.

Trinidad Rocks. Hauling ground for about 900 California sea lions and 300 Steller sea lions in the fall and spring; most animals found on Flatiron Rock.

Humboldt Bay and Eel River. Over 1,000 harbor seals haul-out on the mudflats of Humboldt Bay and in the mouth of the Eel River in late-spring and summer; 125 pups counted in May.

Sugarloaf Rock. Second-largest Steller sea lion rookery in California. Population of about 1,000 animals including 140 pups on land in June and July.

Mistake Point. Largest contiguous harbor seal hauling ground in California. Population of 775, including at least 130 pups, present in May of 1982; 839 harbor seals counted here in June of 1982.

Bodega Rock. Hauling ground for California sea lions. Maximum population of about 1,000 animals present here in the late-fall and winter.

Drakes Estero. Important haul ing and pupping ground for harbor seals. Maximum population of about 750 animals present in June; 527 counted in May of 1982, including 166 pups.

Double Point. Major harbor seal hauling ground; maximum population of 722 animals counted in June.

Farallon Islands. Breeding population of over 600 northern elephant seals present in winter; pup production of about 340 in 1982. Small Steller sea lion rookery of about 200 animals on land in June; pup production of about 14 in 1982. Important hauling ground for California sea lions; spring and fall peak populations of 3,000 and 5,000, respectively.

Año Nuevo Island and mainland Point. Northern elephant seal breeding population of 1,890 on the Island, and on the mainland Point in 1982; over 1,500 pups born. Largest Steller sea lion rookery in California; breeding population of over 1,000 animals including 321 pups in 1982. Most important hauling ground of California sea lions in central and northern California; peak population of 7,300 animals counted here in the fal 1 of 1982.

Monterey Breakwater. Hauling ground of California sea lion in the spring through fal l ; maximum population of about 1,500 animals.

Point Lobos area rocks. Lobos Rocks near Soberanes Point, Sea Lion Rocks near Point Lobos, and Bird Rock near Cypress Point used as a hauling ground for about 1,500 California sea lions in the fall; about 600 animals use these rocks in the spring.

Cape San Martin. Haul ing ground for about 500 California sea 1 ions and 300 northern elephant seals in the fall. Smal l northern elephant seal rookery in the winter with a population on land of about 40 animals; 20 pups estimated to have been born here in 1982.

Point Piedras Blancas. Hauling ground for over 1,500 California sea lions in the fall; over 1,000 in the spring. Animals haul-out on offshore rocks.

Lion Rock. Hauling ground for over 2,800 California sea lions in the fall, and 1,200 in the summer. Birth of a few California sea 1 ion pups on Lion Rock has been reported.

Pecho Rock. Haul ing ground for over 1,500 California sea 1 ions in the summer and about 800 in the fall.

Point Sal Rock. Haul ing ground for over 1,000 California sea 1 ions in the summer and about 600 in the spring and fall .

San Miguel Island. Not part of centra 1 and northern California study area; l i steal because of importance to pinnipeds and proximity to oil resource development in the Santa Maria Basin and western Santa Barbara Channel. One of the largest pinniped colonies in the world. Five species of pi nnipeds breed here; i argest breeding populations of California sea l ions and northern elephant seals in the species' range. Only colony of northern fur seals south of Alaska. Total pinniped population of over 30,000 in the summer, and 25,000 in the winter and spring.

Seasonal distribution

Winter

On Land. The smallest pinniped populations of the year are present on land in central and northern California during winter. The maximum winter count in this survey series was obtained in 1981. In all, 12,1S0 pinnipeds were counted—an increase of 4.5% from the count of 11,632 recorded the previous year.

The 1981 winter count of 12,150 represented a 41.5% decrease relative to the 1981 autumn count of 20,775. This decrease was due in large part to the departure of three-fourths *of* the California sea lions from the area, some northward into Oregon and some southward to form the winter peak in the Southern California Bight,

Winter is the breeding season of the northern elephant seal, whose populations on Año Nuevo Island and Southeast Farallon Island have shown steady growth. The combined northern elephant seal population in the winter *of* 1982 was 3,407 animals, an increase of 28.2% over the count of 2,658 obtained in 1981. Based on the most recent complete winter survey (1981), the northern elephant seal population represented 21.9% of the winter pinniped population in central and northern California.

Harbor seal numbers in winter were similar to those counted in autumn, We counted 3,616 in January 1981, representing 2S.8% of the survey total. California sea lion *numbers* declined from 16,S20 in autumn 19131 to 4,469 in winter, which represented 36.8% of the survey total. Steller sea lion numbers also declined from 1,571 in autumn 1S81 to 1,407 in winter; the latter figure represented 11.6% of the survey total.

At Sea. An overall mean density of 0.15 animals/km^2 (±0.03 SE) was obtained for the study area in winter. This figure corresponds to an at-sea pinniped population of about 8,217 animals over the shelf and slope waters to the 2,000 m isobath, or up to 22,755 animals for the entire area surveyed in winter months.

The highest mean monthly density was obtained in February during the migration of northern fur seals into central and northern California waters. The mean density of 0.318 animals/km^2 (±0.176 SD) recorded on February surveys was double the mean density of January surveys (0.137 ±0.041 SD).

In February northern fur seals were predominant over other species, representing 74.3% of all sightings. Fur seal relative abundance increased steadily from 20.0% of the total on December surveys to 57.7% in January, and to 74.3% in February, reflecting the arrival of the migrant population.

Other pinniped species were most numerous in early winter before the influx of northern fur seals. In December California sea lions were the predominant species with 57.8% of the pinniped sightings. Northern elephant seals, which also reached their winter peak abundance at sea in December, accounted for 10.6% of total sightings.

In winter pinnipeds were found in greatest density south of cape Mendocino and in offshore waters; 92% of all sightings were recorded south of Cape Mendocino and within this area 44% of all sightings occurred in the offshore depth region (beyond the 2,000 m isobath). Mean densities were highest in offshore waters in the south-central and north-central sectors (36°20'N to 40°30'N, from about Point Sur to cape Mendocino). Northern fur seals represented 73% and 86%, respectively, of the pinniped populations in these two sectors, Where similar densities of about 0.25 animals/km^2 were recorded. Greatest

use of shelf waters (less than 200 m in depth) was observed in the southern sector (34°20'N to 36°20'N) where shelf, slope, and offshore densities were most alike. This greater use of shelf waters in the south was due to the nearshore contribution of California sea lions, which represented 42.4% of the pinniped population in the southern sector.

The distribution of pinnipeds at sea in the winter months is shown in Figure 5. Several areas of higher density are apparent; these are areas of consistently greater use by pinnipeds in the winter months of 1900-1983. In the south, the waters over Arguello Canyon, near San Miguel Island, and near Point Sal over the Santa Lucia Bank received great use by California sea lions, which accounted for 88.7% of the sightings in this part of the study area. Farther west over the Santa Lucia Bank, northern fur seals were especially numerous, representing 73.1% of the pinniped population in the offshore depth region.

From the latitude of Point Sur north to Point Reyes, northern fur seals accounted for 63.7% of the total area abundance; north of Point Reyes this figure rose to 80%. Fur seals were most abundant in a broad offshore band in waters over the Monterey Seavalley, Guide and Pioneer seamounts, Cordell Bank, and west of the Mendocino coast from Point Arena to Cape Mendocino.

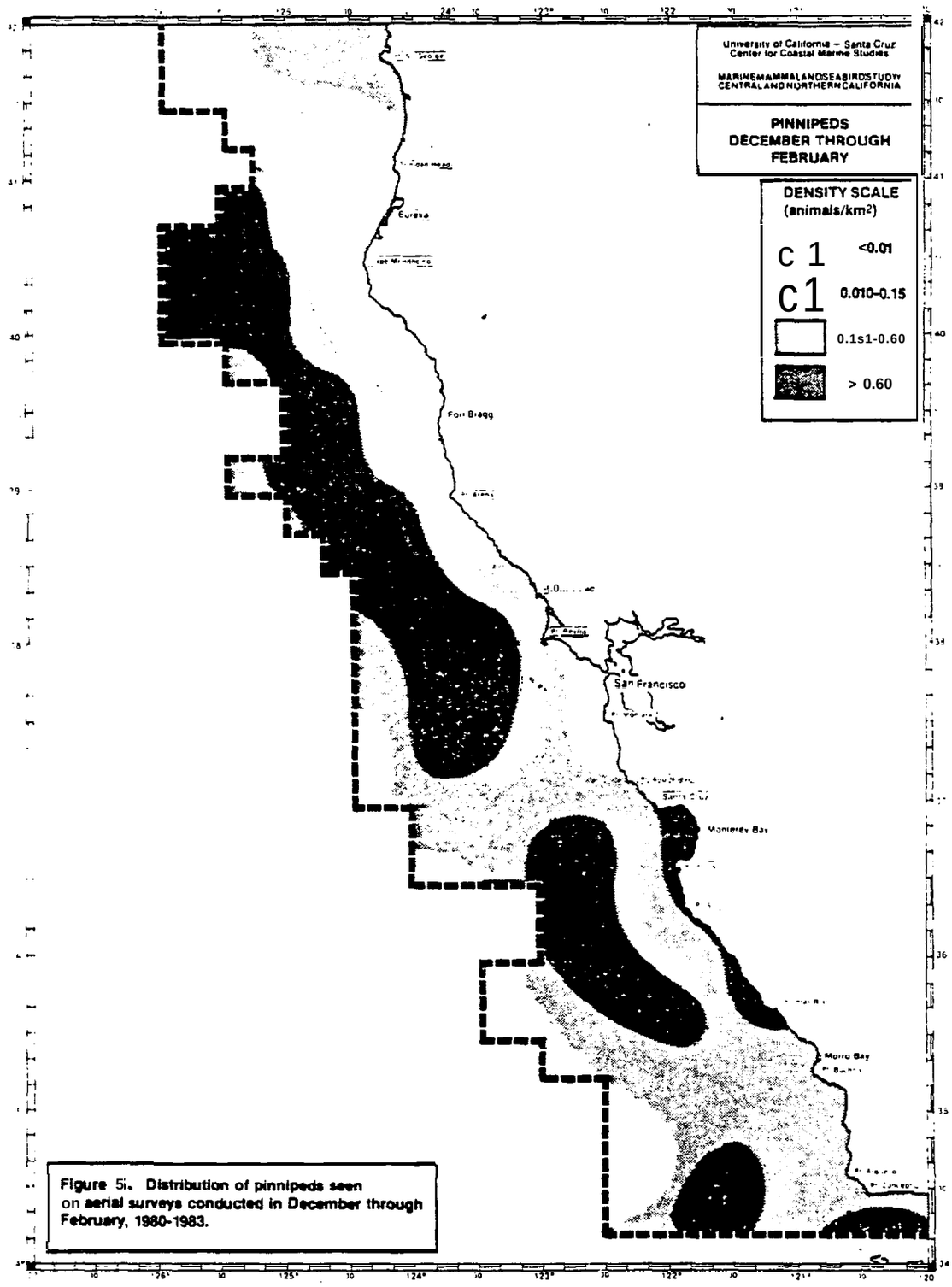


Figure 5. Distribution of pinnipeds seen on aerial surveys conducted in December through February, 1980-1983.

Spring

On Land. Counts obtained in May of each year showed a substantial increase over January counts. This was due to increases in abundance of all species, with the influx of sea lions providing the greatest contrition. In 1980 the spring arrival of California sea lions increased the winter population by about 3,000 animals, By 1981 and 1982 the spring peak represented an increase of 8,000 to 9,000 in the population of this species.

The pinniped population on land in May 1961 and 1982 was stable at slightly more than 24,000 animals. California sea lions represented 55% of the total in 1901 and 47% of the total in 1982 (the maximum spring count of 13,586-was obtained in 1981). The decreased relative abundance of this species in 1982 was due both to a real decrease of about 2,000 animals in numbers counted and to an increase in numbers of other pinnipeds--the harbor seal population showed a 33% increase tc a maximum spring count of 6,941, and the northern elephant seal population, near its annual peak of numbers on land, increased 13% to a maximum spring count of 4,704. The apparent decrease in numbers of California sea lions in May counts was likely due to the two-week difference in the timing of the surveys. The survey conducted on 19 May 1981 was closer to the peak in numbers of California sea lions migrating in a southbound "wave" toward rookery islands in the Southern California Bight.

At Sea. In spring the overall mean density declined slightly from winter levels. The mean density recorded for March through May surveys was 0.14 animals/km^2 (±0.04 SE), corresponding to a pinniped population of 7,o?7 in the shelf and slope waters to the 2,0C0 m isobath, and a population of 21,472 animals for the entire surveyed area.

Mean monthly densities were higher in March and May than in April, reflecting the simultaneous decline in numbers of northern fur seals from a February peak and the increase in numbers of California sea lions building toward a May peak.

Northern fur seals were the predominant pinniped species on all surveys, with a declining relative abundance through the season from 82.8% of the sightings in March to 53.8% by May. California sea lions, the second most prevalent species on spring surveys, increased their share of the total from 11.6% in March to 41.5% in May.

In spring pinnipeds were seen with greatest frequency on transects in the south-central sector (36°20'N to 38°30'N). In this area, extending from Monterey Peninsula in the south to the latitude of Fort Ross in the north, we recorded 430 (55%) of the 794 pinnipeds sighted. Of these, 253 (58.8%) were recorded in offshore waters (beyond the 2,000 m isobath) and all were northern fur seals.

In the north-central sector (38°30'N to 40°30'N), which extends northward to Cape Mendocino, most pinnipeds were seen on transects over the offshore depth region, where a mean density of 0.22 animals/km^2 (±0.25 SD) was obtained; few animals were seen on the shelf.

In the northern sector (40°30'N to 42°00'N) few sightings were recorded in the sampled area (mean density of 0.05 animals/km^2 ±0.01 SE); northern fur seals in spring may have been farther offshore than the westward extent of our transect lines.

In the southern sector (34°20'N to 36°20'N) the predominance of California sea lions again influenced the distribution of density; mean density on the shelf (0.15 ±0.13 SD) exceeded that of either slope or offshore waters (0.11 ±0.08 SD and 0.11 ±0.09 SD, respectively).

The distribution of pinnipeds at sea in spring is shown in Figure 6 . The greatest densities appear in grid-cells offshore from Monterey Bay to Point Reyes. This area includes waters over the Monterey SeaValley, Guide and Pioneer seamounts, and Cordell Bank off of Point Reyes. Gther offshore areas of greater use by pinnipeds were the waters west of Point Arena and along the Mendocino Ridge. The above-described distribution was predominantly that of northern fur seals. California sea lions in spring were mostly over Santa Lucia Bank in the southern sector, and in Monterey Bay where squid were spawning.

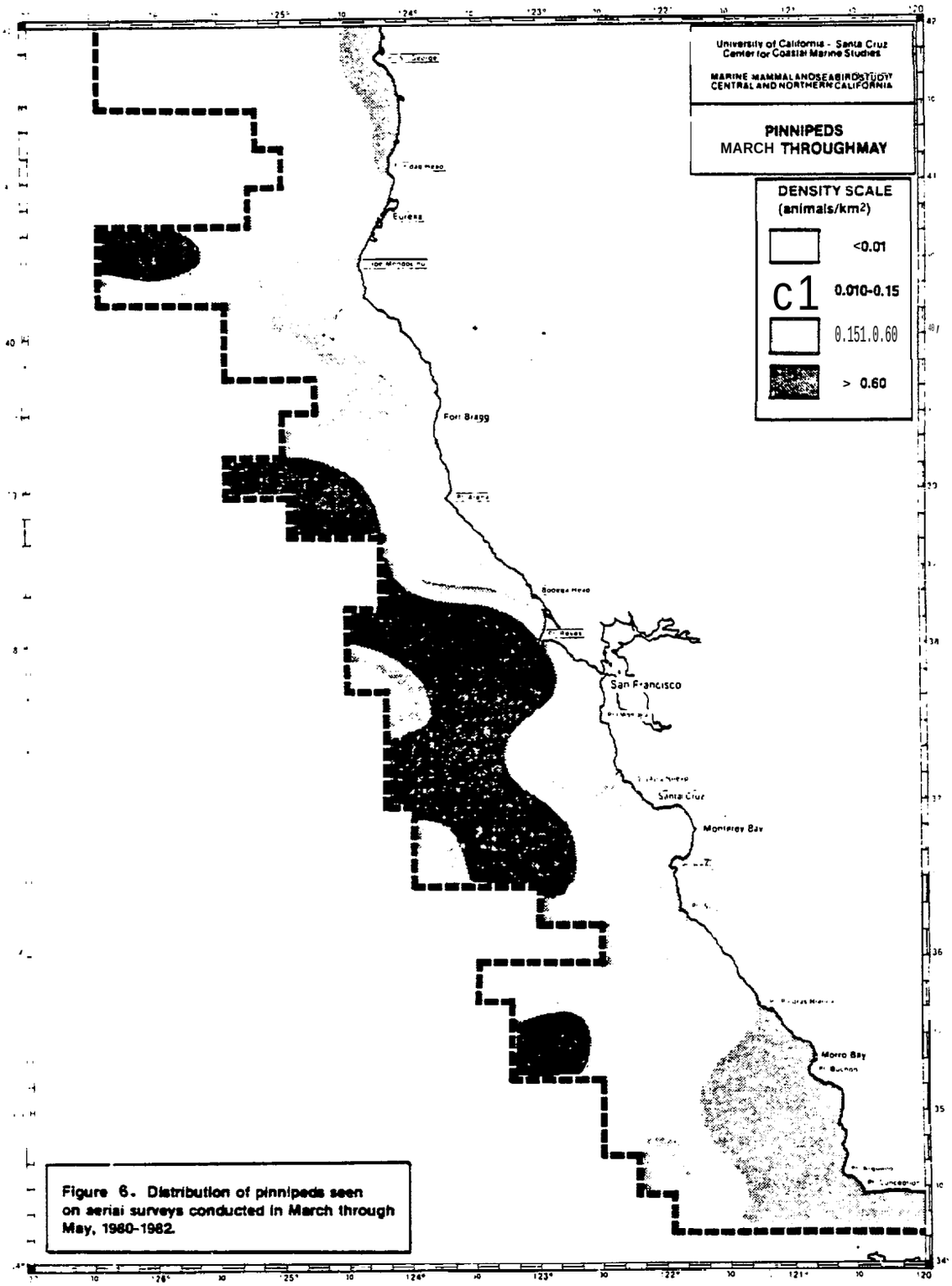


Figure 6. Distribution of pinnipeds seen on aerial surveys conducted in March through May, 1980-1982.

Summer

On Land. Several events of the summer season were monitored by the June-July surveys. Of greatest importance is the breeding *season* of the Steller (northern) sea lion. Pups are born at four locations in California: Año Nuevo Island, Southeast Farallon Island, Sugarloaf at Cape Mendocino, and Southwest Seal Rock on the St. George Reef. Summer is also the season of peak counts of harbor seals on land, as animals complete their annual molt. For the other two species, northern elephant seals and California sea lions, summer in central and northern California is generally considered to be the season of minimum use of traditional hauling grounds. This was certainly found to be true of northern elephant" seals; the entire population on land consisted of fewer than 1,000 adult males hauled-out for their annual molt , However, one of the most surprising findings of this survey series was seen in the results of summer censuses of California sea lions.

Within their breeding range in Mexican and southern California waters, California sea lions have an annual cycle of numbers on land dominated by a peak abundance in the breeding season and , in some locations, a smaller peak in winter or early spring, representing the return of a portion of the population to the area to feed upon seasonally abundant prey species. The summer peak is due both to the concentration of adults on land for breeding and to the birth of pups. In contrast to the pattern of occupation of rookery islands, the annual cycle of numbers on land in central and northern California is bimodal, with spring and autumn peaks reflecting the movement of adult and subadult males through the area prior to, and after, the summer breeding season. Until *very* recently, summer populations in central and northern California have been very small. But, as was evident beginning with the July 1981 census, the pattern of use of the central and northern California area by this species began to change in a most

interesting way. Great numbers of young California sea lions (yearling to about 3 years of age) entered the area in May, concurrent with the departure of adult and subadult males to the south. These animals comprised 90% or more of the enormous summer populations of California sea lions on Año Nuevo and Southeast Farallon islands. This unprecedented influx of young animals may reflect, in part, the pressure of growing populations in the Southern California Bight, but it also suggests a response to changes in food availability in different parts of the range. The steady increases in sea surface temperatures recorded along this coast since 1977 were compounded in 1982 by a severe "El Niño" event with markedly elevated water temperatures.

The numbers of pinnipeds counted in central and northern California on June-July surveys increased from 14,860 in 1990 to 18,632 in 1961 (an increase of 2S.4%), and to 25,201 in 1982 (an increase of 35.3%). Summer counts remained lower than those of spring in 1980 and 1981, but by 1982 growth in the populations of two species, the California sea lion and the harbor seal, resulted in a summer population actually greater than that of the previous spring (an increase of 4,2%). The steady growth in numbers of harbor seals in central and northern California may have been augmented by immigration into the area in 1982. Harbor seal *numbers* increased from 6,776 in 1980 to 7,562 in 1981 (an increase of 11.6%), and to 10,724 in 1982 (an increase of 41.8%). In 1982 harbor seals represented 42.6% of the pinniped population on land in the summer seaeon. California sea lions increased from 4,486 in 1900 to 7,935 in 1961 (an increase Of 76.9%), and to 11,209 in 1982 (an increase of 41.3%). In 1982 California sea lions represented 44.5% of the summer pinniped count, whilethe breeding population of Steller sea lions accounted fcr 9.7%.

At Sea. An overall mean density of 0.05 animals/km^2 (±0.03 SE) was obtained for the central and northern California area for Summer. This corresponds to an at-sea pinniped population of about 4,064 animals over the shelf and slope (to the 2,000 m isobath), and 5,579 for the entire area surveyed in the summer months. The mean density obtained in summer was the lowest of the year, due to the return of northern fur seals to their rookery islands in the Bering Sea and the return of California sea lions to their rookery islands in the Southern California Bight.

The California sea iion was the predominant species in summer months , representing 62.7% of all sightings. Northern fur seals represented 22.8% of all sightings and were the second most commonly sighted pinniped on transect surveys.

In summer the greatest pinniped densities were found in the southern sector (34°20'N to 36°20'N) and over the shelf. In the shelf depth region (0-199 m isobath) of the southern sector, a high summer mean density of 0.26 animals/km^2 (±0.34 SD) was obtained, The pinniped population in this area was comprised entirely of California sea lions, reflecting the proximity of the Santa Lucia Bank area to the rookery on San Miguel Island, 45 km south of Point Conception.

The distribution of pinnipeds at sea during the summer months is shown in Figure 7. Except for the great use of the Santa Lucia Bank as a foraging ground by California sea lions, and their use of the nearshore waters for northward or southward commutes, the distribution was patchy and cell-densities low. One area, however, deserves comment . California sea lions were seen in summer with great frequency in the vicinity of Año Nuevo Island, the most important hauling ground in central and northern California, and over Pioneer Canyon, 30 km to the northwest. The latter area emerged during this study as a major foraging ground for the pinnipeds associated with Año Nuevo Island, and perhaps Southeast Farallon Island as well.

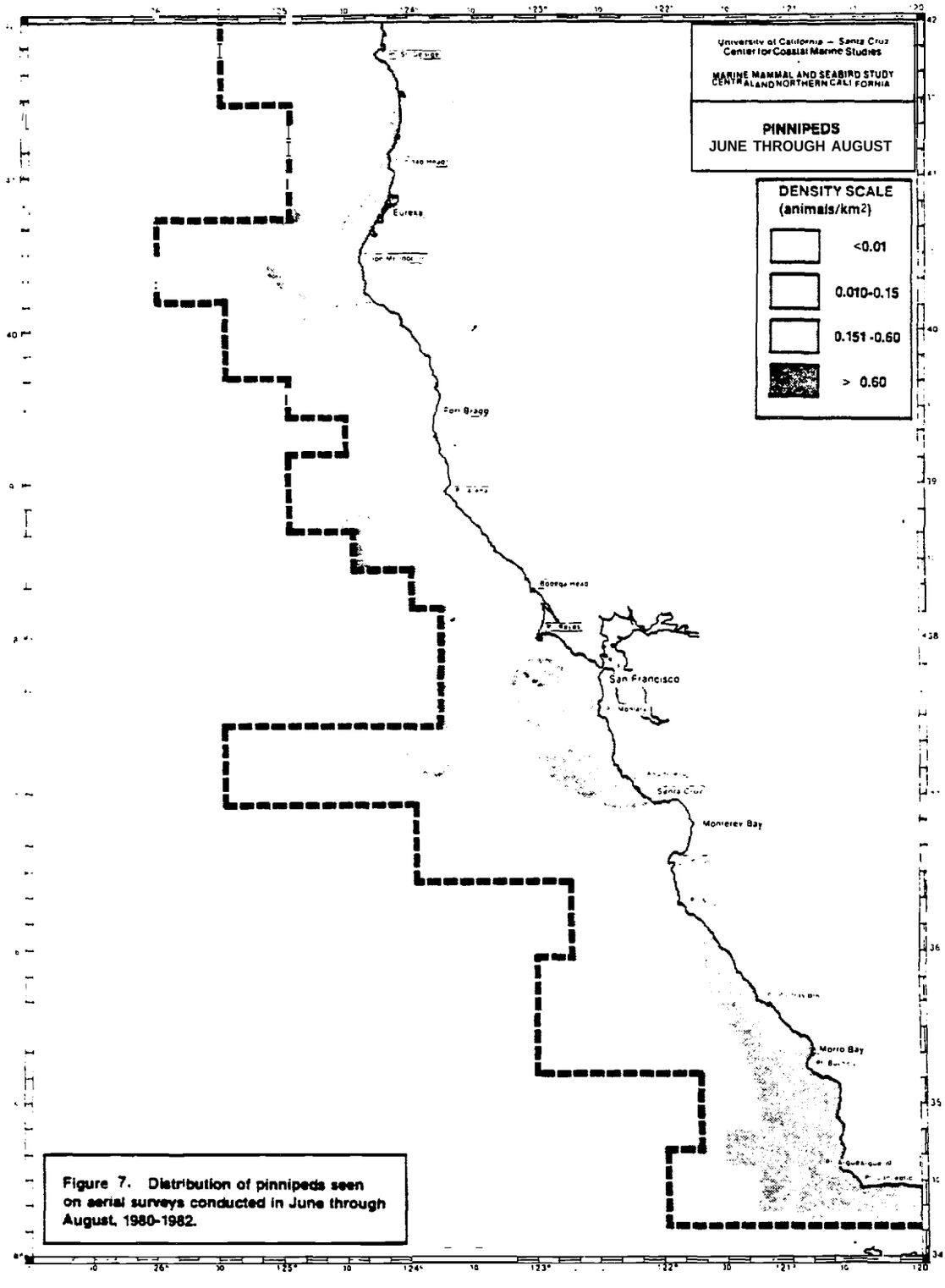


Figure 7. Distribution of pinnipeds seen on aerial surveys conducted in June through August, 1980-1982.

Autumn

On Land. The pinniped population of central and northern California reached its annual peak in autumn due to an influx of subadult and adult male California sea lions during that species' post-breeding season dispersal from the islands of the Southern California Bight. In each year, the autumn count showed a uniform increase over that of summer. The population on land in October 1982 was the largest recorded at 31,262 animals-a 24.1% increase over the summer count of 2S,201.

The magnitude of the autumn peak increased each year from 15,763 in October 1980 to 20,775 in September 1981 (an increase of 31.8%), and to 31,262 in October 19S2 (an increase of 50.5%). California sea lions accounted for 77.9% of the 1982 total, with a population of 24,348 hauled-out on land in central and northern California—more than double the summer count of this species. Harbor seals represented 11.5% of the autumn survey total in 1982 with a population of 3,599 counted on land. Harbor seal numbers were down from the maximum count of 10,724 in summer 1982.

Northern elephant seals, with a population of 2,026 yearlings and juveniles on land, represented 6.5% of the autumn survey total in 1982.

The autumn pinniped distribution is essentially the distribution of California sea lions, With the exception of the small autumn population of northern elephant seals, all other pinniped species were declining in numbers.

At Sea. The overall mean density of 0.21 animals/km^2 (±0.12 SE) obtained for the autumn months was the highest of the year, corresponding to an at-sea population of 12,796 for the shelf and slope (out to the 2,000 m isobath) and 14,310 for the entire surveyed area. The fact that this pinniped population is only two-thirds of that obtained for winter and spring, reflects the inshore distribution of sightings and the smaller extrapolation area.

The highest monthly mean density was obtained in September, as a wave of California sea lions entered the central and northern California area from the south. Not surprisingly, the greatest mean density was recorded in the shelf depth region of the southern sector (1.42 animals/km^2 ±1.73 SD). California sea lions represented 75.3% of all sightings in the central and northern California area and s4.1% of all animals seen on transect.

In autumn pinnipeds were found in greatest densities in the southern sector (34°20'N to 36°20'N), where a mean density of 0.56 animals/km^2 ±0.44 SD was obtained. High mean density of 1.42 animals/km^2 (±1.73 SD.) was found on the shelf, and moderate density was found on the slope (0.22 animals/km^2 ±0.20 SD). Moderate densities on the shelf and slope of about 0.26 animals/km^2 were also obtained for the south-central sector (36°20'N to 38°30'N). Very low densities were obtained for all offshore depth regions (beyond the 2,000 m isobath) in all sectors, reflecting the inshore distribution of the California sea lion, the predominant species in autumn.

Figure 8 shows the distribution of pinniped densities in autumn. Animals were widespread over the shelf, with little use of offshore waters. The greatest densities were found nearshore along the coast from Point Conception in the south to Monterey Bay. The pattern of use in autumn suggests a migratory pathway for California sea lions

along the coast from San Miguel Island to Monterey Bay, where animals began to be somewhat more dispersed at uniformly high density.

North of Monterey Bay, great use of two areas was recorded: the waters over the Pioneer Canyon off Point Montara, and the waters over Cordell Bank off Point Reyes. Both of these areas appear to be important feeding grounds for California sea lions.

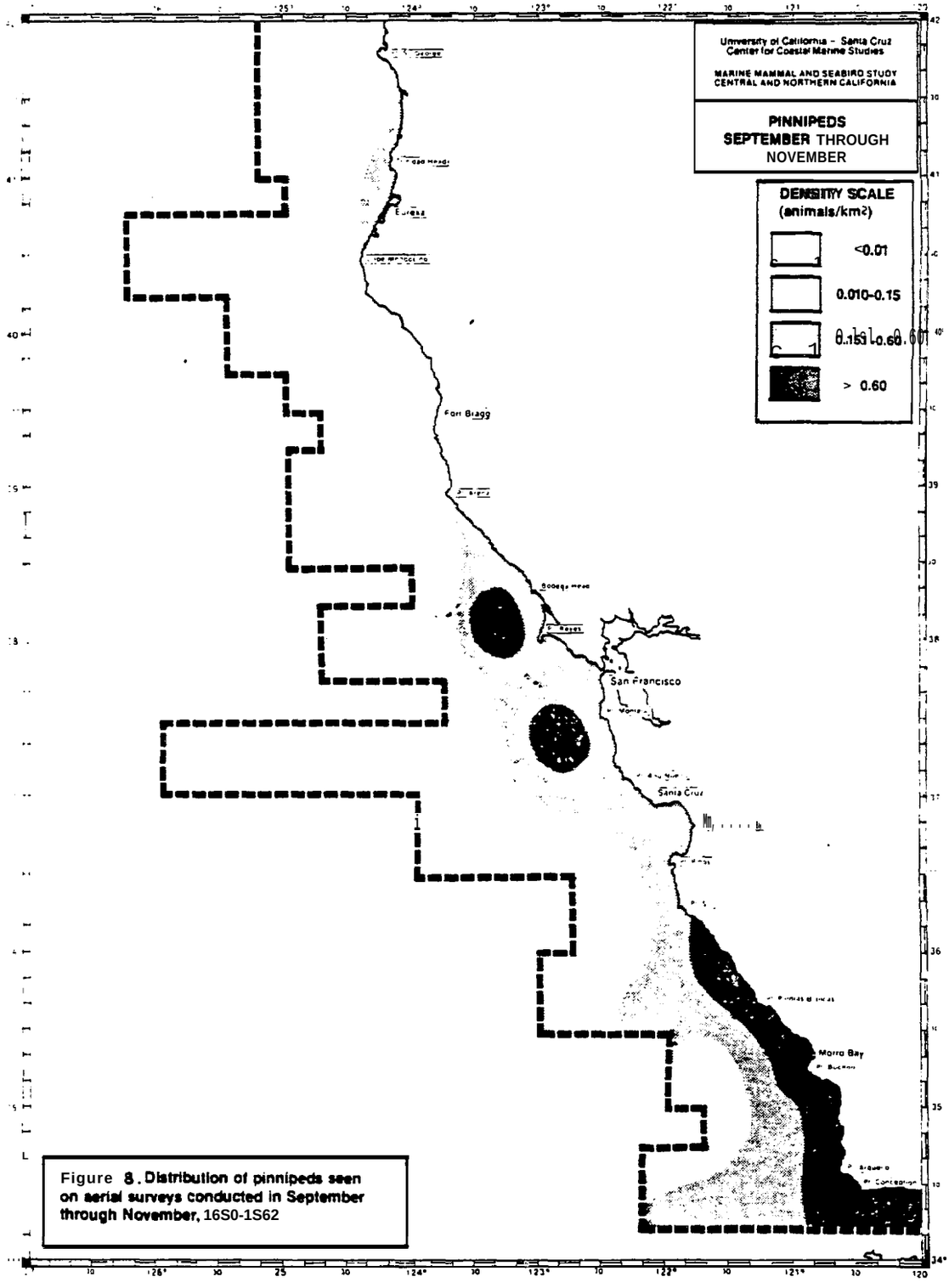


Figure 8. Distribution of pinnipeds seen on aerial surveys conducted in September through November, 16S0-1S62

FAUNAL SUMMARY: SEA OTTERS

As a result of the extensive harvest of sea otters for their pelts in the last century, the population in California was reduced to a small remnant found along the Big Sur coast. Since the 1930s, the population has increased in size and range; at present, sea otters are found from Point Conception (34°27'N) to Point Año Nuevo (37°07'N). The largest single count of sea otters, obtained in 1976 by the California Department of Fish and Game, was 1,565. Subsequent counts in 1979 and 19S2 have been lower, leading the U.S. Fish and Wildlife Semite (USFWS) to conclude that population growth has ceased, and population size may have actually declined. The present population estimate by USFWS is 1,300 independent sea otters (this figure does not include dependent pups). Because of its compressed range, relatively small population size, and vulnerability to oil *in* the environment, the population of sea otters in California is listed as "*threatened **, pursuant to the requirements of the Endangered Species Act of 1973.

Aerial surveys conducted as part of this study, and the USFWS shore-based census of 19S2, indicate that the intra-range distribution has changed substantially since 19S0, resulting in increased use of the Point Sur-to-Cypress Point area and decreased use of the coast from Point Piedras Blancas to Point Sur, and Monterey Bay. The redistribution of sea otters suggests that the population is at, or close to, the carrying capacity of its available habitat. The redistribution is also important from a management standpoint, because it argues for caution in the application of distributional data collected in past years to present decision-making needs.

Spring and summer aerial surveys of 1983 indicate that approximately 6.7% of the present population is found south of Point Buchon, with the large southernmost raft located off Shell Beach near Point San Luis. Few sea otters are found south of this area. The

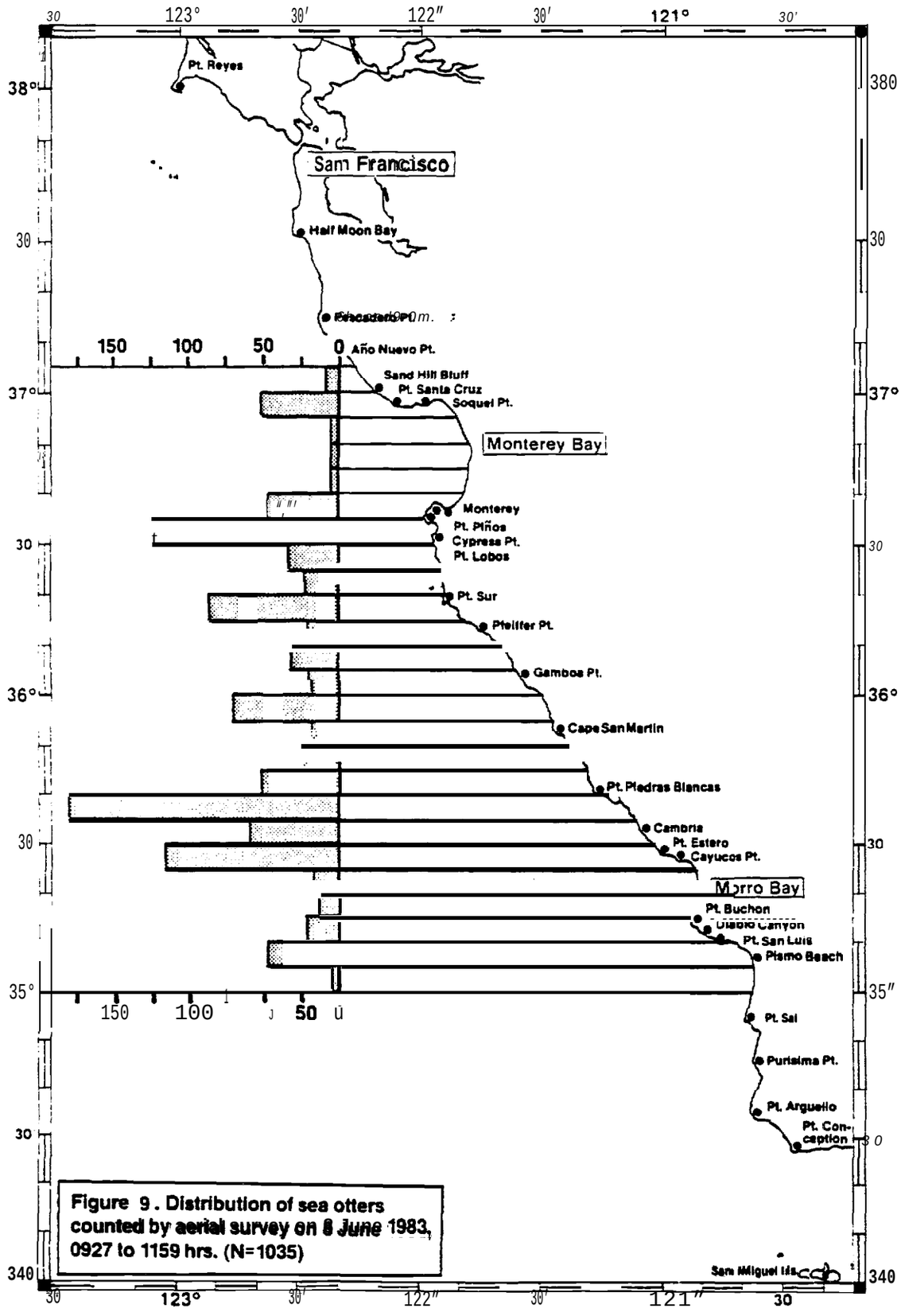


Figure 9. Distribution of sea otters counted by aerial survey on 8 June 1983, 0927 to 1159 hrs. (N=1035)

greatest concentration of sea otters is found near Cayucos Point, Cambria and San Simeon, and Point Piedras Blancas; the relative abundance from Point Buchon to Point Piedras Blancas was 35.9% of the total count. Prom Point Piedras Blancas north to Point Sur, 30.1% of the sea otters are found, and from Point Sur to Cypress Point 17.3% of the sea otters are found. Approximately 10% of the total population is found in, or north of Monterey Bay, with the largest rafts in this area found near the City of Monterey, off Sequel Point near Santa Cruz, and near Sandhill Bluff, six miles north of Santa *Cruz.* Figure 9 shows the general features of the present winter/spring distribution.

3b . FAUNAL SUMMARY: CETACEANS

Winter

Winter ranked as the season with the second highest mean cetacean density (0,95 animals/km^2 ±0 .94 SE)- and a mean cetacean biomass of (948.29 kg/km^2) on a statewide basis (Fig. 8). Approximately 29% of all cetaceans recorded year-round occur in this season.

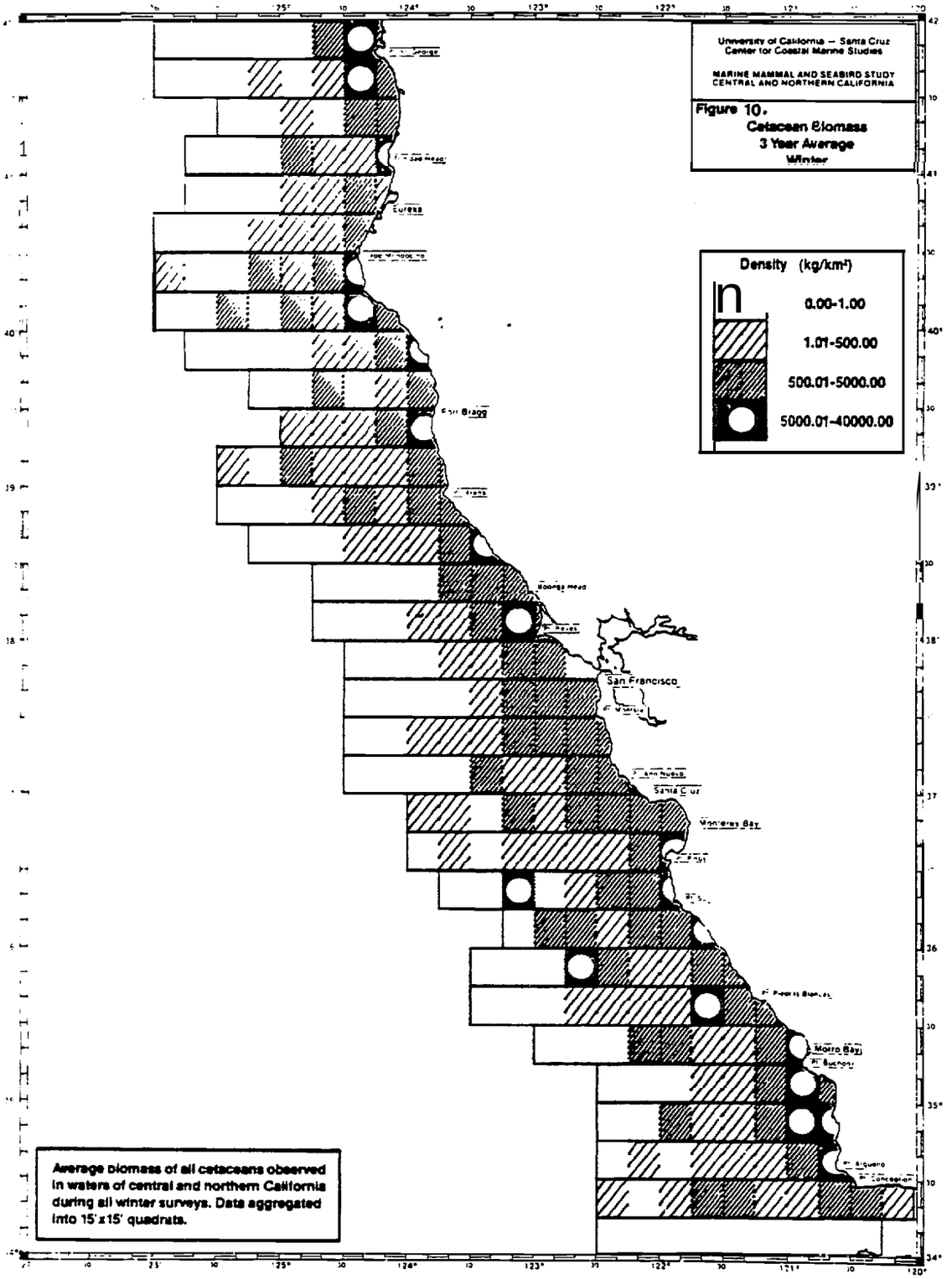
The spatial distribution of cetaceans was highly skewed, with 93% of the animals occurring in the southern half of the state from Point Reyes to Point Conception. Although there is an overall distributional bias of population favoring the southern sectors of the state in any season, this marked degree of imbalance is found only during winter and summer.

Over the continental slope (100-1,000 fro), the favored depth region for cetaceans in every season, statewide totals (67%) were depressed due to the paucity of animals in the northern sector.

The gray whale southern migration helped distribute biomass values nearly equally along the coastline north to south, and provided continental shelf waters (0-99 fm) with almost 70% of the total biomass (Fig. 10).

Three species in ranked order, northern right whale dolphin, Pacific white-sided dolphin, and grampus, accounted numerically for 91% of the cetaceans observed. '

The dominant species this season, northern right whale dolphin, represented 42% of the cetacean fauna observed. The species was completely missing from the most northern waters, and 90% of its numbers occurred from Point Reyes south to Point Conception.


University of California — Santa Cruz
Center for Coastal Marine Studies
MARINE MAMMAL AND SEABIRD STUDY
CENTRAL AND NORTHERN CALIFORNIA
Figure 10.
Cetacean Biomass
3 Year Average
Density (kg/km²)
0.00-1.00
1.01-500.00
500.01-5000.00
5000.01-40000.00
San Francisco
Monterey Bay
Morro Bay
Average biomass of all cetaceans observed in waters of central and northern California during all winter surveys. Data aggregated into 15'x15' quadrats.

This species, although predominantly distributed over the continental slope, tended to move closer to shore and shallower waters. A small percentage of the animals were found within the 100 fm isobath.

During winter the greatest number of schools of over 1,000 individuals and the greatest numbers of newborn northern right whale dolphins were observed.

The Pacific white-sided dolphin, the second most numerous cetacean seen in this season, demonstrated a general withdrawal from northern grounds, as well as a distributional shift offshore into deeper waters. Although seen from Point Reyes south to Point Conception, -pockets of greatest concentration existed within the Farallon basin and the Point Piedras Blancas/Morro Bay area.

Average school size of this species was reduced over autumn values by approximately 33% statewide. This statewide reduction of school size by one-third end a population reduction by two-thirds, when coupled to the very patchy distributional patterns, produces artificially reduced overall density values; however, within the areas of concentration, both the number of sightings and school size corresponded to, or exceeded, the annual highs seen in autumn.

Only two sightings of young-of-the-year and three examples of reproductive behavior were recorded during winter for Pacific white-sided dolphins, The paucity of such sightings is not surprising considering the season; indeed the two newborn animals *observed were* most anomalous.

Although grampus was the third mst prevalent cetacean (23%) in this season, it was the period of their greatest abundance. Average school size was double that of any other season, as well as total numbers; only sighting frequency fell below the annual mean.

Their distribution contracted to the southern half of the state from Point Montara to Point Conception. Areas of highest density were Point Pines to Point Sur and adjacent to Point Conception. Secondary loci of moderate to high density occurred from Point Montara to Santa Cruz and west of Morro Bay, The few small schools of grampus found north of Cape Mendocino in autumn had coalesced, by winter, into fewer schools of greater numbers off Trinidad Head, Point St. George and, to a lesser extent, off Cape Mendocino.

Along with their southerly withdrawal there was a generalized inshore movement. Although still predominately located over the continental slope, grampus schools tended to be found clustered in shallower waters from 100 to 500 *fm* deep. This selection for nearshore waters was in marked contrast to their spring distribution across the 1,000 fm isobath.

Juvenile grampus may be found in any season, but the greatest percentage are observed during winter, One large school of 4,000 animals recorded off Monterey Bay in February contained 200 young animals.

Dan's porpoises, in winter, became a minor element of the statewide cetacean fauna, representing only 1% of the animals seen. This was the season of lowest overall Dan's porpoise numbers, reduced by almost two-thirds over peak autumn levels. Their distribution becomes more homogeneous in winter, with animals leaving the high density areas in the north and spreading into the southern portions of the study area. These animals were predominately found over the slope (79%) and in lesser percentages (13% and 8%) on the shelf and beyond the 1,000 fm isobath. As with grampus, Dall's porpoises tended to occupy the shallower waters of the slope during winter, compared to their congregation in autumn over the deeper regions along the 1,000 fm isobath.

Harbor porpoises were a small but consistent percentage of the total cetacean fauna. Numerically, winter ranked as their third most populous season. Distribution, unlike the species previously discussed, was heavily biased toward the northern portions of the state, with 88% north of Monterey Bay, The waters around Cape Mendocino accounted for the majority (54%) of the animals recorded statewide, The nearshore shallows, within 0.5 nm of the beach along open coastline, marked their preferred habitat. Only 5% of these animals were more than 5 nm from the beach and none were observed in water deeper than 125 fm.

Sperm whales, always present offshore in some numbers, reached their annual peak during winter. The majority were found well offshore from Point Pines to Point Conception. A second concentration of animals occurred between Point Arena and Cape Mendocino but, in this area, distribution clustered along the 1,000 fm isobath rather than farther offshore.

The remaining species of the cetacean fauna found along the California coast contributed, to an insignificant degree, to total numbers, biomass, or density values during this season. Small numbers of large whales were recorded, but no discernible patterns of occupancy or movement were revealed. Killer whales might be an exception, since they were found only over the slope and predominately in the northern half of the state, indicating a slight inshore movement during this season.

Winter is one of the more difficult seasons to analyze in a generalized manner. Total numbers of animals in each of the three winters showed a marked decrease at a greater rate than that expressed by annual totals. Winter in year I of the study was the most populous season, and by year III it ranked fourth. It is felt that the overall warming trends experienced, particularly in the last two years, have

affected both the numbers of animals and species distribution in central and northern California,

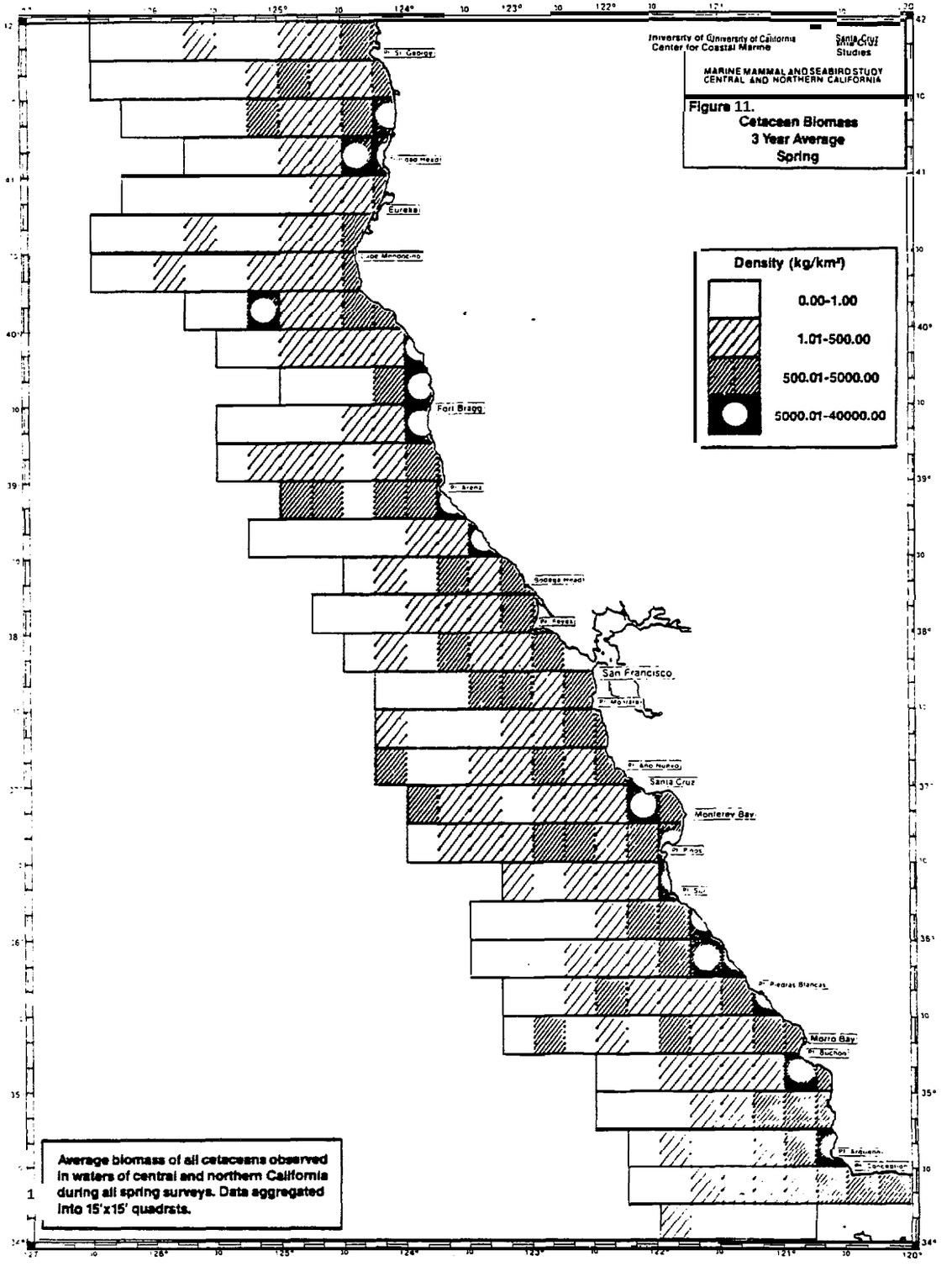
Spring

The cetacean population in spring totaled 23,899 individual animals, with a statewide mean density of 0.54 animals/km^2 (±0.41 *SE)* and a mean biomass of 611.67 kg/km^2. On an annual basis, spring ranked third in total seasonal abundance and biomass and fourth in mean density.

Distribution of the species by depth region accounted for less than 7% of the population in shelf waters, 86% on the slope, and slightly more than 7% offshore. The shelf supported more than 75% and the slope 21% of the seasonal biomass. Migrating gray whales were primarily responsible for the high biomass percentage values in nearshore waters.

The general north-south distribution of cetaceans in the study area is shown *in* Figure 11. While precise sighting locations are not indicated on the map, *areas* of significant biomass density are delineated. Grid cells with the highest biomass values are adjacent to the coastline and, as mentioned above, represent the gray whale seasonal passage through the area.

Moderately high species diversity occurred in spring, with 13 of a possible 21 species seen in this season. Three species of toothed cetaceans predominated in the OCS waters: northern right whale dolphins, Pacific white-sided dolphins, and grampus. These species are known for their gregarious nature, Two other toothed species, Dan's and harbor porpoises, were present in fair numbers, but not in large or concentrated schools. Sperm, killer, and Baird's beaked whales represented the medium to large toothed cetaceans seen in


University of California Santa Cruz
Center for Coastal Marine Studies
MARINE MAMMAL AND SEABIRD STUDY
CENTRAL AND NORTHERN CALIFORNIA
Figure 11.
Cetacean Biomass
3 Year Average
Spring
Density (kg/km²)
0.00-1.00
1.01-500.00
500.01-5000.00
5000.01-40000.00
Fort Bragg
San Francisco
Santa Cruz
Monterey Bay
Morro Bay
Average biomass of all cetaceans observed in waters of central and northern California during all spring surveys. Data aggregated into 15'x15' quadrats.

spring. Gray, humpback, and minke whales were the only baleen species seen in the season.

Northern right whale dolphins were the most abundant species in spring, but the population exhibited a decline in number as the season progressed. Approximately 56% of these animals were sighted in March, 43% in April, and less than 1% in May. Sightings were distributed throughout the survey area, with waters of the southern half supporting approximately 25% more individual animals than the northern half. Only one school of more than 1,000 animals was observed in this season. Immature northern right whale dolphins totaled more than 200 individuals counted in seven sightings. One hundred of these were within the largest school of northern right whale dolphins sighted during the three-year survey, recorded off Trinidad Head in April 1980. The species tended to select the continental slope for maximum occupancy in spring, where over 90% of sightings and individuals were seen. Less than 10% occurred offshore and none over the shelf.

Pacific white-sided dolphins were the second most abundant species sighted on spring surveys. Pacific white-sided dolphins displayed a fairly uniform distribution pattern along the entire north-south range of the study area. More than 94% of these animals occupied waters of the continental slope. In spring, April was the month of their greatest abundance, when approximately 59% of the animals were sighted. March had 43%, and only 2% of the animals were seen in May. Schools sizes in spring were relatively small for this species, with more than one-half of the groups containing less than 9 animals. Only one school exceeded 1,000 individuals. No juvenile or newborn animals were observed in the 95 sightings recorded in this period.

Grampus, the third most numerous species recorded in spring, made up 19% of the cetacean population with more than 4,4oo individuals counted during this season. This species was represented in all

portions of the study area, but 58% of the sightings were between Point Conception and Monterey Bay. Depth selection by grampus centered on the continental slope, where approximately 82% of the animals were observed. Only a small number (2%) were in shelf waters, and slightly over 16% were offshore outside the 1,000 fm isobath. School sizes in spring were small to moderate and, with the exception of a single group of 900 animals, 7"5% of-sightings were of 20 animals or less. Grampus schools were often observed intermixed with other cetacean species. These interspecific associations had no seasonal bias and were recorded in all seasons.

Gray whales, during spring, accounted for approximately 4% of the cetacean seasonal total. The majority of individuals observed in this time period were migrating northward. The animals tended to transit the central and northern California coast in waters of the continental shelf, where over 90% of sightings were made. As a result of this nearshore travel, biomass in the area was correspondingly high. Many of the northbound migrants were accompanied by their newborn or young calves. About S5% of the young animals were observed in spring months. Approximately 20% of the juvenile gray whale sightings were recorded in March, and 65% in the months of April and May,

Dan's porpoises were the fifth most abundant species sight ed (>2%) in spring, but it was numerically their third lowest period. The animals occupied all portions of the study area, with about 60% utilizing waters of the southern and south-central sectors. However, within these sectors two notable voids in distribution were apparent: *one* between Point Buchon and Point Pines, and the other inside Monterey Bay.

Harbor porpoises were ranked as the sixth most prevalent species in spring but contributed less than 2% to the seasonal fauna totals. Since they are primarily solitary animals, their groups rarely exceed 3 to 4 individuals. In spring their north-south distribution was

somewhat spotty, with a small scattering of animals in the southern portion of the study area centering around Morro Bay. Based on our observations during this survey, these sightings may constipate a small subpopulation of the species in the coastal portion of the southern sector. Progressing northward to the vicinity of Monterey Bay, more significant numbers of animals began to appear. Except for two or three isolated areas between Monterey Bay and Cape Mendocino, scattered sightings were made with increasing frequency all the way to the California/Oregon border. The coastal area north of Cape Mendocino was occupied, to a major extent, almost year-round.

Harbor porpoises are a nearshore inhabitant; relatively few sightings were made beyond the boundaries of the continental shelf. More than 98% of these animals were observed less than 0.5 nm offshore. The species occupied" not only protected waters of bays and harbors, but our observations indicate that they are generally prevalent along open unprotected coastal areas as well.

Several other cetacean species were sighted throughout the spring -period: sperm, killer, humpback, and minke whales, Baird's beaked whales, *Kogia* sp., and pilot whales. With the exception of sperm whales, Baird's beaked whales, and pilot whales, total numbers of the other species listed above were insignificant.

The sperm whales selected to occupy slope and offshore waters in about equal proportions. Most spring sightings were in the northern and north-central sectors, in waters averaging 900 fm *or* greater. Pods of this species rangedinnumber from as many as 10 individuals down to scattered solitary animals.

Baird's beaked whale was the most abundant Ziphiid in OCS waters of central and northern California during the three-year survey. Two sightings occurred in spring totaling 11 individuals. The sites of the two groups were widely separated on the coast, with

one observed close to shore northwest of Port Bragg and the other farther offshore west of Point Piedras Blancas. The species apparently moves inshore to the continental slope in periods of warming water,

Pilot whales, while uncommon in northern and central California waters, were sighted twice in spring. Both sightings were in fairly deep water west of Point Conception. The two schools consisted of 20 and 8 individuals each, with the larger containing 4 juvenile animals.

Summer

The overall mean cetacean density in summer was 0.55 animals/km^2 (±0.40 SE), resulting in a seasonal ranking of third behind autumn and winter season. In terms of total abundance and biomass, the period ranked fourth . Biomass values were equivalent to 382.74 kg/km^2; total animal abundance was equal to 16% of all cetaceans.

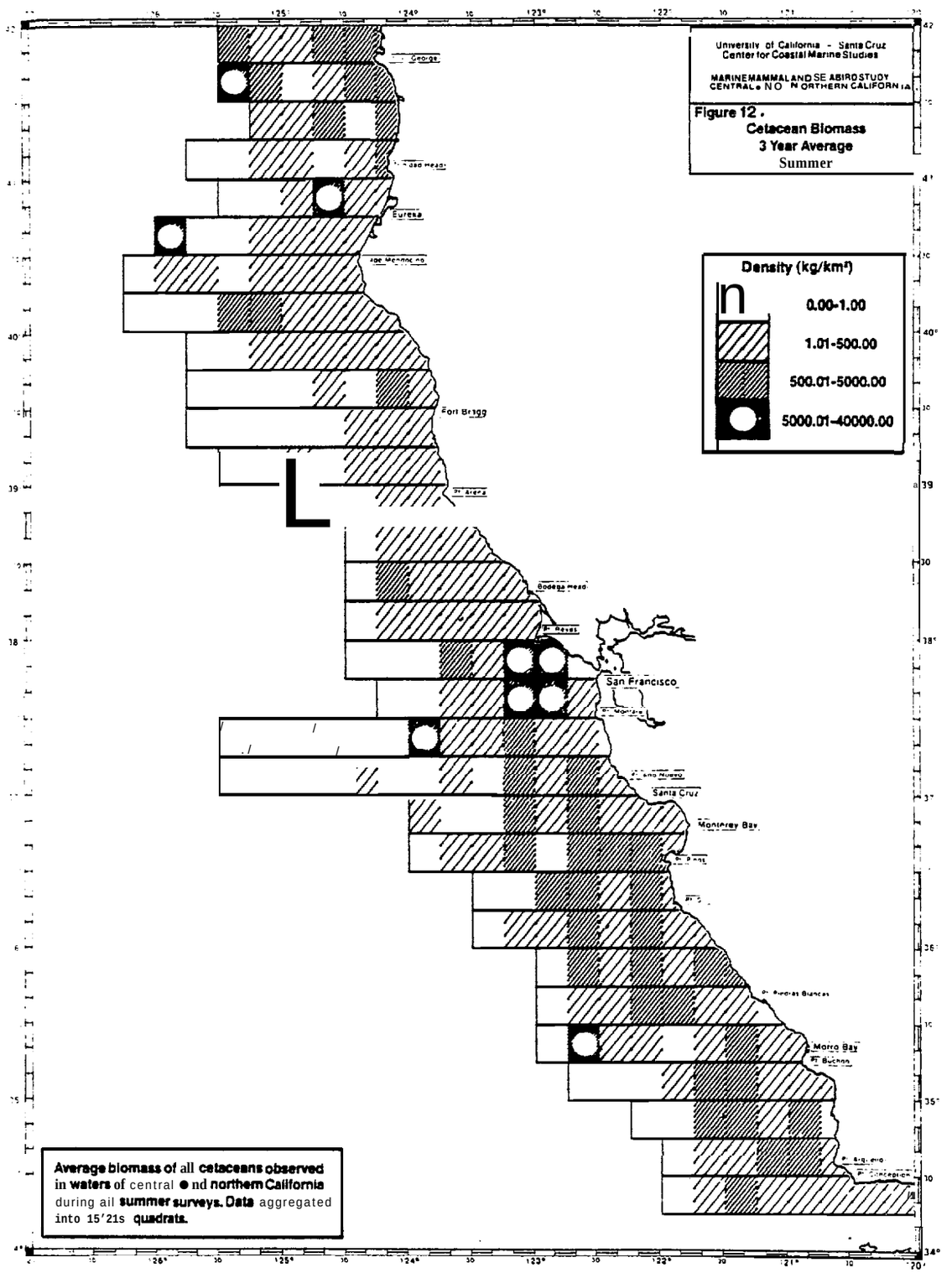
Distribution of the population was biased in favor of the southern half of the study area, where more than 93% of the animals were recorded. A similar distribution pattern, favoring the southern sectors, also occurred in the winter period (93%).

The continental slope supported almost 64% of the summer cetacean population, a decrease of 22% from spring. Although the shelf also supported fewer animals when compared to spring, the difference was less than 1%. Summer had the highest seasonal percentage of animals in the offshore region, which supported 30% of the population. Biomass percentages' in the three depth regions varied from 35% on the shelf, 47% on the slope, to 17% offshore. These percentages differ markedly from those recorded in spring and winter, but are similar to the values recorded in autumn. Migrating gray whales traversing ' coastal waters were responsible for elevating shelf biomass values in

both spring and winter. Summer biomass densities are displayed in Figure 12.

Species diversity in this period increased slightly over spring months, with representatives of 15 different toothed and baleen species" sighted. The most abundant cetaceans observed were Pacific white-sided dolphins, northern right whale dolphins, grampus, and Dan's porpoises. Other species, while not seen in great volume, were present in sufficient number to impact seasonal density and biomass values . These less numerous species included harbor porpoises, humpback, sperm, gray, fin, blue, and killer whales.

The Pacific white-sided dolphin was the most frequently encountered cetacean in California's OCS in the three-year survey. Summer, for this species, was their third most abundant season after autumn and winter, and they represented 41% of all cetaceans counted in this period. More than 90% of the Pacific white-sided dolphins were recorded in the southern and south-central sectors of the study area. Only two sightings were recorded north of Cape Mendocino (40°30'N). Monthly animal counts within the season varied somewhat, with the largest percentage occurring in July (48%). The lowest percentage of animals (22%) was recorded in June, with an increase to 30% in August. The continental slope, where 66% of these animals were recorded, "was the favored depth region for this species in summer. Only 8% were in water depths of less than 100 fm and 26% selected the offshore region, School sizes paralleled those observed in spring, with more than 50% of the pods containing less than 10 animals. Juvenile Pacific white-sided dolphins were sighted five times in summer and totaled 13 individuals. Sites of schools holding the young animals were bounded on the south by Point Conception and on the north by Bodega Head,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MARINE MAMMAL AND SEABIRD STUDY
CENTRAL AND NORTHERN CALIFORNIA
Figure 12.
Cetacean Biomass
3 Year Average
Summer
Density (kg/km²)
0.00-1.00
1.01-500.00
500.01-5000.00
5000.01-40000.00
Fort Bragg
San Francisco
Santa Cruz
Monterey Bay
Morro Bay
Average biomass of all cetaceans observed in waters of central and northern California during all summer surveys. Data aggregated into 15'21s quadrats.

Northern right whale dolphins comprised approximately 35% of the summer cetacean population. This was the season of least abundance for the species, when compared to the other three periods. The animals were not observed in waters north of cape Mendocino (40°30'N). Ninety-nine percent (99%) of the animals and 86% of sightings were south of 38°30'N. A progressive decline in percentages of abundance occurred, with a high of 58% in June to a low of 18% in August. A mean group size of 119 animals per sighting was the smallest seasonal average, when compared to other periods. The largest school recorded held 900 individuals. The species, following a fairly consistent trend, selected the continental slope as a preferred occupancy site. Approximately 64% of the animals were observed on the slope, 35% offshore, and less than 1% on the shelf. Juvenile northern right whale dolphins were "sighted five times in this period. All schools with young were located between Point Buchon and Bodega Head.

Grampus accounted for 17% of cetacean totals, making it the third most prevalent species in summer, The species was least abundant in this period when compared to the other three seasons. They declined by approximately one-third from spring levels, increased by one-and-one-half times in autumn, and doubled in winter. Although the species was widely scattered in OCS waters, approximately 94% of the animals and 95'% of sightings were south of Cape Mendocino. very few animals were in nearshore waters of less than 100 fm in depth. Seventy-five percent (75%) selected the slope and 24? occupied the offshore region. The largest school of grampus seen in summer was composed of 300 animals . Sixty-nine percent (69%) of the remaining pods consisted of 20 or fewer individuals.

Dall's porpoises ranked fourth numerically and represented slightly more than 3% of the season's cetacean fauna. Summer, for these animals, was a period of moderate abundance, and the season ranked second when compared to their peak in autumn. The species was distributed to some degree throughout the entire north-south range of

the study area, but waters south of Cape Mendocino (40 °30'N) held the most animals (94%). Water depth preference continued (as observed in spring) to be over the slope, where 59% of the animals *were* encountered. A slight inshore movement by a portion of the population was noted in this period, when 26% occupied waters of less than 100 fm in depth. The shelf area between Point Año Nuevo and Point Arena was often frequented by this species. Eleven juvenile Dan's porpoises were sighted in summer months: two in June, six in July, and three in August . The groups containing young were small, widely scattered, and almost exclusively selected waters of the slope for occupancy.

Harbor porpoises numerically reached their lowest annual level in summer. Sightings were widely dispersed from north to south in the nearshore waters of the continental shelf. Significant concentrations of the species occurred only in waters north of 39°00'N, where 68% of the animals were recorded. Average group sizes were characteristically low for the species, with a seasonal mean of 2.5 animals per sighting. There was a range in pod size from 1 to 7 animals. The sole exception to the above was a single sighting of 37 individuals near Fort Bragg, in August of year I. Juvenile animals were observed four times in the season, but no geographical bias was noted in the sighting locations, which were scattered between Point Buchon and Point St. George.

Predominant baleen species recorded in summer included humpback, gray, fin, and blue whales. This was the second most abundant period for humpback whales, surpassed only by autumn. The species tended to aggregate in the Farallon basin and/or adjacent waters. Abundance levels increased monthly from June to August, reaching an annual peak in the period August through November.

Gray whales were at their lowest annual numerical level in summer, with sightings of essentially "resident" animals, Some portion of this migratory species selectively occupy predictable areas for "summering". These areas include the Farallon Islands, the

Klamath River mouth, the Big Lagoon/Patricks Point area, and the St. George Reef off Crescent City.

Fin and blue whales were both present in summer, in contrast to spring when neither species was observed. Sightings of these two species increased in frequency as the season progressed, reaching an annual high in autumn. Waters of the shelf and slope in the southern and south-central sectors were areas of primary occupancy by the animals. Subadult and young-of-the-year individuals were sighted only in autumn.

Sperm, killer, Baird's beaked and Cuvier's beaked whales collectively represented only 0.5% of the seasonal cetacean total. Sperm whales were the most abundant of the group. The species was encountered in all seasons and exhibited an affinity for pelagic waters at or just beyond the 1,000 fm isobath. Pod sizes, several in excess of 10 animals, were highest in summer for this species and included the largest group (24 animals) seen in the three-year survey. Spring, summer, and autumn observations were predominantly in the northern half of the study area, in contrast to winter sightings which were scattered in the southern portion.

Killer whales, Baird's beaked and Cuvier's beaked whales exhibited a mixed pattern of occupancy in summer, with killer whales tending to select waters of the northern half of the state. They generally confined themselves to the continental slope and shelf, and pods seldom exceeded 3 to 4 individuals each. Juvenile killer whales were seen in every season including summer. Sexual activity was observed only in autumn (October).

Sightings of two Ziphiids, Baird's and Cuvier's beaked whales, occurred most frequently in summer and autumn. Distribution of both species favored the southern half of the study area in summer months. Baird's beaked whales occupied slope waters in this period, while

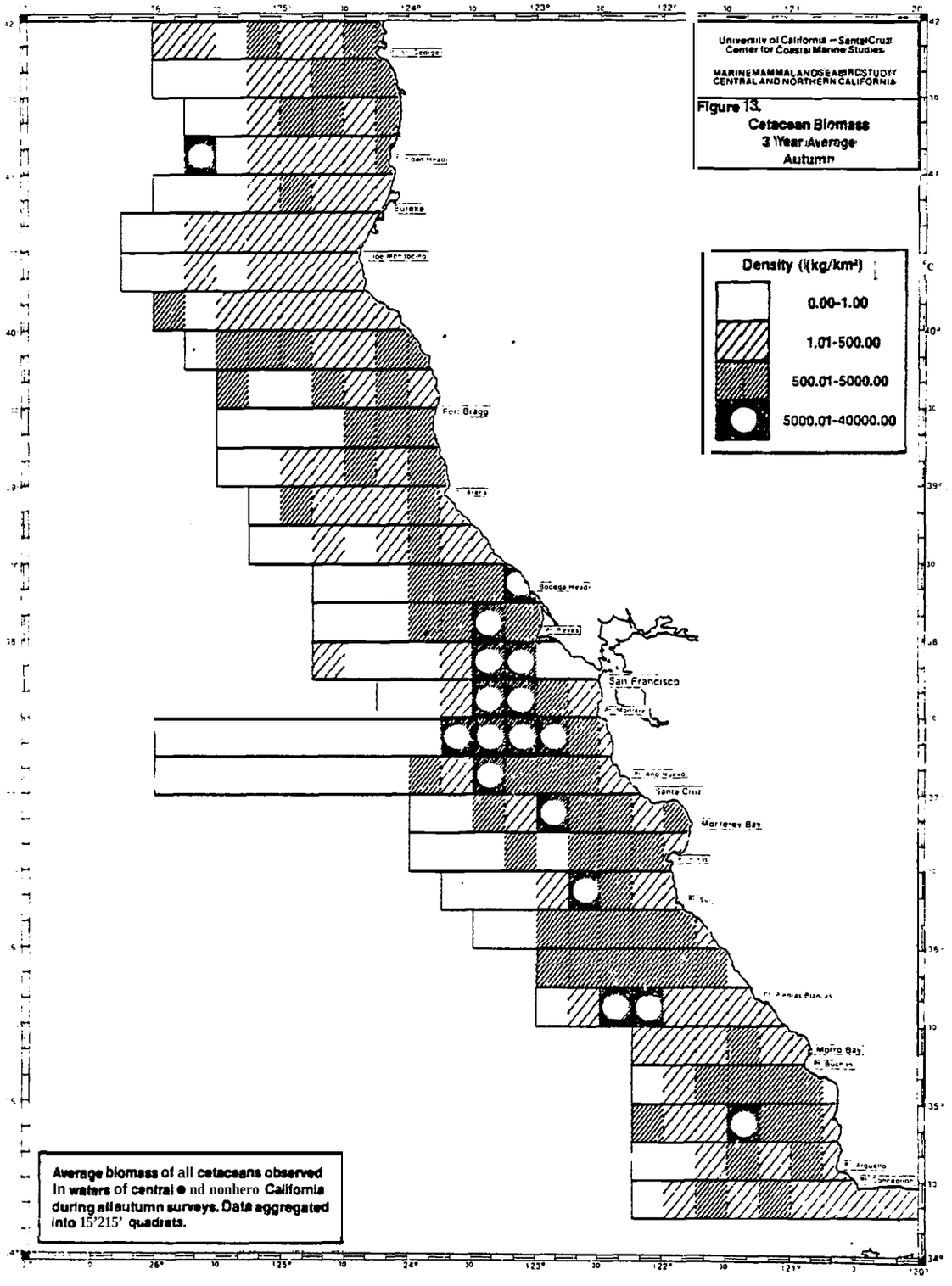
Cuvier's beaked whales selected waters beyond the 1,000 fm isobath. No immature animals of either species were observed in summer.

Autumn

Autumn ranked first as the most populous season, with a mean cetacean density of 1.08 animals/km^2 (±1.24 SE) (Fig. 13). This was the period of greatest animal dispersion throughout the study area, with no region or depth regime lacking occupancy. When compared to the previous season, animal numbers and density values increased over the slope, in particular within the central portion of the state between Point Piedras Blancas and Cape Mendocino. Biomass values shifted in a similar manner, due primarily to the annual influx of large whales into the waters of the central portion of the state and, more specifically, into the Farallon basin. Animal numbers in the usually sparsely occupied northern sector increased tenfold over the summer season, mainly on the continental slope, with some small increase (<10%) over the shelf.

Overall animal numbers increased almost 110% over the summer populations . Of the seventeen species encountered statewide during this season, ten reached their annual maximums. Pacific white-sided dolphins reached their highest annual numbers in autumn, almost three "times greater than the summer average. Northern right whale dolphins ranked second numerically in this season, increasing by approximately 50% over summer numbers. Grampus increased by 60% and ranked third in seasonal numbers.

The massive influx of Pacific white-sided dolphins into the study area was marked by substantial increases of numbers over the slope, while actual counts over shelf and offshore waters were almost identical to summer numbers. Sightings increased by a factor of 27 times north of Point Reyes, again mainly over the mid-depth aspects of the slope.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MARINE MAMMAL AND SEABIRD STUDY
CENTRAL AND NORTHERN CALIFORNIA
Figure 13.
Cetacean Biomass
3 Year Average
Autumn
Density (i(kg/km²)
0.00-1.00
1.01-500.00
500.01-5000.00
5000.01-40000.00
Fort Bragg
San Francisco
Santa Cruz
Monterey Bay
Morro Bay
Average biomass of all cetaceans observed in waters of central and nonhero California during all autumn surveys. Data aggregated into 15'215' quadrats.

Statewide distribution was broader than in any other season, but even with substantial increases in the north, the southern half of the study area contained the majority of the animals (83%). Areas of highest density (>4 animals/km^2) were to be found at three locations: Fort Bragg to Bodega Head, Point Montara to Santa Cruz, and Point Buchon to Point Conception. Statewide density averages were the highest for any season and average school sizes also increased, doubling summer values. These larger schools, however, were found predominantly over the slope and, in many cases, represented the increased population found in the northern half of the state.

These observations raise the possibility that this autumn influx of Pacific white-sided dolphins represents an identifiable subpopulation arriving in coastal waters from much farther offshore. Since actual statewide counts over the other three seasons vary less than 7%, it is likely that we are seeing two elements of this overall population: one "resident'* portion to be found year-round, although shifting in distribution north-south on a seasonal basis, and a second much larger "visiting" population which moves on an inshore-offshore axis into coastal waters in autumn.

Northern right whale dolphins increased in numbers and extended their range during autumn. Distribution, although broader, demonstrated two distinct voids: one from cape Mendocino to Fort Bragg, and the other from Point Arena to Point Año Nuevo. Approximately 36% of the animals were fcund in northern waters, a marked increase over the less than 1% seen there in the previous season.

There was also a bimodal shift in distribution, with a large reduction of both numbers and overall percentage of occupancy away from the slope and toward the shelf and offshore waters. The most

dramatic change was their movement offshore and selection for water depths Considerably deeper than 1,000 fm — a phenomenon completely lacking the remainder of the year.

Late autumn appears to be the beginning of the calving season, with 8% of the annual crop noted at this time, followed by the largest annual newborn increment (70% of observed newborns) in winter. Sexual behavior was frequently observed in large schools containing newborn animals, but never recorded in smaller schools (<30 animals) and infrequently in groups lacking newborns.

Grampus, to a lesser degree, demonstrated changes in population numbers and distribution, similar tc the northern right whale dolphin and Pacific white-sided dolphin. An overall increase in numbers of about 60%, and modest movement into the northernmost portions of the study area, generally paralleled the behavior of the other two major species. However, unlike the other species, grampus moved primarily into shelf waters and showed marked reduction in offshore occupancy. While numbers of sightings over the slope increased, the percentage of total population utilizing these waters remained constant from summer into autumn. The most significant increases (>95%) were found in the coastal shallows from Santa Cruz south to Point Conception.

Population numbers and average school size, for Dan's porpoises, reached annual maximum values in this season. This species generally withdrew from the southernmost portions of the study area, and realigned its distribution from shore seaward. In comparison with summer figures, the shelf and slope waters lost approximately 10% of the overall population, with an attendant increase of occupancy offshore (>1,000fm).

This shift northward and offshore was more pronounced during the third year of the study. Average school size, always at maximum annual values in autumn, steadily dropped in year III to 3.1 animals

per school , in contrast to 4,6 - 5,6 recorded in prior years. It is felt that the general seasonal movement into cooler waters seen in autumn was exacerbated by the overall El Niño conditions found in the third study year. Also, the reduction in school size and the widely dispersed pattern of distribution might be a feeding strategy to compensate for reductions in prey availability due, again, to the widespread elevation of sea surface temperatures.

The harbor porpoise, never an abundant species, reached its population and average school size maxima this season. Distribution was 99% over shelf waters, with 74% in the northern portion of the state, north of Point Arena. A small consistent subpopulation was found scattered in the south, ranging between Point Buchon and Point Conception. This isolated group of animals infrequently exceeded 5% of the state's total sightings or population.

All of the major large whales, with the exception of gray and sperm whales, achieved their maximum numbers during this season, Blue, fin, and humpback whales (Fig.is), although considered migratory, spent considerable time in central California, particularly in the Farallon basin. Killer whales were found most frequently north of Point Arena and across the slope. Baird's beaked whales favored the warmest seasonal waters, occurring in greatest numbers between Point Arena and cape Mendocino in the north, and between Point Sur and Point Buchon in the south. Minke and sei whales, never common, were both recorded during autumn.

3c. FAUNAL SUMMARY: Seabirds

The seabird fauna of central and northern California OCS is large, diverse, and visually conspicuous from the shoreline to waters hundreds of kilometers at sea. Yet, despite the presence of major human population centers in the area, several major aspects of seabird occurrence and abundance were poorly known until recently. This was especially true with regard to a number of familiar and abundant species. Prior to our study, the published literature provided an indication of the species present in each season, general trends of abundance from north to south and occasionally with distance from shore, and substantial information about colony sizes and locations (reviewed in Ainley 1976, Sowls et al. 1980). The nesting fauna of the Farallon Islands was well studied and the occurrence of seabirds on Monterey Bay had been considered in some detail (Ainley and Lewis 1974, StallCup 1976, DeSante and Ainley 1980). The biology and ecology of about fifteen species had received attention during the past two decades. our study provides the first quantitative analysis of the abundance of all the seabirds in time and space; as such, it facilitates interpretation of the earlier seabird research in the area and clarifies the relative importance of various locations to each group of birds.

Seabirds recorded here attend nesting colonies in all corners of the Pacific Ocean, Bering Sea, Arctic Ocean, inland North America and even the North Atlantic. There appear to be acceptable records for 102 species of seabirds in central and northern California, excluding waders, shorebirds except phalaropes and primarily non-marine ducks, gulls, and terns (Jones et al. 1981). Of this number, we found about thirty to thirty-five to be at least moderately numerous in a given seascn; thirty-four species are exceedingly rare (Table 3). Compared with regions to the south and north (e.g. , the Southern California Bight, Orsgon-Washington, Gulf of Alaska), the fauna of central and northern California is dominated numerically by species with ccol-water

Table 3. Seasonal status of marine birds of the central and northern California OCS. In some species more than one category may be applicable. All shorebirds except phalaropes and most anseriforms are excluded. Status is defined by season of maximum numbers. Pacific breeding range center is identified following scientific name (after Palmer 1962).

Breeding species (18)

Fork-tailed Storm-Petrel (*Oceanodroma furcata*); Alaskan marine
Leach's Storm-Petrel (*Oceanodroma leucorhoa*); Alaskan marine
Ashy Storm-Petrel (*Oceanodroma homochroa*); California Current
Double-crested Cormorant (*Phalacrocorax auritus*); eastern North Pacific
Brandt's Cormorant (*Phalacrocorax penicillatus*); California Current
Pelagic Cormorant (*Phalacrocorax pelagicus*); Alaskan marine
Heermann's Gull (*Larus heermanni*); Gulf of California
Western Gull (*Larus occidentalis*); California Current
Caspian Tern (Sterna *caspia*); north Temperate inland
Forster's Tern (*Sterna forsteri*); north Temperate inland
Least Tern (*Sterna antillarum*); coastal California
Common Murre (*Uris aalge*); Alaskan marine
Pigeon Guillemot (*Cepphus columba*); Alaskan marine
Marbled Murrelet (*Brachyramphus marmoratus*); Alaskan marine
Cassin's Auklet (*Ptychoramphus aleuticus*); Alaskan marine
Rhinoceros Auklet (*Cerorhinca monocerata*); southeast Alaskan marine
Tufted Puffin (*Lunda cirrhata*); Alaskan marine

Brown Pelican (*Pelecanus occidentalis*), {nested until 1959, not thereafter; now mostly a summer resident); Gulf of California

Winter residents/visitors (26)

Common Loon (*Gavia immer*); north Temperate inland
Arctic Loon (*Gavia arctica*); Arctic inland
Red-throated Loon (*Gavia stellata*); Arctic inland
Western Grebe (*Aechmophorus occidentalis*); Temperate inland
Red-necked Grebe (*Podiceps grisegena*); north Temperate inland
Eared Grebe (*Podiceps nigricollis*); Temperate inland
Horned Grebe (*Podiceps auritus*); north Temperate inland
Laysan Albatross (*Diomedea immutabilis*); Hawaii
Northern Fulmar (*Fulmarus glacialis*); Alaskan marine
Short-tailed Shearwater (*Puffinus tenuirostris*); southwest Pacific
American White Pelican (*Pelecanus erythrorynchos*); Temperate inland
Black Scoter (*Melanitta nigra*); Arctic coast
Surf Scoter (*Melanitta perspicillata*); Arctic coast
White-winged Scoter (*Melanitta fusca*); Arctic coast
Red-breasted Merganser (*Mergus serrator*); Temperate inland
Harlequin Duck (*Histrionicus histrionicus*); Temperate-Arctic inland

Table 3. Continued.

Winter residents/visitors

Oldsquaw (*Clangula hyemalis*); Arctic-Subarctic coast
Mew Gull (*Larus canus*); Alaskan inland
Ring-billed Gull (*Larus delawarensis*); Temperate inland
California Gull (*Larus californicus*); Temperate inland
Glaucous-winged Gull (*Larus glaucescens*); Subarctic coast
Herring Gull (*Larus argentatus*); Alaskan inland
Thayer's Gull (*Larus thayeri*); eastern North America
Glaucous Gull (*Larus hyperboreus*); Alaska coast
Black-legged Kittiwake (*Rissa tridactyla*); Alaskan marine
Ancient Murrelet (*Synthliboramphus antiquus*); Alaskan marine

Spring/autumn migrants (15)

Flesh-footed Shearwater (*Puffinus carneipes*); Southwestern Pacific
Mottled Petrel (*Pterodroma inexpectata*); Southwestern Pacific
Brant (*Branta bernicla*); Arctic coast
Red Phalarope (*Phalaropus fulicarius*); Arctic-subarctic coast
Red-necked (Northern) Phalarope (*Phalaropus lobatus*); Subarctic inland
Pomarine Jaeger (*Sterocorarius pomarinus*); Arctic inland
Parasitic Jaeger (*Stercorarius parasiticus*); Arctic inland
Long-tailed Jaeger (*Stercorarius longicaudus*); Arctic inland
South Polar Skua (*Catharacta maccormicki*); Antaractic
Laughing Gull (*Larus atricilla*); Temperate inland
Bonaparte's Gull (*Larus philadelphia*); Arctic inland
Sabine's Gull (*Xema sabini*); Arctic inland
Common Tern (*Sterna hirundo*); Temperate inland
Arctic Tern (*Sterna paradisaea*); Arcticinland
Horned Puffin (*Fratercula corniculata*); Alaskan marine

Summer/autumn (nonbreeding) residents/visitors (9)

Buller's (New Zealand) ShearWater (*Puffinus bulleri*);
southwestern Pacific
Black-footed Albatross (*Diomedea nigripes*); Hawaii
Pink-footed Shearwater (*Puffinus creatopus*); south Pacific
Sooty Shearwater (*Puffinus griseus*); south Pacific
Black-vented Shearwater (*Puffinus opisthomelas*);
Baja California marine
Black Storm-Petrel (*Oceanodroma melania*); Baja California marine
Royal Tern (*Sterna maxima*); Gulf of California
Elegant Tern (*Sterna elegans*); Gulf of California
Xantus' Murrelet (*Synthliboramphus hypoleucus*); southern California

Rarities (33)

Yellow-billed Loon (*Gavia adamsii*); Alaskan inland
Short-tailed Albatross (*Diomedea albatrus*); northwestern Pacific
Wandering Albatross (*Diomedea exulans*); Antarctic marine
Cape Petrel (*Daption capense*); Antarctic marine

Table 3. Continued.

Rarities

Cook's Petrel (*Pterodroma cookii*); south Pacific
Stejneger's Petrel (*Pterodroma longirostris*); southeast Pacific
Solander's Petrel (*Pterodroma solandri*); southwest Pacific
Streaked Shearwater (*Calonectris leucomelas*); Japan marine
Greater Shearwater (*Puffinus gravis*); Atlantic
Manx Shearwater (*Puffinus puffinus*); Atlantic
Townsend's Shearwater (*Puffinus auricularis*);
Pacific Mexico marine
Wedge-rumped (Galapagos) Storm-Petrel (*Oceanodroma tethys*);
Tropical marine
Least Storm-Pet re 1 (*Halocyptena microsoma*);
Gulf of California marine
Wilson's Storm-Petrel (*Oceanites oceanicus*);
southern oceans, Antarctica
Whit e-t ailed Tropicbird (*Phaethon lepturus*); Hawaii
Red-billed Tropicbird (*Phaethon aethereus*);
Gulf" of California marine
Red-tailed Tropicbird (*Phaethon rubricauda*); Hawaii
Blue-footed Booby (*Sula nebouxii*); Gulf of California marine
Brown Booby (*Sula leucogaster*); Gulf of California marine
Red-footed Booby (*Sula sula*); Central American marine
Magnificent Frigatebird (*Fregata magnificens*);
Central America marine
King Eider (*Somateria spectabilis*); Alaskan coastal
Franklin's Gull (*Larus pipixcan*); north Temperate inland
Little Gull (*Larus minutus*); eastern North American
Common Black-headed Gull (*Larus ridibundus*); eastern north Atlantic
Lesser Black-backed Gull (*Larus fuscus*); eastern North America
Black Tern (*Chlidonius niger*); Temperate inland
Black Skimmer (*Rynchops niger*); Gulf of California marine
Thick-billed Murre (*Uria lombia*); Alaskan marine
Craveri's Murrelet (*Synthliborampus craveri*);
Gulf of California marine
Least Auklet *Aethia pusilla*; Alaskan marine
Parakeet Auklet (*Cyclorrhynchus psittacula*); Alaskan marine
Least Auklet (*Aethia pusilla*); Alaskan marine
Crested Auklet (*Aethis cristatella*); Alaskan marine

affinities (boreal North Pacific, especially, where upwelling prevails), but the fauna also includes smaller numbers of subtropical species, particularly during late summer and autumn. The density of birds and their biomass per unit area (standing stock) are quite comparable to figures published for Oregon, the Gulf of Alaska and Bering Sea, and are much higher than those reported for southern

California (Wiens and Scott 1975; Briggs et al. 1981; Schneider and Hunt 1981). When maximally abundant, seabirds may number almost 6.5 million, and may consume 200,000 metric tons of food per year (Fig. 14,15). The seasonal curve of total seabird biomass shows abrupt swings of up to 200%, reflecting migrations and breeding events. The probable effects of the California version of the intense El Nino event appear in autumn-winter 1982-S3, with a 69% reduction of average December-January biomass, compared to the previous two years. In large part, this drop reflected low relative numbers of birds that nest north of California and winter in the study area. Bird numbers, biomass, and diversity were always highest over the continental shelf and lower farther offshore. The relatively broad shelf areas north of Cape Mendocino, from Monterey to Bodega and south of Point Buchon always supported the greatest concentrations.

Although seabirds have many fascinating anatomical, physiological and behavioral adaptions enabling them to fly, dive, and capture food animals at sea, all must return to land to reproduce. AS a consequence of adaptation to life at sea, many seabirds are very ungainly on land where they are highly susceptible to predation. Accordingly, most nest on isolated islands and rocks offshore that support no terrestrial predators. Nests or scrapes are constructed on the surface or tunnels may be excavated in island soil. some seabirds including certain alcids and petrels, merely nest on ledges or in crevices. Among all procellariiforms (albatrosses, fulmars, petrels, shearwaters) a maximum of one egg is layed each year while in cormorants, grebes and sea ducks the clutch may exceed five eggs. Many seabirds, especially the procellariiforms, delay the time of first breeding for several years.

The nesting fauna of central and northern California currently comprises seventeen species (the Brown Pelican has not nested here for about 24 years; Sowls et al. 1980). Their aggregate numbers are

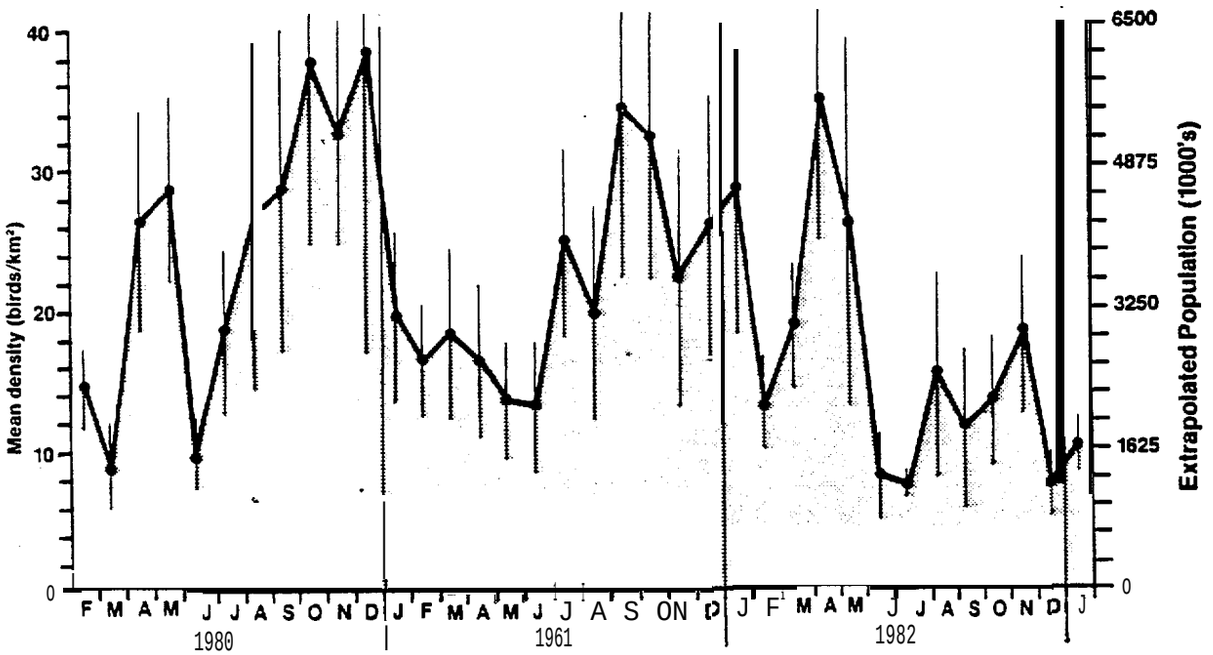


Figure 14. Monthly mean density of all seabirds in waters of central and northern California, 1980-1983. Scale for converting individual density to extrapolated total population appears at right. Vertical bars depict ±1 se. for bird density in all density figures in this report.

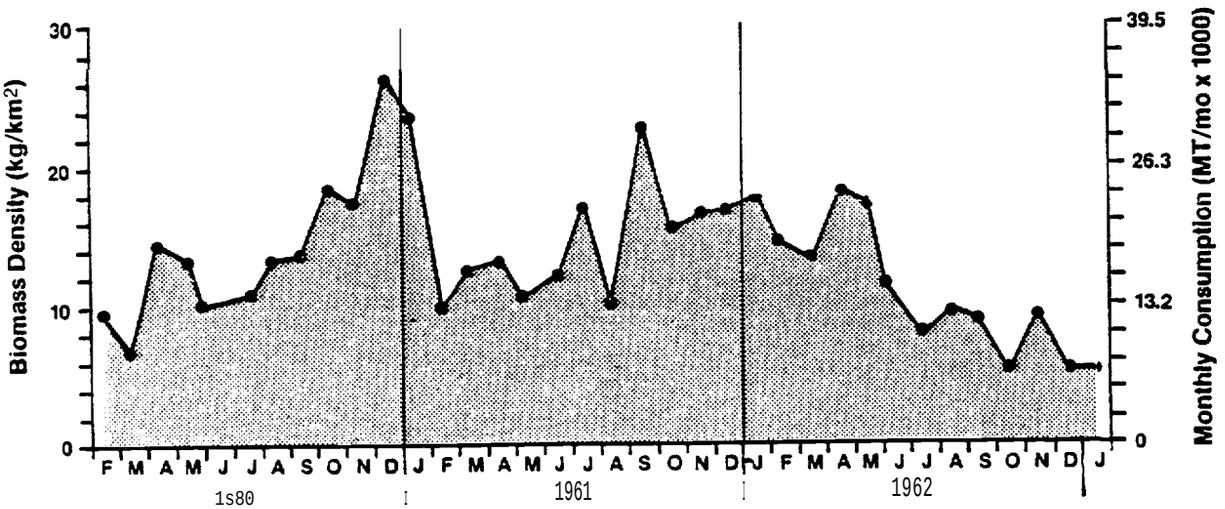


Figure 15. Monthly mean density of all seabird biomass In watera of central and northern California, 1980-1983. Scale for converting biomass density to approximate monthly consumption appears at right.

presently around 0.85 million and are increasing due to rapid expansion of the Common Murre population (Table 4). Cormorant nesting numbers declined by about 15% during our study though their overall population numbers were stable, while the Western Gull nesting population was fairly steady. Because of their burrow- or crevice-nesting habits we could not assess population trends among the other nesting species.

The most numerous of the nesting residents are the murre (0.52 million), Cassin's Auklet (0.13 million), Brandt's Cormorant (0.06 million), and western Gull (0.04 million). The seasons and locations of greatest abundance of these and twenty other abundant species are listed in Table 5. Of greatest importance to seabirds nesting in California are the colonies at the Farallon Islands, Point Reyes, Trinidad Head, and Klamath River to Castle Rock. Castle Rock at Crescent City harbors nesting populations of eleven species including an estimated 142,000 Common Murres. It appears to be the largest murre colony in the northeastern Pacific east of Kodiak Island, Alaska. The Farallon Islands presently support nesting populations of twelve seabird species and clearly are the most important bird colony sites in the U.S. south of Alaska. In addition to being the site of California's second largest murre colony, the Farallones support the largest extant colonies of three species that are essentially endemic to the California Current — Ashy Storm-Petrel, Brandt's Cormorant, and Western Gull. The 105,000-bird colony of Cassin's Auklets here may be the largest in the U.S. (Sowls et al. 1978, Varoujean and Pitman 1979, Sowls et al. 1980, Vermeer et al. 1983) .

During early July, we counted as many as 381,244 birds of all surface-nesting species (cormorants, gulls, and murres) along the central and northern California shoreline , accounting for 90.7% of all birds then found ashore. Numbers of murres, auklets, and puffins in the study area increased during winter due to immigration from

Table 4. Numbers of seabirds (1,000's) nesting in California compared with totals for contiguous regions. Species nesting exclusively in Alaska are uot listed:

Species	Alaska		British			California	
	Total	Southeast	Columbia	Washington	Oregon	Central-Northern	Southern
Fork-tailed Storm-Petrel	5,000.0	24.0	98.2	3.8	< 1	0.3	.0
Leach's Storm-Petrel	4,000.0	140.0	12.7	7.3	136.0	18.3	Present
Ashy Storm-Petrel	0	0	0	0	0	4.0	1.2
Black Storm-Petrel	0	0	0	0	0	0	0.2
Double-crested Cormorant	7+		2.1	0.1	1.7	1.5	0.4
Brandt's Cormorant	<0.1		0.4	0.3	16.2	58.4	5.8
Pelagic Cormorant*	90.0	0.6	10.0	2.8	6.6	15.4	0.5
Brown Pelican	0	0	0	0	0	0	2.7
Glaucous-winged Gull	500.0	16.6	29.5	20.9	0	0	0
Herring Gull	0.3+	0.4	?	Present	0	0	0
Western Gull	()	0	0	1.9	9.9	39.7	11.2
Common Murre	5,000.0	40.6	8.3	23.9	426.1[3]	518.7[4]	0
Pigeon Guillemot	200.0	0.9	6.0	0.?	2.1	12.5	2.2
Marbled Murrelet	Present	Present	Present	Present	Present	2.0	0
Ancient Murrelet	400.0	40.0	42.3	0	0	0	0
Xantus' Murrelet	0	0	0	0	0	0	3.5
Cassin's Auklet	600.0	4.0	1,063.0	0.2	().2	108.9	22.3
Rhinoceros Auklet	200.0	40.1	22.5	42.4	0.2	0.4	0
Tufted Puffin	4,000.0	74.0	324.1	119.8	6.6	0.3	0

1. Sources include Heath (1915), Manuwal and Campbell (1979), Sowls et al. (1978), Sowls et al. (1980), Varoujean and Pitman (1979), and Willett (1912).
2. Includes Red-faced Cormorant (*P. urile*) in Alaska.
3. Data are from Varoujean and Pitman (1979) x 1.67 to compare with numbers for other regions.
4. Current estimate (this study).

Table 5. Status, seasonality, maximum density, and areas of concentration of the 24 seabird species that were numerically predominant off central and northern California during 1980-1983. N.A. signifies density peaks <0.1 birds/km^2, population ashore <1,000, or shoreline population is regarded as a better measure of abundance that is density.

Status	Species	Months of greatest abundance	Peak monthly mean density at sea	Peak abundance at coastline (1,000's)[1]	Areas of greatest concentration
Nesting Resident	Leach's Storm-Petrel	March-August	0.3 to 1.1 birds/km^2	18.3	Slope and offshore regions north of Cape Mendocino and south of Point Buchon; colonies at Little River Rock, Castle Rock.
" "	Brandt's Cormorant	May-August	0.3 to 0.5 birds/km^2	58.4	Farallones Basin and adjacent shoreline.
" "	Pelagic Cormorant	no pronounced peak	N.A.	15.4	Shoreline north of Point Reyes.
" "	Brown Pelican[2]	July-December	0.1 birds/km^2	25.6	Shelf waters and shoreline Monterey to Bodega and south of Point Buchon.
" "	Western Gull	May-November	0.4 to 0.5 birds/km^2	39.1	Shelf waters and shoreline from Monterey to Bodega, especially Farallon Islands.
" "	Common Murre	September - January	4.8 to 5.2 birds/km^2	518.8[3]	Shelf waters north of Eureka and from Point Reyes to Monterey; Castle Rock, Farallon Islands, Rocks at Trinidad Head, Point Reyes.
" "	Cassin's Auklet	November-February	4.6 to 8.1 birds/km^2	131.2	Slope waters Point Pinos to Fort Bragg, especially Cordell Bank-Ascension Canyon; Farallon Islands.
" "	Rhinoceros Auklet	December-March	1.5 to 1.9 birds/km^2	0.2	Slope and offshore waters.
Winter Visitor	Arctic Loon	April and November	0.8 to 1.6 birds/km^2	1.0+	Shelf waters and coastline Point Montara to Bodega, Monterey Bay.
" "	Western Grebe	December-March	N.A.	24.6	Nearshore waters Point Montara to Bodega.
" "	Northern Fulmar	December-March	1.8 birds/km^2	N.A.	Slope waters north of Monterey Bay.
" "	Surf Scoter/ White-winged Scoter	October-March	N.A.	17.4	Nearshore waters north of Cape Mendocino; Tomales Bay.

Table 5. Continued.

Status	Species	Months of greatest abundance	Peak monthly mean density at sea	Peak abundance at coastline (1,000's)[1]	Areas of greatest concentration
Winter visitor	California Gull	October-March	1.4 to 2.5 birds/km^2	4.5[4]	Shelf waters and shoreline south of Point Arena.
" "	Herring Gull	December-March	0.8 to 1.8 birds/km^2	7.1[4]	Shelf waters and shoreline north of Monterey Bay.
" "	Black-legged Kittiwake	December-March	2.0 to 2.4 birds/km^2	N.A.	Slope and offshore waters north of Point Sur
Spring/ Autumn Migrant	Red Phalarope/ Red-necked Phalarope	April-May and September-November	15.2 to 17.6 birds/km^2	19.3	Shoreline in spring, slope waters in fall, especially in areas of convergence bordering and within upwellings.
" "	Bonaparte's Gull	November-December and April-May	0.8 to 3.3 birds/km^2	4.6[4]	Ubiquitous over shelf.
" "	Common Tern/ Arctic Tern	April-May and August-September	1.2 to 1.5 birds/km^2	N.A.	Ubiquitous in slope and nearshore waters during migration.
Summer/ Autumn Nonbreeding Resident	Black-footed Albatross	May-July	0.1 to 0.5 birds/km^2	N.A.	Slope waters Cape Mendocino northward.
" "	Buller's Shearwater	July-October	0.9 birds/km^2	N.A.	Slope waters Point Arena to Cape Mendocino and Cordell Bank to Point Año Nuevo.
" "	Pink-footed Shearwater	June-August	0.8 birds/km^2	N.A.	Shelf watera Point Sur to Trinidad.
" "	Sooty Shearwaters	May-July	17.3 birds/km^2	20.0	Shelf waters Point Sur to Bodega, especially Monterey Bay.

1. For nesting species, population ashore is total nesting population (Souls et al. 1980) while for other species, the maximum coastal count is given.
2. Brown Pelicans nested in central California as late as about 1959, but now nest only as far north as Santa Barbara Channel; shoreline population is our September 1981 count of primarily Mexican nesting birds.
3. Population figure from this study; shout 20% growth in nesting numbers appears to have occurred since the surveys reported by Sowls et al. (1980).
4. As many as 42,800 gulls were unidentified as to species during coastal surveys,

Alaska or the Pacific Northwest, while numbers of cormorants, L-each's Storm-petrels, and guillemots declined at the same time, with movement of local breeders toward the south or north.

Among the migrants, winter residents and summer/autumn visitors were several species whose peak estimated populations exceeded 150,000. Because of the extreme abundance of phalaropes, shearwaters, some gulls, and some alcids, the visitors always outnumbered locally-breeding species at sea (Fig. 16). Species diversity, measured by the Shannon-Wiener Index (H') was lowest at sea in midsummer and highest in autumn and winter.

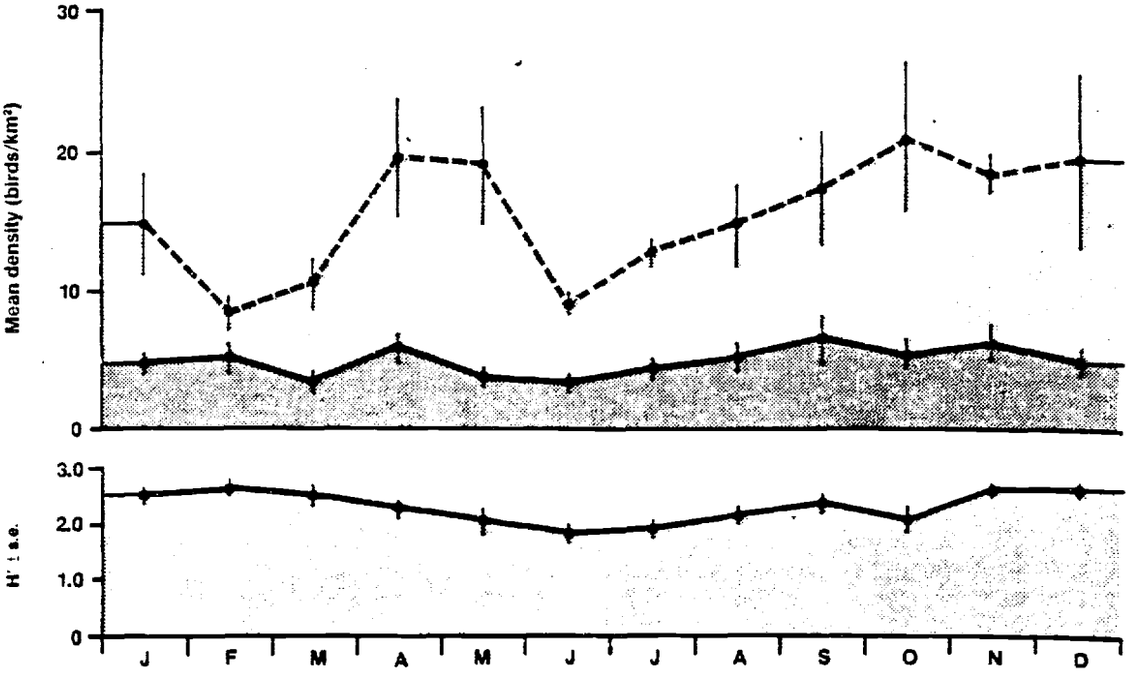
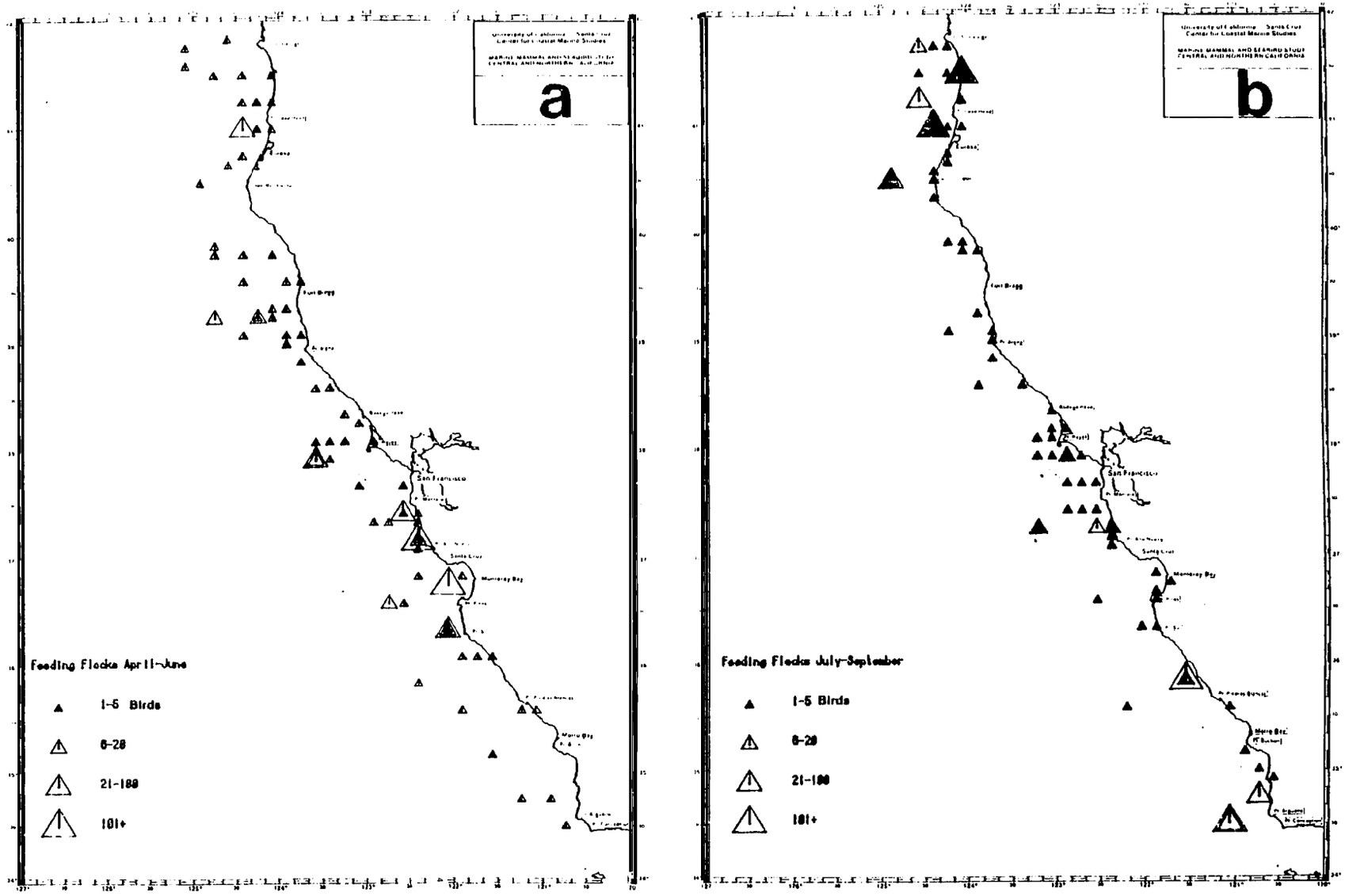


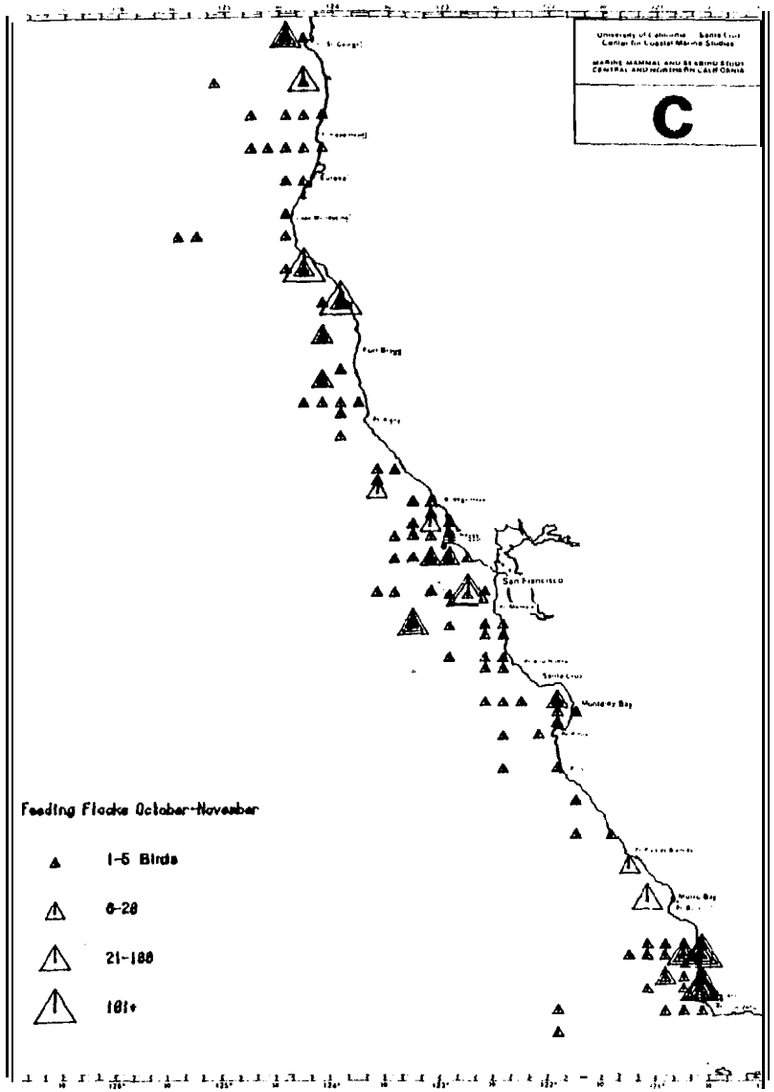
Figure 16, Average monthly densities (± se.) of visiting (top curve) and of locally-breeding seabirds (middle curve) compared to values of bird species diversity (H' of Shannon and Weaver 1963).

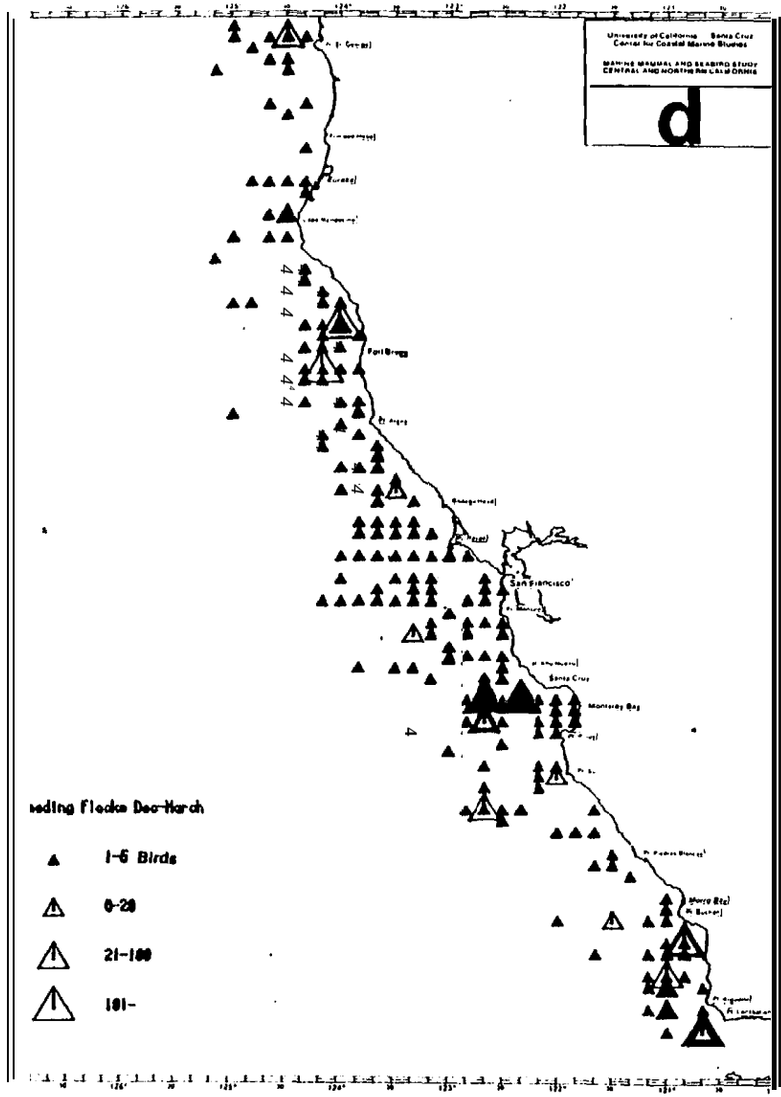
Off central and northern California seabirds capture prey ranging from zooplankton to fish and squid, and several species scavenge fish offal, carrion, and garbage. They employ a variety of methods of prey-capture including active underwater pursuit, seizing at or just below the surface, and plunging from the air. Because of their relatively great daily food demands (averaging perhaps 27% of body weight), birds probably feed wherever they occur and do not fast in the manner of some breeding pinnipeds and migrating whales. Thus, a map of bird biomass distribution may reasonably be taken to reflect feeding areas of greatest importance. seasonal maps of biomass density in each latitudinal sector of the study area appear in Section 4. More direct evidence in the form of maps of locations of observed feeding flocks appears in Fig. 17. The general importance of all shelf areas and particular importance of the broad shelf north of Cape Mendocino from Monterey to Bodega and south of Point Buchon are quite evident.

Another direct indication of important feeding locations derives from the distribution of large colonies, Because they must forage within an energetically-efficient radius of their colonies, nesting adults are dependent on local resources. Birds from the large colonies north of Trinidad and bordering the Gulf of the Farallones exploit adjacent shelf and slope waters generally within 40 km (Fig. 1S).

Figure 17. Locations and sizes of seabird feeding flocks seen during four periods of the year. In some cases, one flock symbol may represent multiple sightings at a given location. (a) April- June; (b) July-September; (c) October-November; (d) December-March.




c
Feeding Flocks October-November
1-5 Birds
6-20
21-180
181+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1-5 Birds
6-20
21-180
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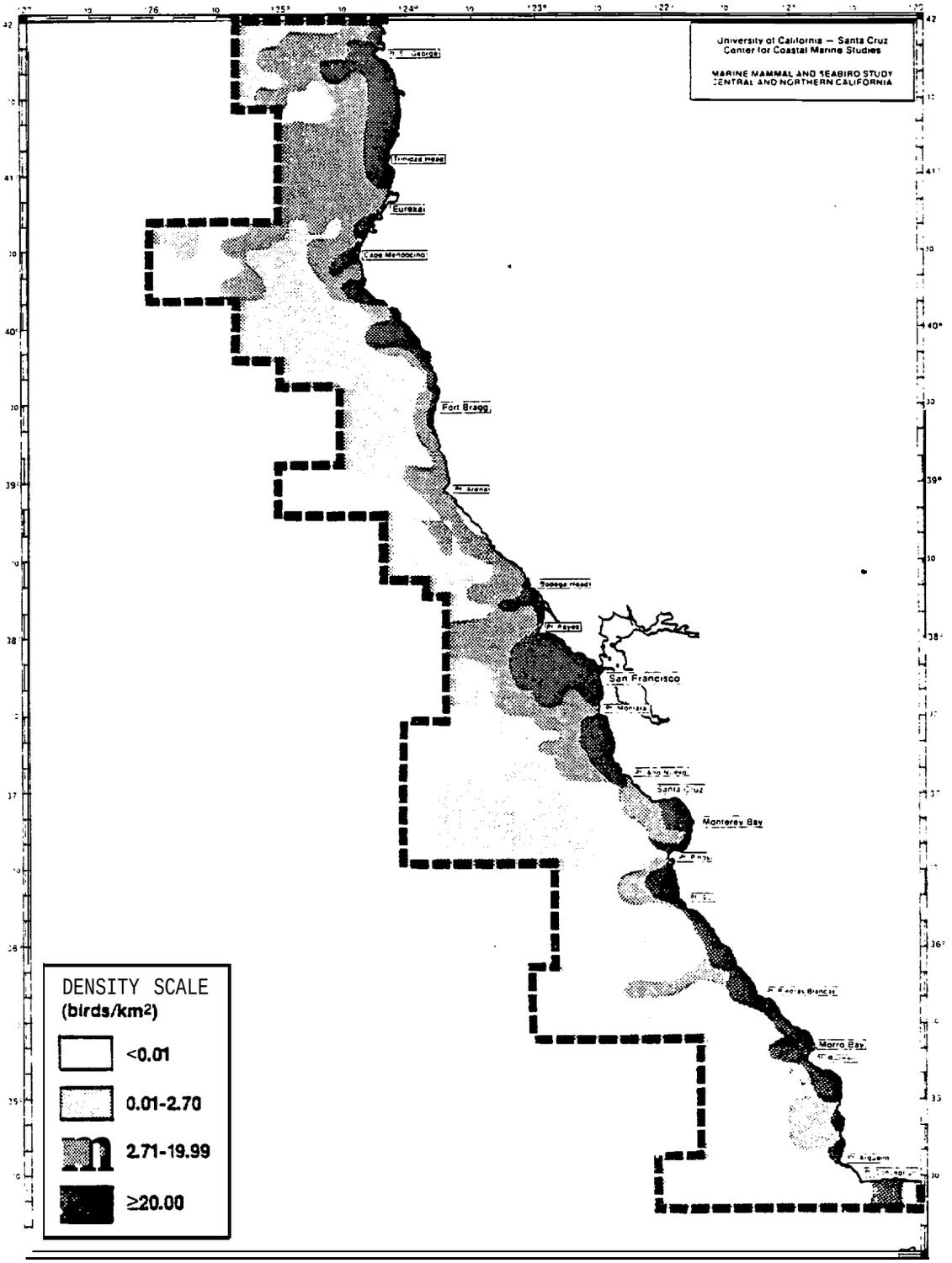


Figure 18. Average distribution of density of all breeding species at sea off central and northern California. Data from twelve surveys during May through July are compiled.

4. GEOGRAPHICAL SEASONAL SUMMARIES

4. GEOGRAPHICAL SEASONAL SUMMARIES

In this section the occurrence and relative abundance of the marine mammals and seabirds are presented for each of four latitudinal sectors in each of four seasons. The division of the study area into approximately equal areas reflects our judgement as to the heterogeneity of animal populations and oceanographic conditions between and within sectors, Balanced against this assessment is the need imposed by the volume of the data to describe populations in relatively restricted spatial units and seasons. The sector boundaries are as follows:

Southern Sector — Point Conception to Point Sur
South-central Sector — Point Sur to Russian River
North-central Sector — Russian River to cape Mendocino
Northern Sector — Cape Mendocino to Oregon border

Owing to differences in timing of various biological events in the annual cycles of birds and mammals, slightly different definitions of the seasons are presented. For the mammals winter includes December through February, spring includes March through May, and summer and autumn comprise June through August and September through November, respectively, The birds data for winter includes December through March and the spring months are April through June, The months of July through September and October-November are taken to represent the seabird summer and autumn, respectively. Graphical depictions and tabular material all represent the three-year mean conditions and variances. For the purpose of facilitating comparisons between animal groups, we graphically depict seasonal biomass densities (standing stocks) of each group and tabulate indices to individual density and abundance on land.

The summaries that follow are organized such that all animal data for each season at each location are adjacent in sequence. Thus ,

material concerning pinnipeds in the southern sector during winter is found together with that pertaining to cetaceans and seabirds at the same place and time. This is followed by material concerning each animal group in the south in spring, summer, and autumn; then by the summary of data for the south-central sector, etc. Preceding the initial seasonal summary at each location is a four-panel figure indicating the monthly mean surface temperature, deviation of temperature from 20-year seasonal means, and the monthly index of upwelling intensity, These three-year curves are presented to illustrate seasonal and interannual variability in physical conditions and to permit comparisons between sectors.

Figure 19. (facing page) Southern sector: Comparison of monthly mean sea surface temperatures, deviation of temperature from climatic (zO-year) seasonal means, and upwelling index. Data are modified from Auer (cd., 1981-19S3), A. Bakun (pers, comm.), and this study.

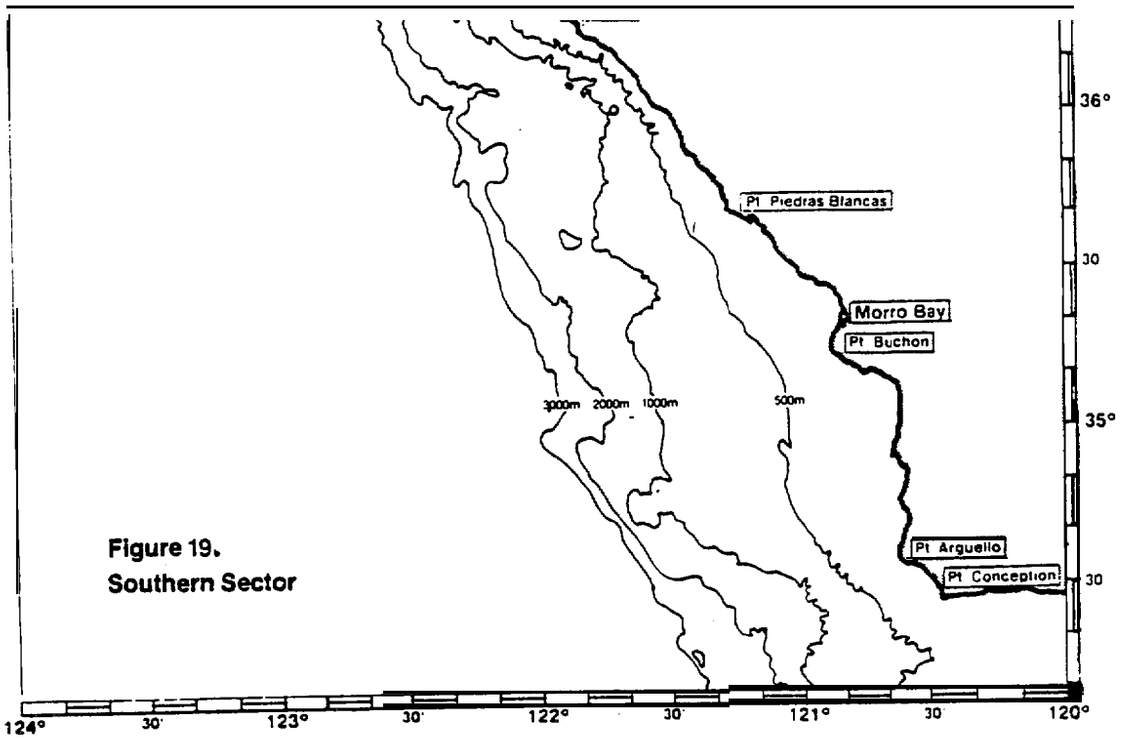
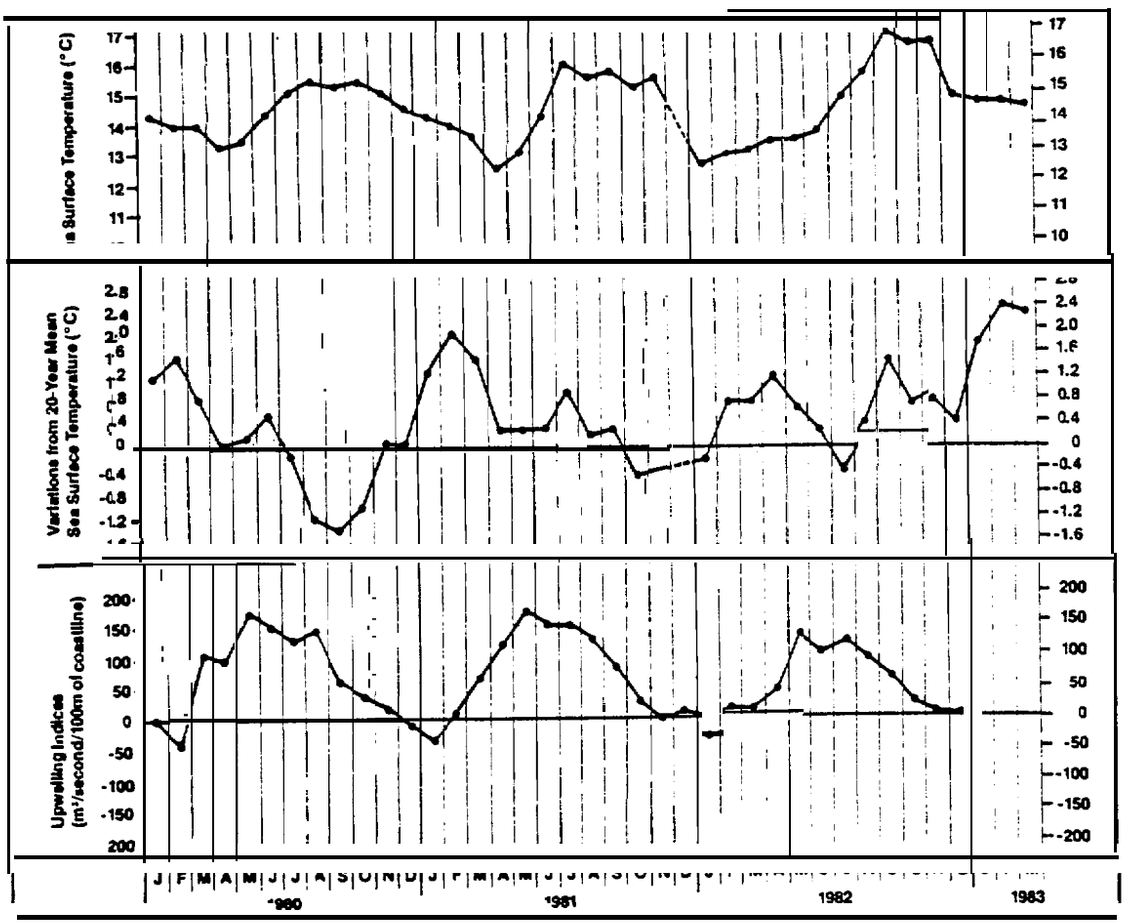
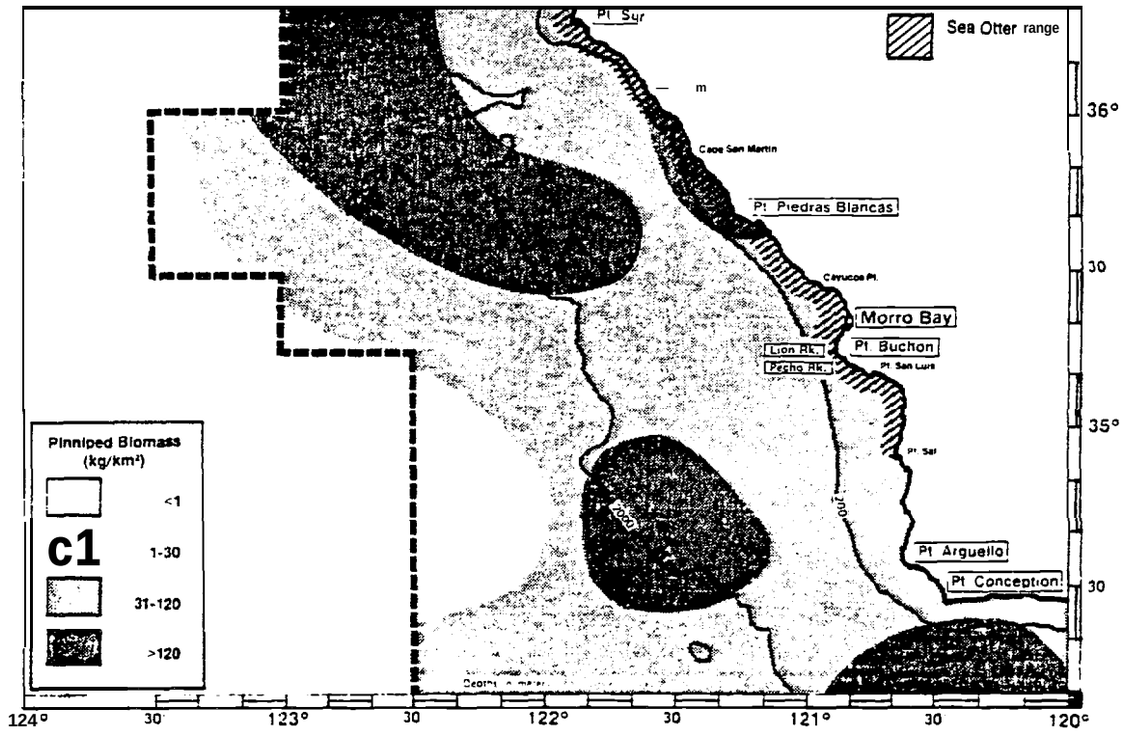


Figure 19.
Southern Sector



SOUTHERN SECTOR
Winter—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000)	Slope (200-1,999m)	Shelf (0-199 m)
California sea lion	0.045 ±0.025	0.067 ±0.023	0.159 ±0.075
Northern fur seal	0.074 ±0.033	0.038 ±0.015	0.0
Steller sea lion	0.0	0.0	0.004 ±0.007
Harbor seal	0.0	0.006 ±0.007	0,030 ±0.024
Northern elephant seal	0.006 ±0.005	0.014 ±0.010	0.018 ±0.023
All Pinnipeds	0.125 ±0.055	0.125 ±0.026	0.211 *0.112
Biomass (kg/km²)	15.80 ±6.02	30.57 ±13.45	66.07 ±35.08

Abundance on LAND (numbers counted)	28-30 Jan. 1980	2S-30 Jan. 1981	25-27 Jan. 1982
California sea lion	892 (43%)	242 (39%)	859 (51%)
Steller sea lion	0	0	0
Harbor seal	1,193 (57%)	386 (61%)	789 (47%)
Northern elephant seal	1 (<1%)	0	38 (2%)
All Pinnipeds	2,086	628	1,686

Pinnipeds

From Point Sal Rock (34°53'N) to Point Buchon (35°15'N), 478 pinnipeds were on land in January 1982. California sea lions, with a population of 413, accounted for 86.4% of the pinniped total. Harbor seals, numbering 65 animals, represented 13.6% of the total in this sector. As in other seasons, most of the California sea lions were hauled-out on Point Sal Rock (40), Pecho Rock (100) and Lion Rock (273). From Cayucos Point (35°26'N) to Point Piedras Blancas (35°39'N), the 1982 pinniped count consisted of 340 harbor seals (59.3% of the total) and 233 California sea lions (40.7% of the total), most on the rocks at Point Piedras Blancas. From Breaker Point (35°44'N) to Point Sur (36°18'N) we counted 635 pinnipeds in 1982, including 384 harbor seals (“64.3%) and 213 California sea lions (35.7%). The California sea lions were found at Cape San Martin (35°53'N) and Grimes Beach (36°12'N). Most of the harbor seals (257) were at False Sur (36°17'N), where counts of 259 and 307 had been recorded on previous winter surveys. A small northern elephant seal rookery has become established at Cape San Martin. Thirty-eight (38) animals, including 11 pups, were counted from the January 1982 survey photographs,

In the southern sector, winter densities at sea ranged from low to moderately high, with the highest mean density (0.21 animals/km^2) found over the continental shelf where California sea lions represented 79% of all pinnipeds seen. Harbor seals and northern elephant seals accounted for the remainder of the nearshore sightings. TWO areas of high density were noted: the vicinity of cape San Martin and the San Miguel Island shelf — both hauling grounds of California sea lions. The waters over the continental slope were a region of overlap in the distributions of the more coastal California sea lions and the pelagic northern fur seals. These two species represented 44% and 46%, respectively, *of* all sightings; northern elephant seals accounted for 7% of all pinniped sightings in the slope depth region.

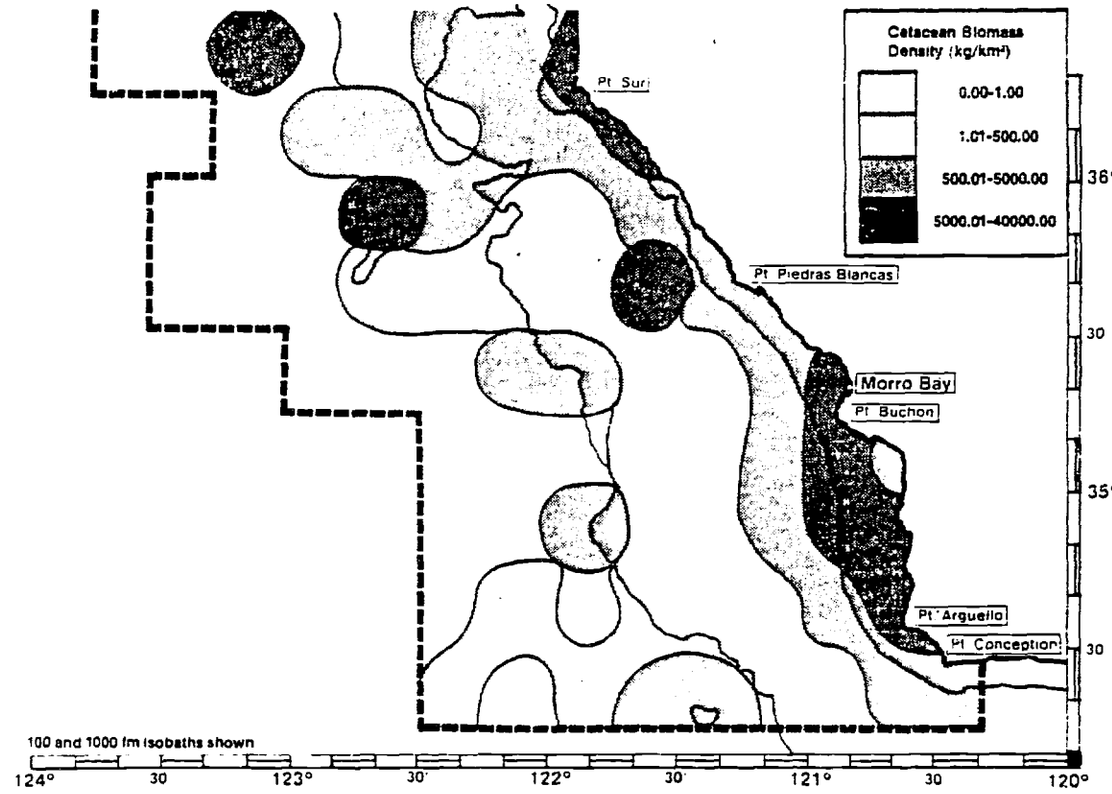
Tine relatively great numbers of northern elephant seals seen reflect their winter movement toward *San* Miguel Island, the largest rookery in the species' range. Northern fur seals predominated in the offshore depth region, representing 76% of all sightings. Overall mean density in offshore waters was moderately low except in two areas of high fur seal abundance: the waters over the outer part of the Santa Lucia Bank bordering on the Santa Lucia Escarpment, and the fan of Sur and Monterey canyons.

Sea Otters

The sea otter population in the southern sector represents about 72% of the California population total. Sea otters are found along most of the coast from Point Sur to about Point Sal. The southernmost large raft was located at Point San Luis in the winter and spring of 1983 and numbered slightly more than 50 animals. A few sightings of solitary sea otters were recorded south of Point Sal toward Point Conception. The distribution of sea otters along the coast of the southern sector is non-uniform. Several general areas of high concentration were identified, including Shell Beach/Point San Luis, Cayucos Point, Cambria/San Simeon, Breaker Point (35°44'N), Prewitt Creek (35°55'N), Anderson Canyon (36°09'N), and the lee of Point Sur. South of Piedras Blancas, the numbers of independent animals increased about 13% from the 374 counted in 1982 (U.S. Fish and Wildlife" Service shore-based census) to 418 in 1983 (relative abundance of 42%). The population size from Point Piedras Blancas north to Point Sur is less well known. A total for this area of 434 independent animals was obtained in 1982 (USFWS census), compared with a count of 303 obtained on aerial survey in 1983 (relative abundance of 30%). It is likely that a real decline in numbers *of* sea otters along the Big Sur coast occurred from 1982 to 1983, reflecting a movement of individuals to the north and south. counts obtained should be considered minimum

population estimates. Winter and spring constitute the pupping season for the California sea otter population and, on several surveys conducted from February to June 1983, pups were seen in all areas occupied by sea otters from Cayucos Point in the south to about Pfeiffer Point in the north (36°15'N).

SOUTHERN SECTOR
Winter-Cetaceans



	Shelf (0-99 fm)	slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km^2 ±SE)	0.15 ±0.22	3.02 ±3.89	0.49 ±3 .97
Mean Cetacean Biomass (kg/km^2)	9,737.35	1,319.87	1,116.31
Mean Sea Surface Temperature 'C (±SE)	15.6° ±0.7	15.8° ±0.6	15.8″ ±0.5
Percentage of Observed Cetaceans x Depth	1.7%	93, 7%	4.6%
Percentage of Biomass x Depth	80.0%	10.8%	9.2%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Northern right whale dolphin	Pacific white-sided dolphin
Dan's porpoise	Grampus	Northern right whale dolphin
Harbor porpoise	Pacific white-sided dolphin	Sperm whale
	Dan's porpoise	Gray whale
	Gray whale	

Shelf. This season produced the highest mean cetacean density and mean cetacean biomass for the nearshore shelf waters to be seen year-round for this sector, The southward-migrating gray whales *were* primarily responsible for these high figures. Concentrations of Dan's porpoises around Point Buchon, and modest numbers of harbor porpoises at Point Buchon and Point Sal, added to these shelf figures.

Slope. High species diversity, coupled with large school size over the slope, yielded the highest mean cetacean density recorded for this sector and was the second highest seen anywhere within the study area in any season.

Northern right whale dolphins accounted for approximately 50% of all cetaceans observed, and were fairly evenly distributed across the slope. Grampus distribution was patchier, with major concentrations west of Point Sur, Point Piedras Blancas, and Morro Bay. Pacific white-sided dolphins, usually an important element of the cetacean fauna, represented only 10% of the total animals seen. Dan's porpoises were found universally over the slope in the second highest numbers seen anywhere in any season.

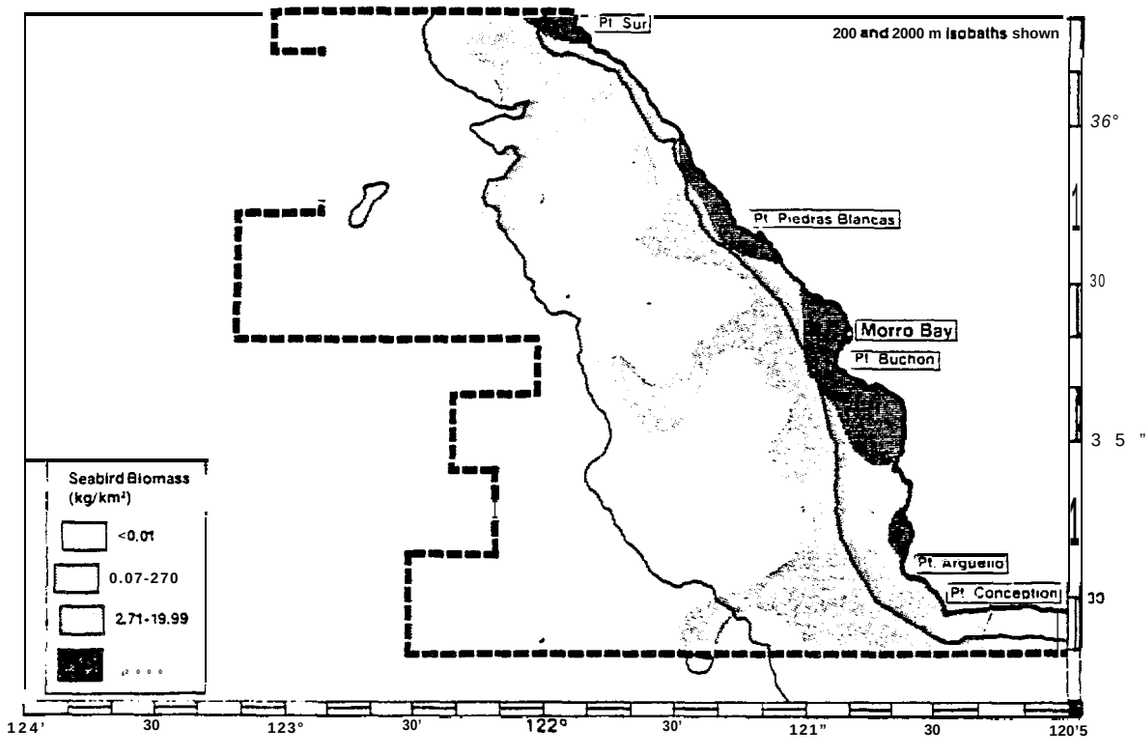
The reasonably high mean cetacean biomass figures found over the slope may be attributed to migrating gray whales moving through deeper waters on their headland-to-headland traverses. Additionally, occasional Baird's beaked whale and killer whale sightings increased biomass averages.

Of significant interest was an area due west of Point Piedras Blancas in waters ranging from 150 to 400 fm deep. This area of gently sloping bottom, north of Santa Lucia Bank and south of Santa Lucia Canyon, consistently contained large mixed schools of cetaceans. Grampus and Dan's porpoises were major contributors to these high concentrations; however, Pacific white-sided and northern right whale dolphins were present as well. Even an occasional harbor porpoise was observed venturing out from shore to the eastern boundary of this area of high utilization.

Offshore. The offshore waters had moderate mean cetacean density values, with well above average biomass figures. Pockets of Pacific white-sided and northern right whale dolphins west of Morro Bay and southwest of Point Sur created areas of high density. Sperm whales, gray whales, and an infrequent fin or beaked whale over the Monterey Canyon created a concentrated area of high biomass. A similar area to the south, Sur Canyon, also attracted sperm whales in large numbers, as well as beaked whales (Baird's beaked whales, in particular).

Mean sea surface temperatures were more homogeneous from the coast out to the pelagic realm than at any other time of year. Consistent northwesterlies and winter storm activity insured uniform water column mixing,

SOUTHERN SECTOR
Winter—Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	4.64 ±0.76	8.86 ±1.63	46.61 ±11.42
Mean Biomass Density (kg/km² ±SE)	1.57 ±0.26	4.25 ±0.73	33.66 ±4.91
Mean Number of Species observed (±SD)	11.58 ±2.33	19.50 ±3.43	19.00 ±3.29
Mean Species Diversity Index (H' ±SD)	1.89 ±0.22	2.20 ±0.21	2.16 ±0.33

January Mean Population Ashore (±SD): **26,156 ±20,777**

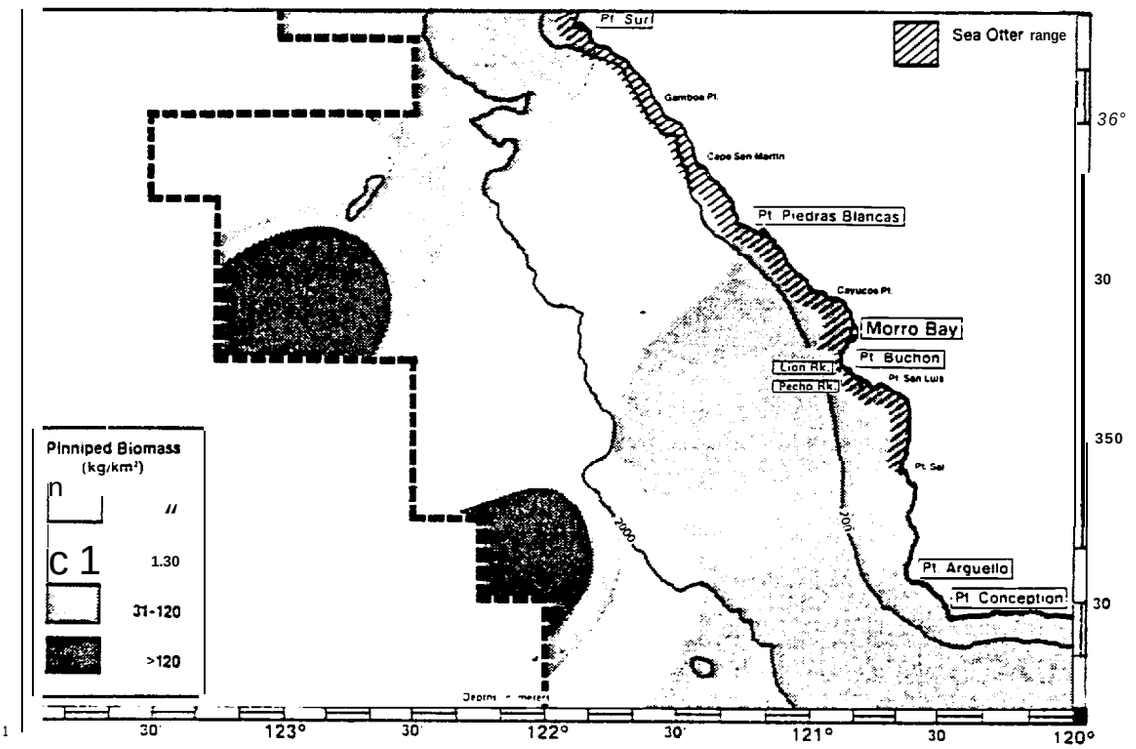
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Phalaropes	Phalaropes	Arctic Loon	Arctic Loon
Cassin's Auklet	Cassin's Auklet	Cassin's Auklet	Western Grebe
Rhinoceros Auklet	Rhinoceros Auklet	Common Murre	Brandt's Cormorant
Black-legged Kittiwake	California Gull	Western Gull	Pelagic Cormorant
Northern Fulmar			Surf Scoter
Herring Gull			Western Gull
			California Gull

Numbers of birds and biomass density here were moderate over the continental slope and high over the shelf, Overall abundance declined slightly from the high in autumn but species numbers and diversity reached yearly maxima. A discontinuous zone of high biomass density extended for 5 to 25 km off the shoreline from Point Sal, south of Morro Bay, to Point Sur. Three "plume-like" bands of moderate biomass density extended up to 85 km seaward from Point Sur, Point Buchon, "and Point Arguello. As in other sectors, overall biomass was relatively low well offshore.

The composition of the fauna was similar to that seen elsewhere, withlarge contributions from wintering gulls, alcids, fulmars, and phalaropes. Shoreline populations, which averaged over 26,000 in three January surveys, comprised relatively more cormorants than in sectors to the north, while grebe and scoter populations were relatively less important. Early visits to nesting colonies by cormorants, gulls, and murres occurred here late in the period, though egg-laying typically does not occur until April.

SOUTHERN SECTOR
Spring—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	slope (200-1,999 m)	shelf (0-199 m)
California sea lion	0.011 ±0.011	0,082 ±0.034	0.180 ±0.065
Northern fur seal	0.067 ±0.018	0.032 ±0.011	0.0
Steller sea lion	0.0	0.001 ±0.001	0.0
Harbor seal	0.0	0.0	0.047 ±0.042
Northern elephant seal	0.001 ±0.002	0.007 ±0.006	0.0
All Pinnipeds	0.079 ±0.022	0.122 ±0.029	0.227 ±0.063
Biomass (kg/km²)	6.17 ±1.69	24.21 ±5.66	39.89 ±11 .01

Abundance on LAND (numbers counted)	5-7 May 1960	19-21 May 1981	3-5,19 May 1982
California sea lion	1,587 (61%)	3,119 (42%)	2,310 (52%)
Steller sea lion	3 (<1%)	0	0
Harbor seal	1,011 (39%)	4,105 (55%)	1,983 (44%)
Northern elephant seal	0	215 (3%)	190 (4%)
All Pinnipeds	2,598	7,439	4, 483

Pinnipeds

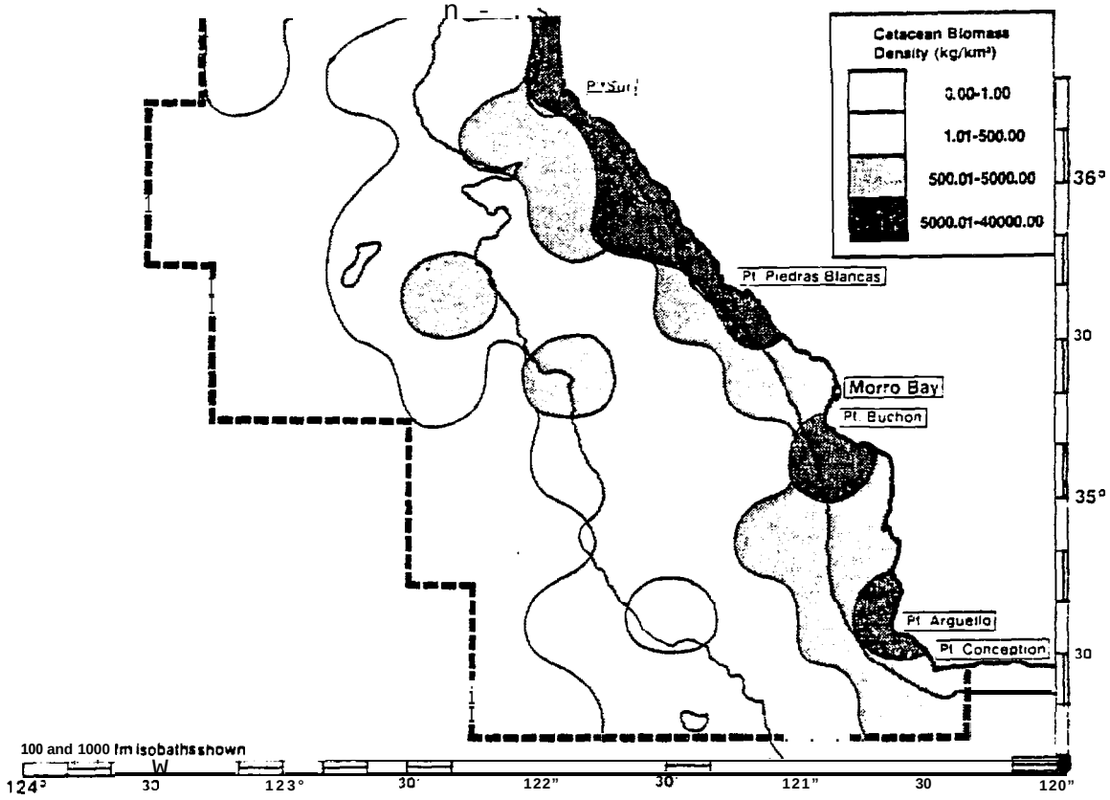
The rocks from Point Sal to Point Buchon (34°53'N to 35°15'N) were occupied by 1,173 California sea lions and 275 harbor seals in May 1982. While approximately the sane numbers of California sea lions [more than 700) were present on Lion Rock in both 1981 and 1982, the numbers of sea lions on Pecho Rock were greatest in 1981, when about 800 were counted. In 1982 "725 harbor seals were counted on nearshore rocks from Cayucos Point (35°26'N) to Point Piedras Blancas (35°39'N), and 562 California sea lions were counted on White Rock near Cambria and on the rocks at Point Piedras Blancas. On the rocky beach at Cape San Martin (35°53'N) 426 California sea lions and 189 northern elephant seals were counted in May 1902. To the north, at a number of locations along the Big Sur coast, 812 harbor seals were counted in 1982.

Spring densities at sea in the southern sector ranged from very high to very low; areas of high density contrasted with areas of low density due to concentrations in the abundance of northern fur seals in offshore waters. Two areas of high density *were* apparent in spring surveys: the waters over Davidson Seamount west of Point Piedras Blancas, and the waters over the western margin of the Santa Lucia Bank. Overall, the mean density offsnore was moderately low due to large voids associated with an area of warm-water intrusion. Northern fur seals predominated in offshore waters, representing 89% of the sightings; the remaining sightings were of California sea. lions. Over the shelf, California sea lions predominated, representing 88% of the sightings with most of the remainder comprised of northern fur seals. Both species were present at moderately low densities over the continental slope.

Sea Otters

The sea otter population in the southern sector represents about 72% of the California population total. Sea otters are found in nearshore waters along most of the coast from Point Sur to about Point Sal. The southernmost large raft was located at Point San Luis in the winter and spring of 1983, and numbered slightly more than 50 animals. A few sightings of solitary sea otters were recorded south of Point Sal toward Point Conception. The distribution of sea otters along the coast of the southern sector is non-uniform. Several general areas of high concentration were identified in 1983, including Shell Beach/Point San Luis, Cayucos Point, Cambria/San Simeon, Breaker Point (35°44'N), Prewitt Creek (35°55'N), Anderson Canyon (36°09'N), and the lee of Point Sur. South of Point Piedras Blancas the numbers of independent animals increased about 13% from 374 counted in 1982 (U.S. Fish and Wildlife Semite shore-based census) to 418 in 1983 (relative abundance of 42%). The population size from Point Piedras Blancas north to Point Sur is less well known. A total for this area of 434 independent animals was obtained in' 1982 (USFWS census), compared with a count of 303 obtained on aerial survey in 1983 (relative abundance of 30%). It is likely that a real decline in numbers of sea otters along the Big Sur coast occurred from 1982 to 1983, and reflects a movement of individuals to the north and south. Counts obtained should be considered minimum population estimates. Winter and spring constitute the pupping season for the California sea otter population; on aerial surveys, conducted from February to June 1983, pups were seen in all areas occupied by sea otters from Cayucos Point in the south to about Pfeiffer Point in the north (36°15'N).

SOUTHERN SECTOR
Spring—Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.11 ±0.08	0.83 ±0 .48	0.42 *0.78
Mean cetacean Biomass (kg/km²)	2,231.70	393.0	122.80
Mean Sea Surface Temperature "C (±SE)	11.9° ±0.5	13.3° *0.4	13.5° ±0.4
Percentage of Observed Cetaceans x Depth	4.3%	80.3%	15.4%
Percentage of Biomass x Depth	81.2%	14.3%	4.5%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Northern right whale dolphin	Northern right whale dolphin
Grampus	Grampus	Grampus
Harbor porpoise	Pacific white-sided dolphin " -	Pacific white-sided dolphin
	Gray whale	
	Baird's beaked whale	
	Humpback whale	

Cetaceans observed in the spring period were generally widespread throughout the sector but with several specific areas of concentration. Of the three depth regions surveyed, the continental slope supported the greatest abundance (80%) of animals.

Shelf. Nearshore waters of the shelf held only 4% of the animals but 81% of the sector biomass. The relatively high shelf biomass figures are directly attributable to the seasonal presence of migrating gray whales, More than 200 individual animals were sighted between Point Pines and Point Conception. Gray whales also contributed a significant portion of the biomass on the slope.

Harbor porpoises were a minor faunal constituent in shelf waters where only scattered sightings were recorded. The southern sector is basically the southern terminus of the harbor porpoise range along the northern and central California coastline. The species has rarely been observed south of Point Conception.

Relatively few scattered sightings of small groups of grampus, Dall's porpoises, and Pacific white-sided dolphins occurred in the area between Morro Bay and Point Sur. These three species were among the most abundant animals in the waters of both the slope and the offshore regions.

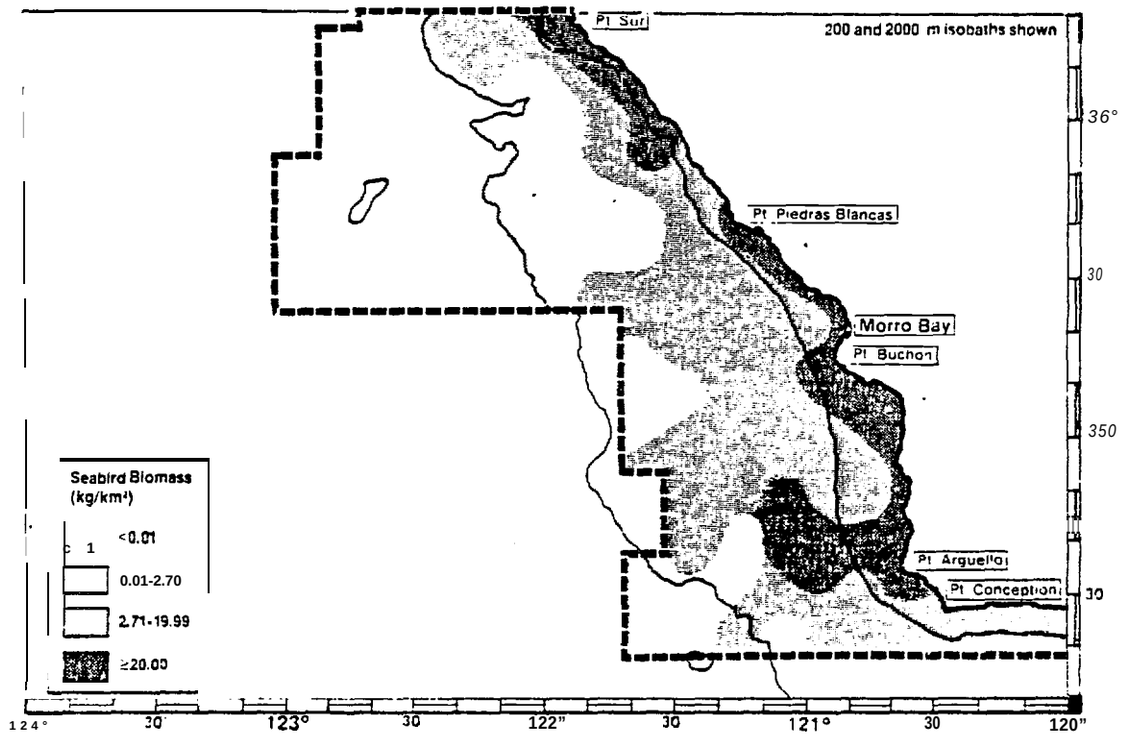
Slope. As indicated above, more than 80% of the seasonal count of cetaceans in the southern sector occurred over the continental slope. Combined numbers of the three most prevalent species — northern right whale dolphins, grampus, and Pacific white-sided dolphins — yielded almost 5,000 Individuals or 97% of all cetaceans in the region. Of this total, more than 38% were northern right whale dolphins. Larger schools and higher densities of Pacific white-sided dolphins and northern right whale dolphins were observed west of Point Piedras Blancas, near the edge of the *slope.* Modest numbers of Dall's porpoises were also present, reflecting almost a seven-fold increase in abundance over that of the adjacent shelf region. Groups *were* small and widely scattered over the slope, with their distribution pattern supporting the traditionally held opinion that they prefer cooler waters deeper than 100 fm.

Representative species of larger cetaceans on the slope were humpback whales, gray whales, and Baird's beaked whales, which added significantly to biomass figures for this depth region. Gray whales were the most abundant of the three species. The majority of the gray whale sightings occurred between Point Sur and Point Piedras Blancas, where the continental shelf is quite narrow and the slope fairly broad.

Offshore. Five species were present in offshore waters in spring, with northern right whale dolphins, grampus, and Pacific white-sided dolphins again the most prevalent. School sizes were

moderate and sightings patchy. These three species were greatly reduced in number when compared to the adjacent slope area (less than one-fourth the slope population). Dan's porpoises and pilot whales were also in the area but not in notable numbers.

SOUTHERN SECTOR
Spring-Seabirds



POPULATION INDICES	Offshore (22,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km^2 ±SE)	3.07, ±0.51	17.47 ±2.91	91.18 ±41.34
Mean Biomass Density (kg/km^2 ±SE)	1.30 ±0.69	8.65 ±1.92	37.31 ±10.89
Mean Number of Species Observed (±SD)	6.56 ±1.77	18.67 ±2.87	15.56 ±3.98
Mean Species Diversity Index (H' ±SD)	1.53 *0.31	1.48 ±0.46	1.52 ±0.63

May Mean Population Ashore (±SD): 12,186 ±3,753
May Mean Surface-nesting Population Ashore (±SD): 5,665 ±557

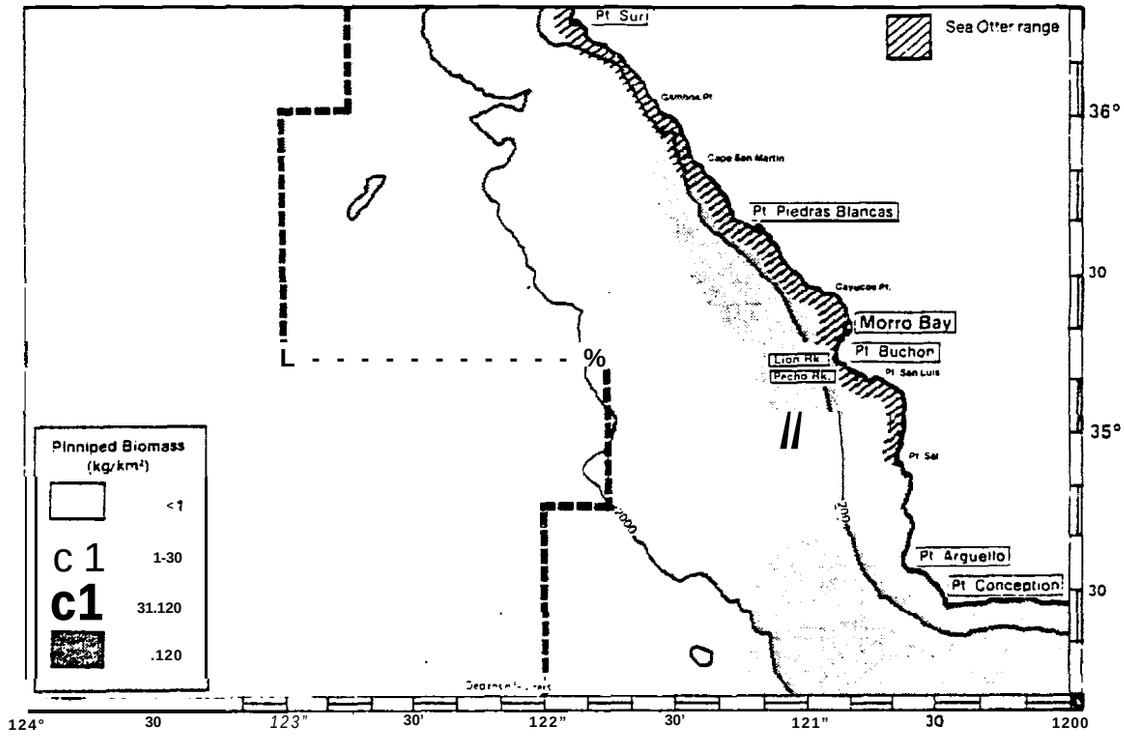
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Socty Shearwater	Sooty	Arctic Loon	Western Grebe
Phalaropes	Shearwater	sooty Shearwater	Brandt's Cormorant
Leach's	Phalaropes	Phalaropes	Surf Scoter
Storm-Petrel		Bonaparte's Gull	Western Gull
			Phalaropes
			Common Murre

Relatively few seabirds nest south of Point Sur, compared with areas to the north. Instead, the fauna is dominated in spring by numbers of migrants, particularly Sooty Shearwaters, phalaropes, and Bonaparte's Gulls and by late-wintering populations of gulls, Western Grebes, Murres, and auklets. As the wintering populations move northward in April and May, species numbers drop, particularly offshore. Coastal populations then" are dominated by birds from small nesting colonies of Brandt's Cormorants and Western Gulls, while shearwaters and phalaropes are numerically preeminent everywhere else.

A zone of high biomass density extended along the shelf here in spring, primarily reflecting the presence of shearwaters, phalaropes, and gulls. Very high abundance averages in shelf waters were not matched by biomass figures, primarily due to the relatively great contribution to numbers by the small (0.05 kg) phalaropes. Variation in mean bird density on the shelf was quite high here due to temporal unpredictability of extreme concentrations of shearwaters and phalaropes.

SOUTHERN SECTOR
Summer—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200 -1,999 m)	Shelf (0-199 m)
California sea lion	0.003 ±0.003	**0.079** ±0.038	**0.277** ±0.127
Northern fur seal	0.017 +0.012	**0.014** ±0.008	0.002 ±0.003
Steller sea lion	0.0	0.0	0.005 ±0.005
Harbor seal	0.0	0.0	0.003 ±0.005
Northern elephant seal	0.0	0,008 ±0.005	0.012 ±0.018
All Pinnipeds	0.020 ±0.007	0.101 ±0.044	0.299 ±0.131
Biomass (kg/km²)	1.21 *0,40	26.05 ±11.30	77.69 ±33.95

Abundance on LAND (numbers counted)	1-3 July 1980	30 June, 1,8 July 1981	28-30 June 1992
California sea lion	2,091 (55%)	4,403 (69%)	4,398 (66%)
Steller sea lion	1 (<l%)	2 (<l%)	2 (1%)
Harbor seal	1,708 (45%)	1,946 (31%)	2,248 (34%)
Northern elephant seal	0	20 (<1%)	0
All Pinnipeds	3,800	6,371	6,648

Pinnipeds

In the summer of 1982, 3,681 pinnipeds were counted on rocks from Point Conception to Point Buchon (35°15'N). California sea lions, with a population of 2,713 animals, represented 73,7% of the count in this area. They were found primarily at three locations: Point Sal Rock with 755 animals in 1982 (down from 1,055 in 1981), Pecho Rock with 581 animals in 1982 (down from 1,568 in 1981), and Lion Rock with 1,259 in 1982 (up from 830 in 1981). Harbor seals totaled 968 for this area, representing 26.3% of the total, and were found on nearshore rocks and beaches at several locations. From Cayucos Point (35°26'N) to Point Piedras Blancas (35°39'N) 1,743 pinnipeds were on land in 1982; California sea lions, with a population of 1,193, accounted for 68.4% of the pinnipeds in this area and were found primarily at White Rock near Cambria (128) and on the rocks at Point Piedras Blancas (1,065). Harbor seals, with a population of 548 hauled-out on nearshore rocks (down from 714 counted in 1981), accounted for 31.4% of the pinnipeds in the area. Along the Big Sur coast from Point Piedras Blancas to Point Sur 1,224 pinnipeds were hauled out in 1982. Harbor seals, with a population of 732, accounted for 59.8% of the total number counted in this area. A total Of 492 California sea lions (40.2% of the pinnipeds counted) were seen at cape San Martin (35°53'N) and at Vicente Creek (36°02'N). at cape San Martin in June-July 1981, 19 northern elephant seals were seen; none were seen there in 1982.

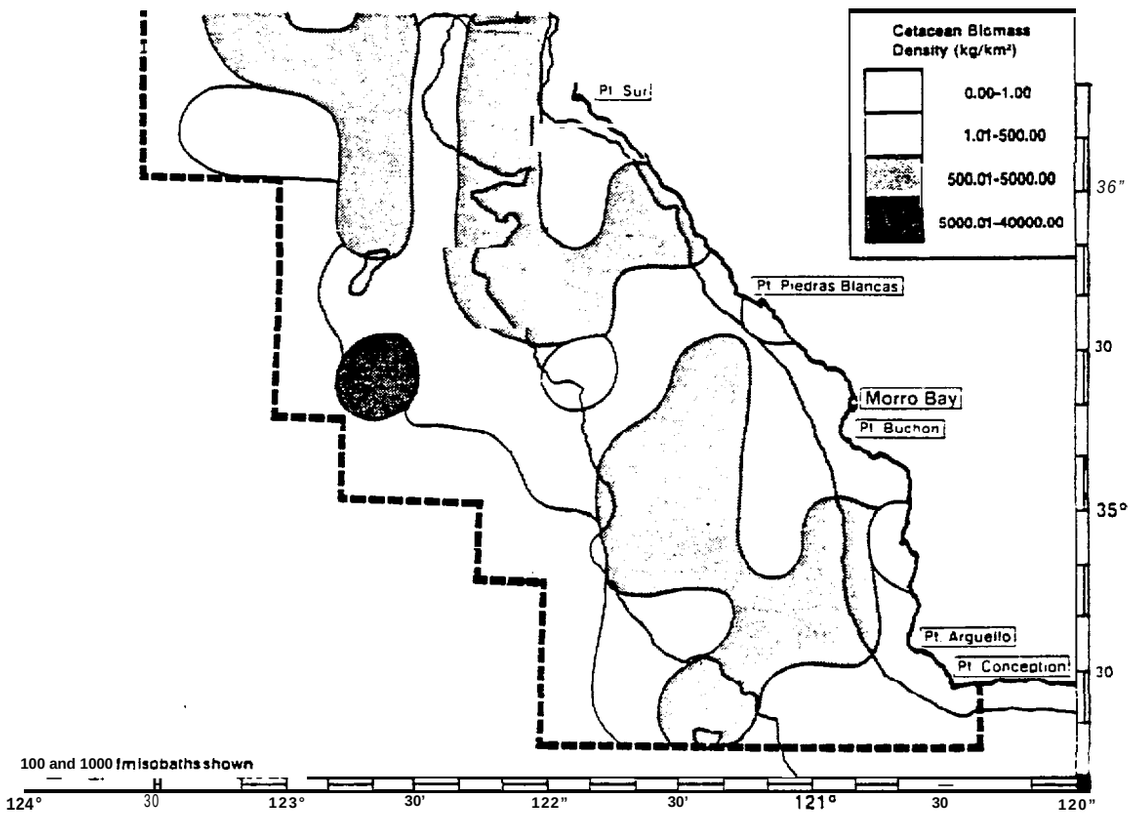
In the *summer* months, the highest mean density at sea was found for waters over the continental shelf where California sea lions represented 85% of all sightings. The abundance of California sea lions in the southern sector in summer is higher than that of either spring or winter due to the general concentration of this species for breeding in the waters of the Southern California Bight. The population found on land in the southern sector constitutes a peripheral nonbreeding component of the species' distribution during

the summer breeding season: however, many of the California sea lion sightings at sea in this sector are probably foraging animals directly associated with the San Miguel Island Rookery. The pelagic population of northern fur seals was much reduced from spring levels, and nearly ail were found over the continental slope, Northern fur seals represented 16% of all pinniped sightings in summer in the southern sector; most fur seals seen were probably associated with the San Miguel Island colony.

Sea Otters

In summer and autumn the sea otter population in the southern sector becomes more concentrated in the center of the range as males from the southern peripheral groups move northward in search of estrous females. From spring to autumn on U.S. Fish and wildlife Service shore-based censuses in 1982, the population component south of Cayucos Point declined 56% from 147 to 65 independent animals, while numbers from Cayucos Point to Point Piedras Blancas increased 11% from 227 to 252 independent animals. Numbers from Point Piedras Blancas northward to Point Sur declined from spring to autumn due to a population redistribution probably involving females as well as males. Calculations based on the proportional decrease in numbers south of Point Piedras Blancas associated with the breeding season indicate a minimum autumn 1983 population estimate of 406 independent animals south of Point Piedras Blancas (relative abundance of 41%), and 375 independent animals from Point Piedras Blancas to Point Sur (relative abundance of 38%).

SOUTHERN SECTOR
Summer-Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km^2 ±SE)	0.04 ±0 .09	1.15 ±1.31	1.31 ±1.62
Mean Cetacean Biomass (kg/km^2)	1,330.81	1,139.34	381.86
Mean Sea Surface Temperature 'C (±SE)	13,6° ±0.6	14.4° ±0.5	15.2" ±0.3
Percentage of Observed Cetaceans x Depth	0.7%	73.6%	25.6%
Percentage of Biomass x Depth	46.7%	39.9%	13.4%

Predominant Species

Shelf	Slope	offshore
Dall's porpoise	Pacific white-sided dolphin	Northern right whale dolphin
Harbor porpoise	Northern right whale dolphin	Grampus
Humpback whale	Grampus	Pacific white-sided dolphin
	Dall's porpoise	
	Humpback whale	
	Fin whale	

Species diversity, biomass, and total individual animals in this sector increased relative to the other sectors in this season. Mean sea surface temperatures were also highest of the summer in this sector, ranging from 13.6°C on the shelf to 15.2°C offshore.

shelf. Shelf waters supported relatively small numbers of animals and contributed less than 1% to the total cetacean fauna of the sector, but accounted for almost 50% of the biomass. Low numbers of Dall's porpoises and northern right whale dolphins, plus a few scattered harbor porpoises, constituted the toothed whale population. Humpback and blue whales represented the baleen species on the shelf, and all were observed as either solitary individuals or pairs. All blue whales were encountered between Point Arguello and Point Buchon, while the humpbacks were between Morro Bay and Point Sur.

Slope. The continental slope contained the highest numerical totals (74%) for summer. Pacific white-sided dolphins, northern right whale dolphins, and grampus were responsible for the region's high

animal count, with a combined total of more than 7,100 animals. These three species yielded approximately 98% of the slope count.

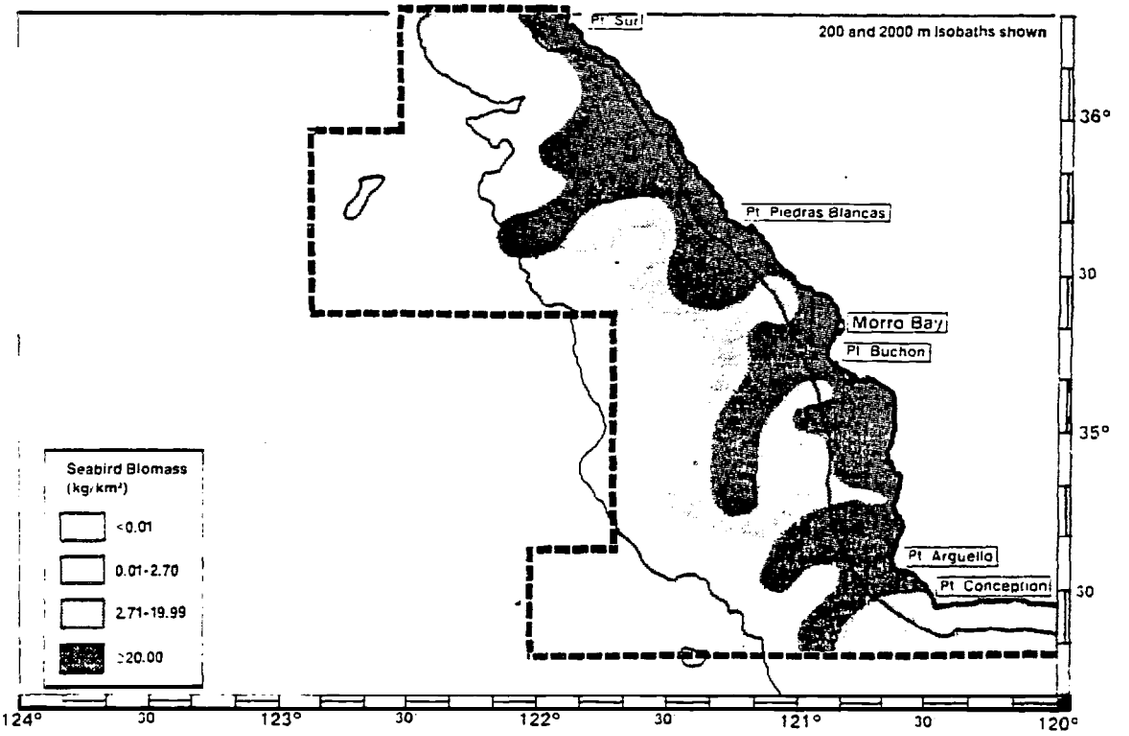
Dan's porpoises, seen in all three depth regions, contributed less than 1% to the cetacean slope population. In contrast, this species was the most numerous toothed whale on the continental shelf.

Three baleen species — humpback, fin, and blue whales — were observed on the slope in moderately high numbers for the season. The humpback whales were represented by 46 individuals in the area plus one solitary animal offshore. The species was significantly more abundant in the Farallon basin of the south-central sector than in this sector. Sixteen fin whales were observed in the area — the largest aggregation of the species recorded during the three years of survey. In autumn this same sector supported 14 fin whales.

Blue whales totaled 16 individuals in Summer: 2 in shelf waters and 14 on the slope. The largest single pod recorded during the three-year survey (10 animals) was observed in July, southwest of Point Conception. This sighting technically occurred outside the limits of the study area since it occurred in a marginal zone, but is included to delineate movement patterns and relative abundance of the species. The major influx of this species into/through the survey area did not occur until the autumn period.

Offshore. The offshore region in summer supported Dan's porpoises, Bairdgs beaked whales, and a single humpback whale. Northern right whale dolphins, grampus, and Pacific white-sided dolphins were the most numerous species in the area, with the northern right whale dolphins having a 2:1 numerical advantage over the other two species. School sizes of the three species ran moderately high in some areas, with some composed of as many as 200-300 individuals.

SOUTHERN SECTOR
Summer-Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope (200-1,999 m)	Shelf (0-200 m)
Mean Seabird Density (birds/km^2 ±SE)	3.12 ±0.69	32.05 ±8.88	154.53 ±56.25
Mean Biomass Density (kg/km^2 ±SE)	0.74 ±0.12	18.66 ±6.24	72.07 ±26.25
Mean Number of Species Observed (±SD)	6.56 ±2.22	20,56 ±3.44	15.22 ±2.97
Mean Species Diversity Index (H' ±SD)	1.44 ±0.34	1.42 ±0.45	1.42 ±0.34

July Mean Population Ashore (±SD): 24,961 ±16,245

July Mean Surface-nesting Population Ashore (±SD): 9,043 ±2,383

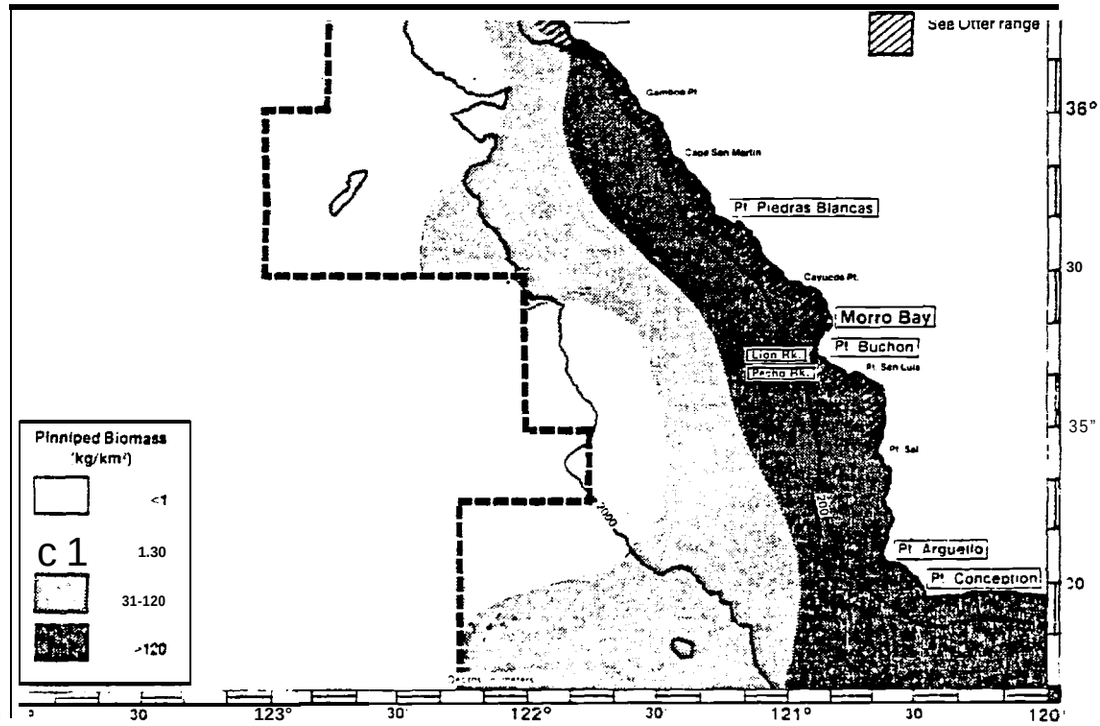
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Phalaropes	sooty	sooty	Brown Pelican
Leach's	Shearwaters	Shearwater	Brandt's Cormorant
Storm--Petrel	Phalaropes	Phalaropes	Western Gull
			Heerman's Gull

The nesting population of Brandt's Cormorants reached the annual maximum at the half-dozen moderately large colonies here in July. Smaller numbers of Pelagic Cormorants, Western Gulls, and Pigeon Guillemots rounded-out the bulk of the nesting fauna. Also prominent along the shoreline were thousands of Brown Pelicans and Heermann's Gulls that summered in the area following their nesting seasons in southern California and Mexico, In waters overlying the continental shelf we encountered very high densities of Sooty Shearwaters, phalaropes, murres, and Cassin's Auklets, in addition to the nesting species and summer visitors mentioned previously. Farther to seaward, Leach's Storm-Petrels, Buller's Shearwaters, Sabine's Gulls, Common/Arctic Terns, and murrelets (probably Xantus') occurred in moderate numbers during migration. Overall bird species numbers and diversity were relatively low here in summer, particularly offshore,

A zone of high biomass density occurred over the shelf north of Point Arguello; its outer margin and width were irregular. A 'tongue' ' or 'plume' of high biomass density also extended toward Davidson Seamount from the coast about 50 km south of Point Sur; its outlines somewhat resembled those of upwelling plumes frequently seen.in satellite surface temperature images of the same region.

SOUTHERN SECTOR
Autumn—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.013 ±0.011	0.174 ±0.057	1.340 ±0.567
Northern fur seal	0.008 ±0.006	0.010 ±0.004	0.0
Steller sea lion	0.0	0.002 ±0.002	0.0
Harbor seal	0.0	0.001 ±0.002	0.012 ±0.014
Northern elephant seal	0.0	0.008 ±0.005	0.015 ±0.014
All Pinnipeds	0.021 ±0.013	0.195 ±0.060	1.367 ±0.557
Biomass (kg/km²)	2.46 ±1.55	48.46 ±14.88	624.71 ±253.63

Abundance on LAND (numbers counted)	28-30 Oct. 1980	28-30 Sept. 1981	27-28 Oct. 1982
California sea lion	1,782 (97%)	5,660 (97%)	3,824 (86%)
Steller sea lion	0	2 (<1%)	0
Harbor seal	64 (3%)	82 (1%)	331 (7%)
Northern elephant seal	0	80 (1%)	317 (7%)
All Pinnipeds	1,846	5,824	4,472

Pinnipeds

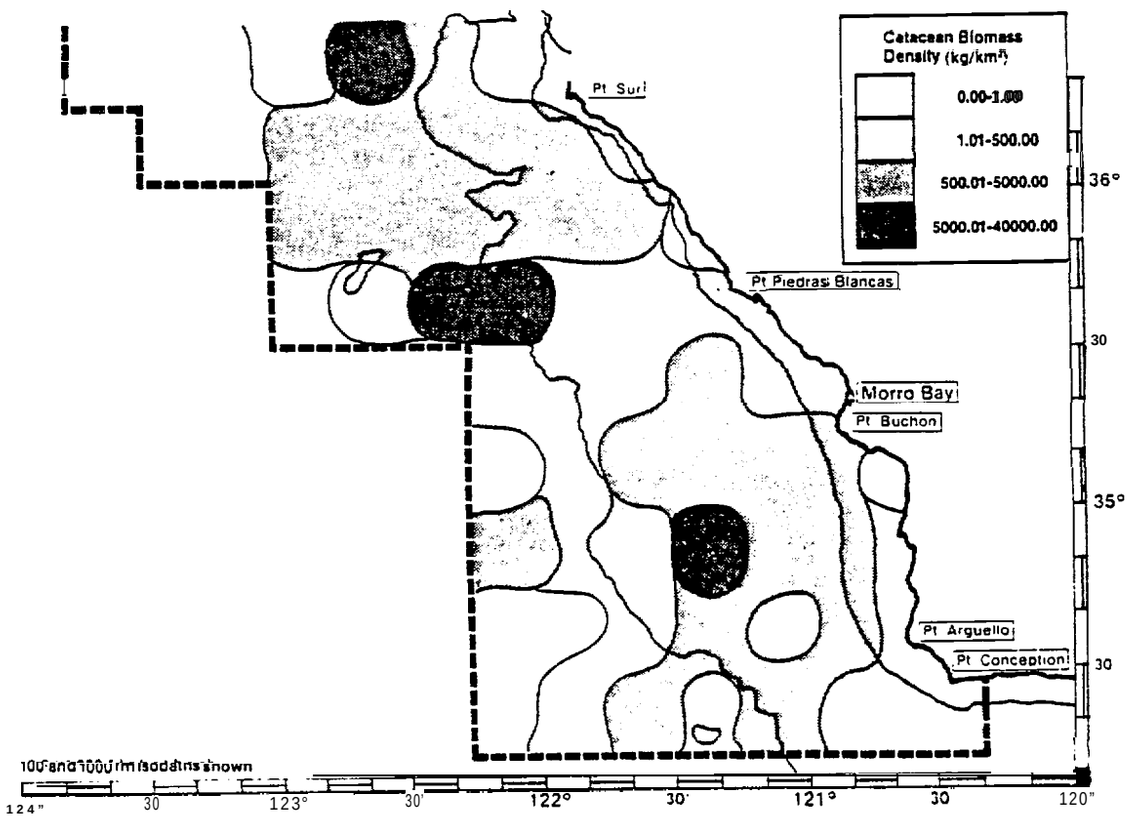
The rocks from Point Sal (34°53'N) to Point Buchon (35 °15'N) were well occupied by California sea lions in 1981 and 1982, with populations of 3,687 and 2,566, respectively; only 848 were counted in autumn 1980. Other species present in these years included only a single elephant seal in 1982 and 4 harbor seals in 1981. From Cayucos Point (35°26'N) to Point Piedras Blancas (35°39'N) we counted 661 pinnipeds in 1982. California sea lions represented 91.7% of the total for this area, with a count of 606. This was a decrease from the 1,511 counted in 1981. In both years almost all the California sea lions were hauled out on the rocks of Point Piedras Blancas. North from Piedras Blancas to Point Sur (36°18'N) we counted 1,223 pinnipeds in 1982. The autumn 1982 count included 653 California sea lions (53.3% of the total), 316 northern elephant seals (25.8% *of* the total), and 255 harbor seals (20.9% of the total). All of the elephant seals and 502 of the California sea lions were hauled out at Cape San Martin (35°53'N); the remaining California sea lions were seen at *Grimes* Point (36°12'N).

In the southern sector the highest densities at sea occurred in autumn as California sea lions migrated northward into central California waters following their summer breeding season. Most sightings *were* recorded *over* the shelf (49%) and slope (46%); the mean density over the shelf (1.37 animals/km^2) was seven times that of the slope due to the smaller extrapolation area. California sea lions represented 86% of all pinniped sightings and 96% *of* sightings over the shelf. Northern fur seals, probably associated with the San Miguel Island colony, were seen occasionally on transects through the slope and offshore depth regions and represented 9% of all pinniped sightings at sea. Nearly the entire shelf and slope area was occupied at high to moderately high density; the greatest use of the offshore waters appeared to be centered in the vicinity of Davidson Seamount and the Santa Lucia Escarpment.

Sea Otters

In summer and autumn the sea otter population in the southern sector becomes more concentrated in the center of the range, as males from the southern peripheral groups move northward in search of estrous females. From spring to autumn on U.S. Fish and Wildlife Service shore-based censuses in 1982, the population component south of Cayucos Point declined 56% from 147 to 65 independent animals, while numbers from Cayucos Point to Point Piedras Blancas increased 11% from 227 to 252 independent animals. Numbers from Point Piedras Blancas northward to Point Sur declined from spring to autumn due to a population redistribution probably involving females as well as males. Calculations based on the proportional decrease in numbers south of Point Piedras Blancas associated with the breeding season indicate a minimum autumn 1983 population estimate of 405 independent animals south of Point Piedras Blancas (relative abundance of 41%), and 375 independent animals from Point Piedras Blancas to Point Sur (relative abundance of 38%).

SOUTHERN SECTOR
Autumn—Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.11 ±0.38	1.72 ±2.04	2.35 ±0.76
Mean Cetacean Biomass (kg/km²)	211.15	1,077.99	580.88
Mean Sea Surface Temperature °C (±SE)	15.3° ±0.6	16.0° *0.5	16.1° ±0.1
Percentage of Observed cetaceans x Depth	1.4%	70.2%	28.3%
Percentage of Biomass x Depth	11.3%	57.6%	31.1%

Predominant Species

Shelf	slope	Offshore
Pacific white-sided dolphin	Pacific white-sided dolphin	Northern right whale dolphin
Harbor porpoise	Grampus	Pacific white-sided dolphin
	Northern right whale dolphin	Sperm whale
	Humpback whale	
	Baird's beaked whale	
	Fin whale	
	Blue whale	

Shelf. The number of animals occupying shelf waters increased substantially over the low summer periods, due primarily to an influx of Pacific white-sided dolphins along the Big Sur coast and near Point Buchon. Diversity, as usual, was low in the shallow waters of this sector. Harbor porpoises, sever prevalent along this coast, approached peak annual numbers off Point Piedras Blancas and Point Sal (34°54'N). Mean cetacean biomass, the lowest for any season, reflected the absence of humpback, blue, and gray whales noted in these waters in other seasons.

slope. Autumn, on the slope, produced the second greatest animal abundance and mean cetacean density of the year. Animals were distributed throughout the sector, with one area of particularly high utilization and several of modestly high values. Schools were frequently comprised of two or three cetacean species; the Pacific white-sided dolphin was the dominant animal observed. Concentrations southwest of Point Sur and Point Buchon were primarily of Pacific white-sided dolphins and grampus, while less densely occupied waters

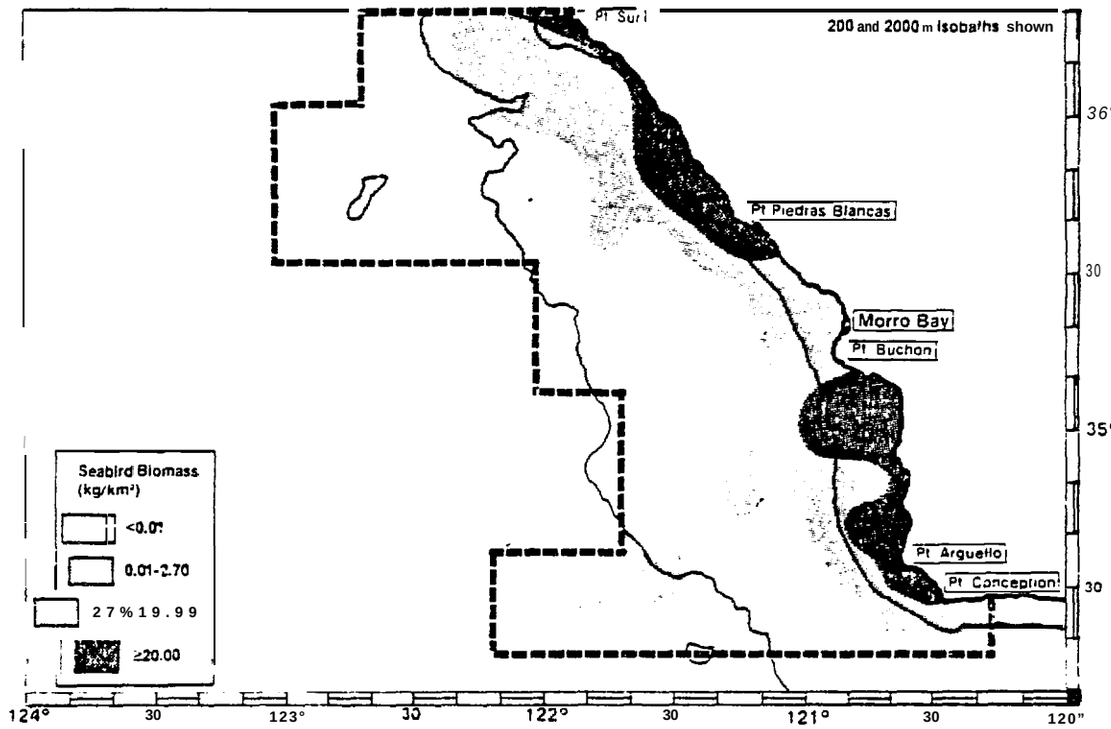
off Point Conception and Point Piedras Blancas were frequently the province of northern right whale dolphins and Dan's porpoises.

The Santa Lucia Banks lie about 40 nm west of Point Sal and rise to within 200 fm of the surface. These banks are always heavily utilized by cetaceans, with thirteen different species having been observed during this three-year study and seven species seen during one aerial survey. Contributing substantially to the biomass values were frequent observations of humpback, Baird's beaked, fin, blue, and sperm whales, in addition to the smaller cetaceans. Mixed schools of these smaller animals, including Pacific white-sided dolphins, northern right whale dolphins, grampus, and Dan's porpoises, were the rule rather than the exception in this particular region.

Offshore. Northern right whale dolphins were distributed in all the offshore waters, with greatest concentrations found west cf Point Piedras Blancas to the northern boundary of this sector. This species reached maximum numbers for these offshore waters in this season. In contrast, the distribution offshore of the Pacific white-sided dolphin was patchy and tended to concentrate south and west *of* Point Buchon as an irregular continuation of their pattern over the slope. Sperm whales congregated over the steeper portions of the Santa Lucia Escarpment, probably as an extension of their occupancy on the Santa Lucia Banks. Surprisingly, no blue, fin, or bottlenose whales were ever sighted in these deeper waters in autumn, and only a small percentage of humpback whales (<2%) were recorded.

Sea surface temperatures were slightly cooler in nearshore waters, compared to the homogeneous temperatures found over the slope and offshore.

SOUTHERN SECTOR
Autumn-Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope (200-1,999 m)	Shelf (0-1.99 m)
Mean Seabird Density (birds/km² ±SE)	7,86 ±3.23	25.56 ±5.19	98.23 ±41.46
Mean Biomass Density (kg/km² ±SE)	2.15 ±1.05	6.52 ±2.33	79,03 *37.79
Mean Number of Species Observed (±SD)	7,83 ±2.79	20.67 ±4.23	18.00 ±3.21
Mean Species Diversity Index (H' ±SD)	1.32 ±0.57	1.26 ±0.51	2.01 ±0.31

September/October Mean Population Ashore (±SD): 20,735 ±8,519

PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Phalaropes	Phalaropes	Arctic Loon	Arctic Loon
	California Gull	Sooty Shearwater	Western Grebe
		Phalaropes	Brown Pelican
		Cassin's Auklet	Brandt's Cormorant
		Common Murre	Western Gull
		California Gull	California Gull
		Western Gull	Heerman's Gull
			Bonaparte's Gull

Populations of migrants, winter visitors and nesting residents intermingled to produce high average biomass densities throughout continental shelf waters of this sector in autumn. For the most part, the fauna of the area was dominated numerically by gulls, phalaropes, and alcids, most of whom persisted in abundance into the winter months. Along the shoreline a variety of gulls, loons, grebes, and cormorants were abundant, Additionally, the dispersal of Brown Pelicans from Mexico into central California reached the annual maximum in September and October with over 8,000 birds at roosts along this section of coast in 1981. Brandt's Cormorants which nested at colonies north of Point Sur appeared to disperse away from the area from Point Arena to Crescent City; many of them probably passed the fall and winter along the coastline south of Point Sur.

Zones where we found high biomass densities were confined to a section of neritic waters near point Arguello, and a longer, but narrow (to 20 km) section extending over the shelf from Point Sur to a point about 20 km southeast of Point Piedras Blancas. Biomass densities were much lower in waters seaward of tne shelf. Here, the gulls and other species that predominated nearshore were replaced by much smaller numbers of small-bodied phalaropes and Cassin's Auklets.

Figure 20. (facing page) South-central. sector: Comparison of monthly mean sea surface temperatures, deviation of temperature from climatic (20-year) seasonal means, and upwelling index. Data are modified from Auer (cd., 1981-1983), A. Bakun(pers. comm.), and this study.

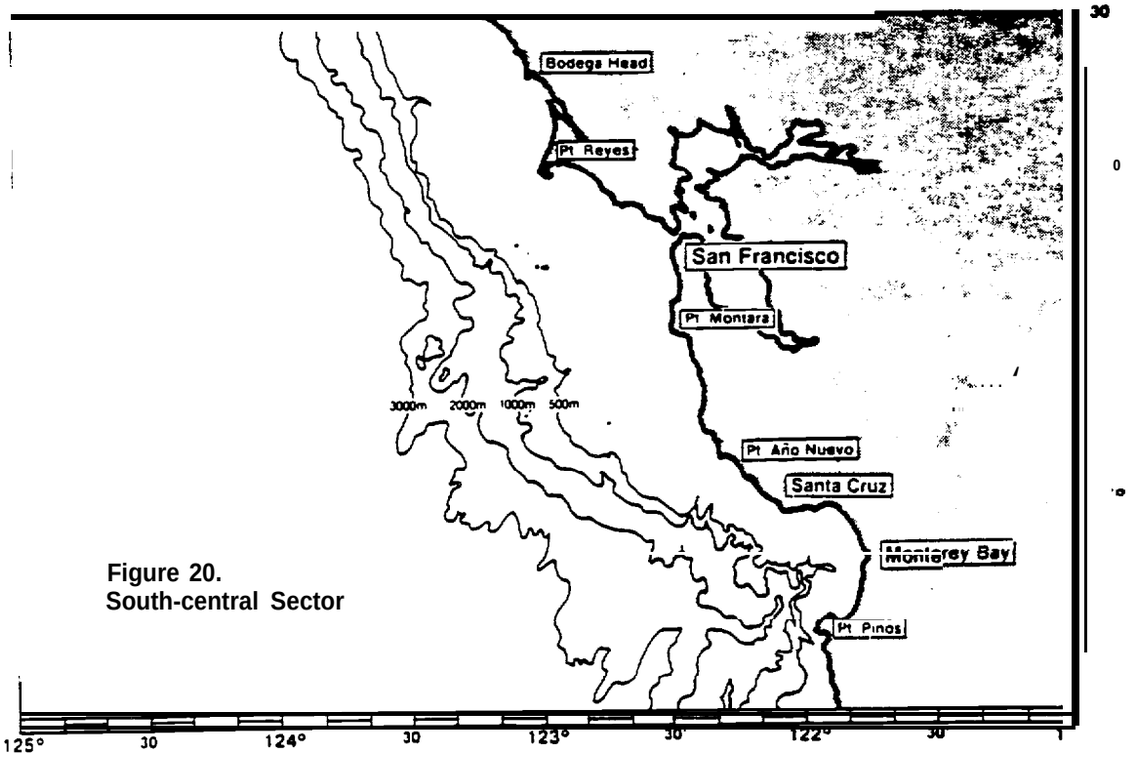
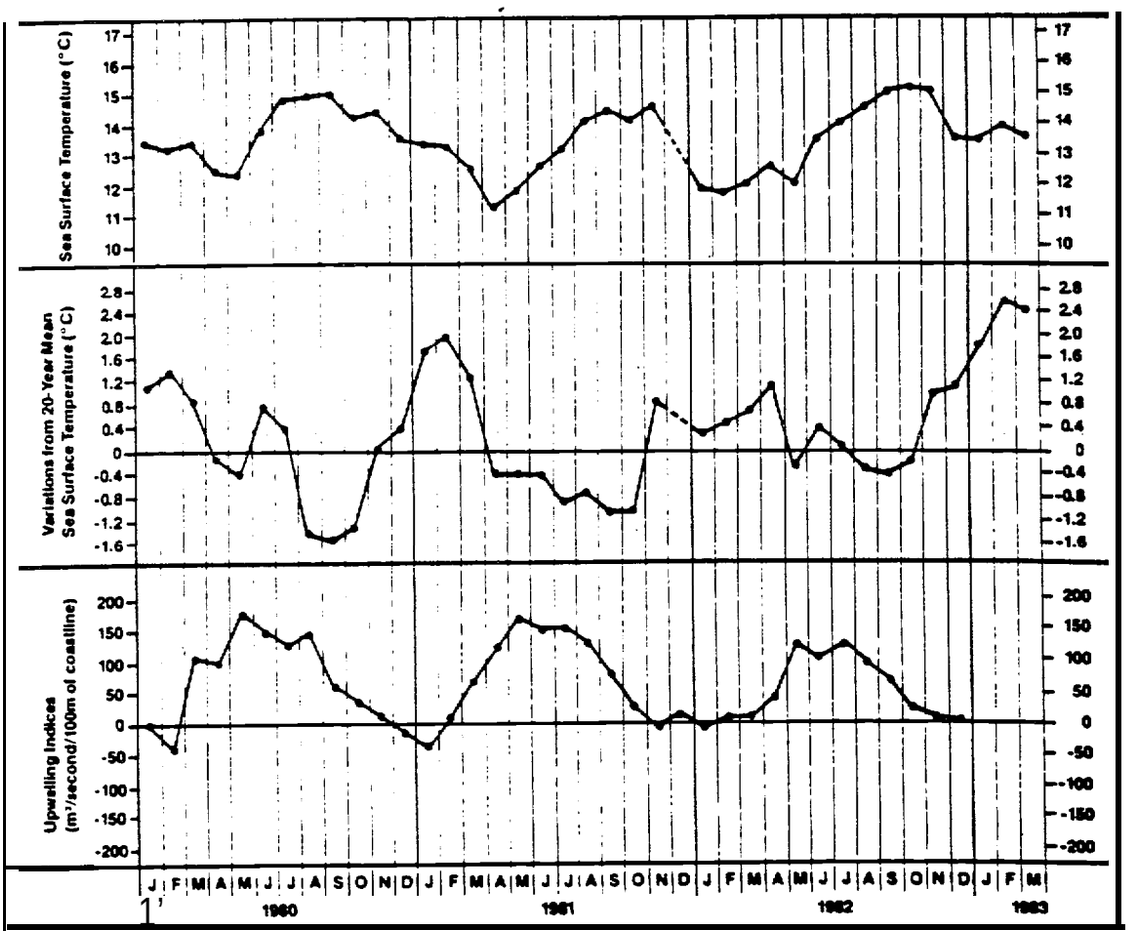
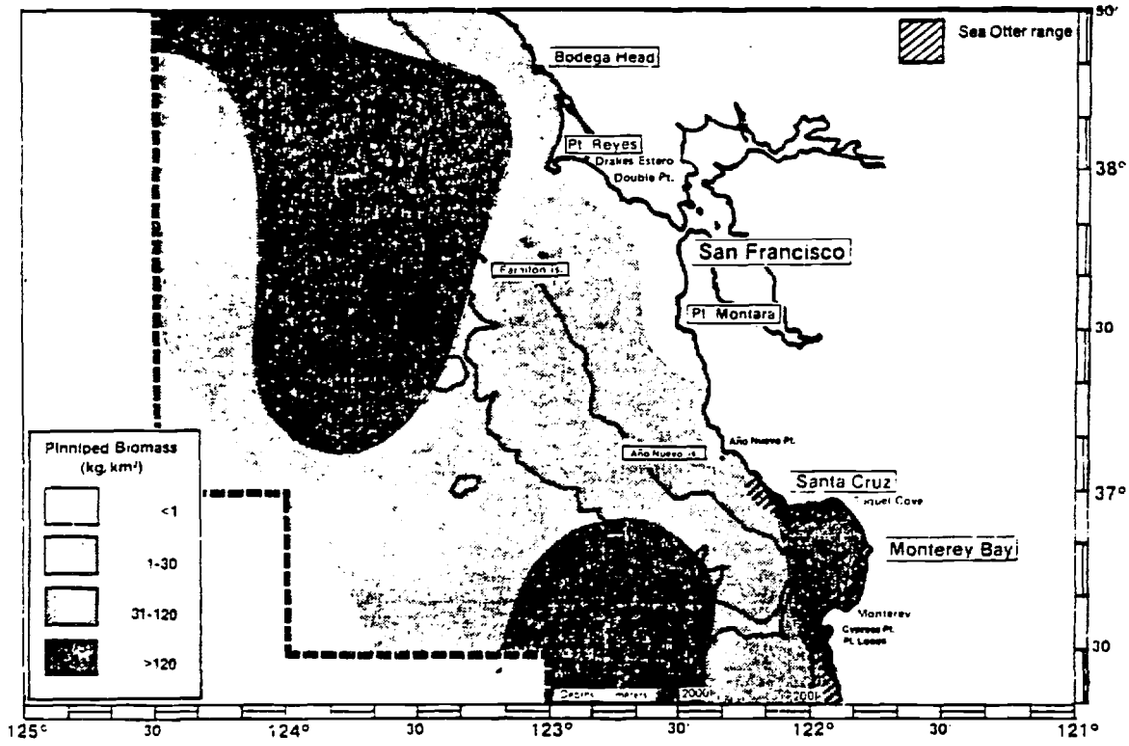


Figure 20.
South-central Sector



SOUTH-CENTRAL SECTOR
Winter—Pinnipeds, Sea Otters



Abundance at SEA (animals/km ±SE)	Offshore (>2,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
California sea non	0.007 ±0.001	0.061 ±0.029	0.159 ±0.074
Northern fur seal	0.141 ±0.042	0.065 ±0.032	0.005 ±0.004
Steller sea lion	0.002 ±0.004	0.0	0.002 ±0.002
Harbor seal	0.0	0.002 ±0.003	0.064 ±0.041
Northern elephant seal	0.004 *0.005	0.006 ±0.005	0.14 ±0.012
All Pinnipeds	0.154 ±0.045	0.134 *0.054	0.370 ±0.141
Biomass (kg/km^2)	12.56 ±3.65	18.57 ±7.46	91.13 ±34.72

Abundance on LAND (numbers counted)	20-30 Jan. 1980	2S-30 Jan. 1981	25-27 Jan. 1982
California sea lion	2,411 (3S%)	2,750 (37%)	2,240 (37%)
Steller sea lion	54 (l%)	242 (3%)	258 (4%)
Harbor seal	1,280 (20%)	1,883 (25%)	125 (23)
Northern elephant seal	2,561 (41%)	2,658 (35%)	3,365 (56%)
All Pinnipeds	6, 306	7,533	5,988

Pinnipeds

From Point Lobos (36°31'N) to Monterey Harbor (36°37'N) we counted 620 pinnipeds in 1982, representing 7.2% of the survey total. California sea lions, with a population of 506 animals on land (81.6% of the area total), were found primarily at Sea Lion Rocks (36°31'N), on Bird Rock (36°35'N), and on the Monterey Harbor breakwater (36°37'N). Also sighted on Sea Lion Rocks were 2 juvenile or adult female Steller sea lions. Harbor seals (112 animals, sighted at several locations on the Monterey Peninsula) comprised 18.1% of the area total.

On Año Nuevo Island and the adjacent mainland point, 2,743 northern elephant seals were counted from photographs taken in late January 1982. Of the total, 1,090 (68.9%) were on Año Nuevo Point, and 853 were on the mainland. The 1982 northern elephant seal count was an increase of 25.5% from the total of 2,185 obtained the year before. The Año Nuevo elepnant Seal population produced over 1,500 pups in 1982: an estimated 1,145 on the island and 364 on the mainland point. Northern elephant seals represented 90.5% of the area total in 1982; 287 California sea lions (9.5%) comprised the remainder of the Año Nuevo pinniped population in winter 1982.

On Southeast Farallon Island and contiguous West End (or Maintop), 622 northern elephant seals were counted from January 19S2 photographs. This represents a 31.5% increase from the 473 counted in 1981. The northern elephant seals were evenly divided between the Southeast Farallon rookery beach and that *on* Maintop. We estimate the pup production of the Farallon colony to have been 341 in 1982. Northern elephant seals represented 29.6% of the total pinniped count. Other species present *on* the Farallones were California sea lions (1,22s, or 58.4% of the island total), and Steller sea lions (254 *or* 12.1%).

From Bolinas Lagoon (37°56'N) to Point Reyes (37'' 59" N) we counted 688 harbor seals in 1981, representing 5.8% of the winter count; 468 were in Drake's Estero.

In the vicinity of Tomales Bay (38"10'N) and Bodega Rocks (38°17'N) we counted 1,158 pinnipeds in 1981, representing 9.5% of the 1981 winter survey total. Harbor seals, with a population of 645. represented 55.7% of the area total. California sea lions, with 513 animals present on Bodega Rocks, represented 44.3% of the total. Bodega Rocks are an important hauling ground fcr this *species* in winter; we counted 1,094 California sea lions *here* in 1980.

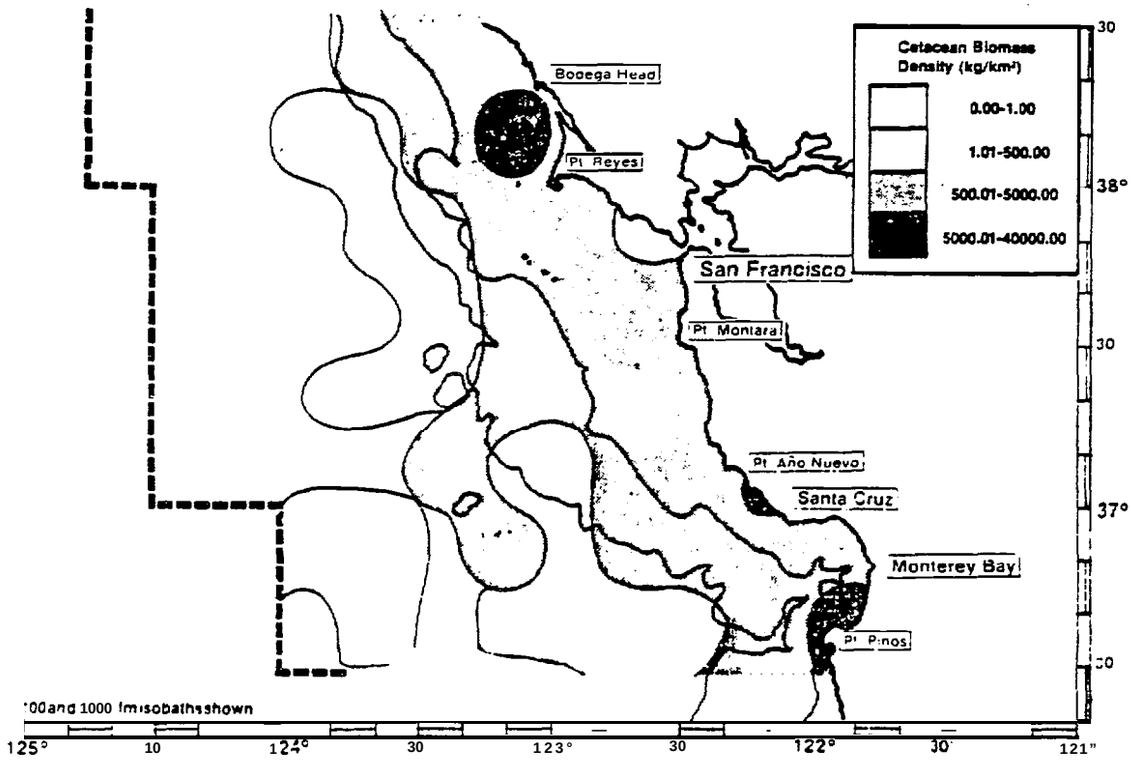
Pinniped sightings at sea in the south-central sector accounted for 36% *of* all sightings recorded on surveys in winter months. Of a total of 305 sightings, northern fur seals predominated with 68% of the sector-wide total, and 93% of all sightings in the offshore depth region. The second most abundant species was the California sea lion with 24% of the sector-wide total, and 61% of the population over the shelf. Harbor seals, with 4% of the total, were seen over the shelf; northern elephant seals, with 4% of the total, were seen in all depth regions. The overall mean density of pinnipeds in offshore waters was 0.15 animals/km^2. *Over* the slope, the mean density was 0.13 animals/km^2; over the shelf, the highest mean density of 0.37 animals/km^2 was recorded. Northern fur seals were most numerous over parts of the Monterey Seavalley, over and west of Guide and Pioneer seamounts, and over Cordell Bank. California sea lions were most abundant in Monterey Bay, and over Cordell Bank west of point Reyes.

Sea Otters

Approximately 28% of the California *sea* otter population is presently found north of Point Sur in winter and spring. Most sea otters are found in the lee *of* major points on the outer coast from

Point Sur to Point Piños (36° 38' N). Moderately large numbers are also found near Monterey and at Sequel Point near Santa Cruz. The Sequel Point raft has been declining in size since 1980 when 59 animals were counted; the count of June 1983 was 33 sea otters. The decline in the size of this raft was accompanied by an advance of the northern front to Sandhill Bluff (about 6 mi north of Santa Cruz), and by a wider distribution of solitary sea otters in the nearshore waters of northeastern Monterey Bay, The raft at Sandhill Bluff numbered 16 animals on surveys conducted in spring 1983; a few wanderers were seen between Sandhill Bluff and Año Nuevo Point. Numbers from Monterey to Cypress Point have shown a clear decline from 119 counted in 1982 to 56 counted in 1983. Concurrently, the population inhabiting the nearshore waters from Cypress Point southward to Point Sur has shown an increase in size, representing .17% of the total California population recorded on aerial surveys in spring 1983. The present size of the population from Cypress Point to Point Sur, while not known with certainty, probably numbers slightly more than 200 independent animals. Pups were commonly seen from Point Sur to Point Pines along the outer coast on aerial surveys conducted in winter and spring 1983, but were never seen in Monterey Bay from Point Piños to the Monterey/Seaside area. Single mother-pup pairs were recorded in Sequel Cove and near the Sandhill Bluff raft in spring 1983.

SOUTH-CENTRAL SECTOR
Winter-Cetaceans



	Shelf (0-99 fm)	slope (loo-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density <cetaceans/km² ±SE)	0.10 ±0.13	2.71 ±2 .21	0.32 *0,74
Mean Cetacean Biomass (kg/km²)	4,460.02	780,57	138.76
Mean Sea Surface Temperature 'C (±SE)	14.5° ±0.6	14.9° ±0.6	14.9° ±0.5
Percentage of Observed Cetaceans x Depth	4.5%	83.9%	11.6%
Percentage of Biomass x Depth	82. 9%	14.5%	2.6%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Pacific white-sided dolphin	Pacific white-sided dolphin
Grampus	Northern right whale dolphin	Northern right whale dolphin
Harbor porpoise	Grampus	Grampus
	Gray whale	sperm whale
	Dan's porpoise	

Shelf. Gray whales migrating through the shelf waters off Point Reyes, Santa Cruz County, and Point Piños were the major contributors to the high biomass values found in these areas, Harbor porpoises were seen clustered in Monterey Bay, south of Point Montara and, to a lesser degree, in the waters between Point Reyes and the Farallon Islands. Grampus were found off Point Pines, in Monterey Bay over the inner portions of the Monterey Canyon, and in shallow water from north of Point Reyes up to Tomales Point. Scattered sightings of small groups of Dan's porpoises and Pacific white-sided dolphins along the coast from Point Montara to Point Año Nuevo made up the remainder of the cetacean nearshore biomass.

Slope. Nine species of cetaceans, in fair to moderate numbers over the continental slope, accounted for the high percentage of observed animals for this realm. Gray whales traversing the Farallon basin added to the biomass figures, as did the occasional sperm, humpback, and killer whales.

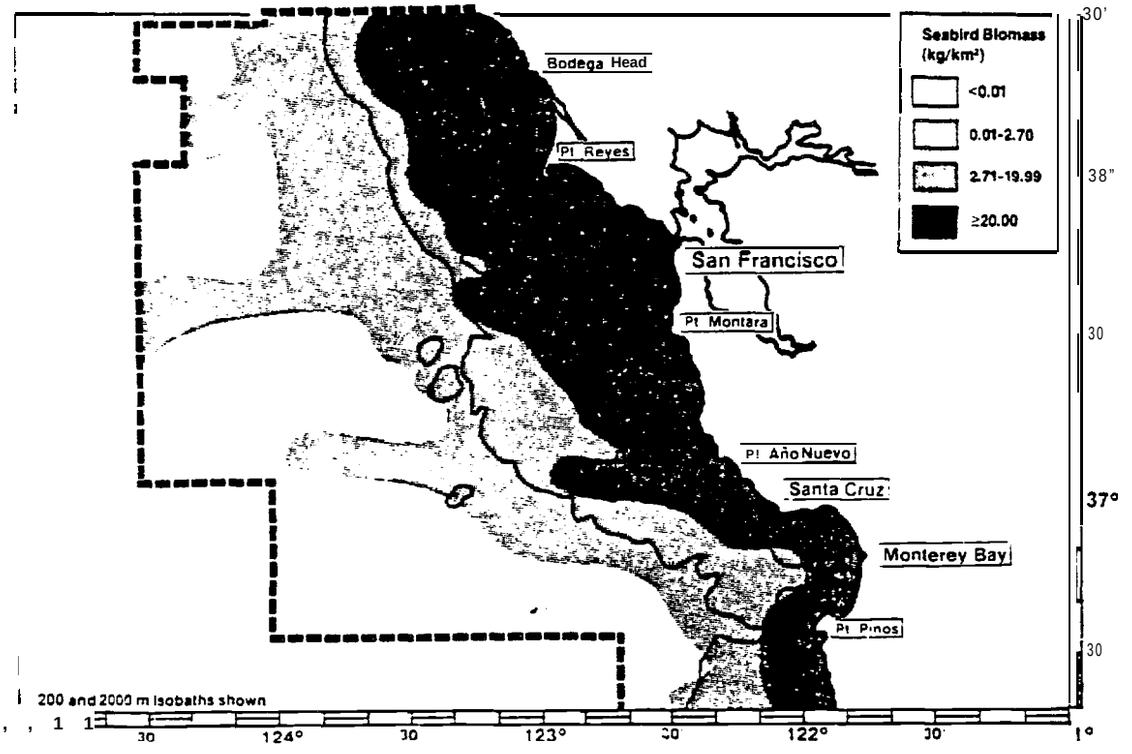
The largest cetacean schools observed consisted of Pacific white-sided and northern right whale dolphins, with grampus and Dan's porpoises seen in smaller groups. All four species were fairly evenly

distributed over the slope waters of this sector. However, some higher densities were noted for Pacific white-sided dolphins west of the Farallon Islands and for northern right whale dolphins south of those islands.

Offshore. Offshore waters contained many small isolated schools of grampus, northern right whale and Pacific white-sided dolphins. With small groups scattered throughout the pelagic zone, no areas of significantly high biomass were noted. It is of interest to note that cetaceans tended to cluster along the 1,000 fm isobath and no aggregations were noted in deeper water, although sampling extended approximately 45 nm west of that point.

Mean sea surface temperatures were identical for the slope and offshore zones due to mixing caused by winter stems and strong northwesterlies. Inshore shallow waters were cooler, with the coolest water adjacent to the Golden Gate where large volumes of fresh water emerge from the Sacramento River system.

SOUTH-CENTRAL SECTOR
Winter—Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	10.66 ±1.46	59.46 ±19.85	84.50 ±15.44
Mean Biomass Density (kg/km² ±SE)	4.26 ±0.86	36.02 ±13.98	72.60 ±12.08
Mean Number of Species Observed (±SD)	16.08 *3.84	20.25 ±3.39	26.33 ±3.25
Mean Species Diversity Index (H' ±SD)	1.93 ±0.25	2.03 ±.023	1.93 ±0.28

January Mean Population Ashore (±SD): 68,917 ±17,875

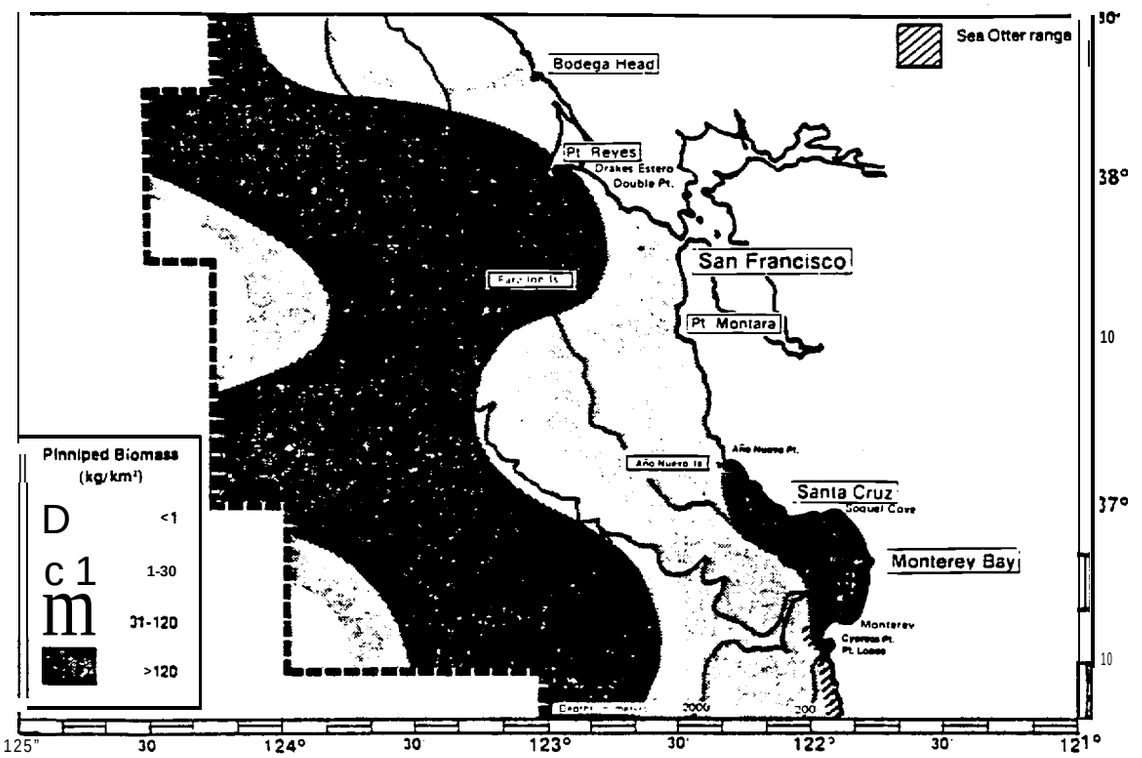
PREDOMINANT SPECIES

Offshore	slope	Shelf	Shoreline
Northern Fulmar	Cassin's Auklet	Western Grebe	Arctic Loon
Cassin's Auklet	Rhinoceros Auklet	Common Murre	Western Grebe
Rhinoceros Auklet	Common Murre	California Gull	Brandt's Cormorant
Black-legged Kittiwake	Black-legged Kittiwake		Pelagic Cormorant
Herring Gull	California Gull		Surf Scoter
	Herring Gull		White-winged Scoter
			Western Gull
			Herring Gull
			California Gull
			Common Murre

Populations of seabirds wintering here were both large and diverse. This sector harbored high average densities and biomass as far seaward as the outer continental slope margin and moderate biomass density (to 20 kg/km^2) to more than 150 km off San Francisco. in keeping with the correlation between high numbers/biomass and ' shallower water depths, we found that the zone of high bird abundance was narrowest where the Monterey Canyon bisected the shelf of Monterey Bay. Numbers of species seen here were higher than in other sectors, reflecting the overlap here of the bird fauna typical of subtropical waters with that of cooler, subarctic waters. Populations found ashore were large compared to other sectors and were concentrated along the shores of Monterey Bay to Año Nuevo Island and from Point Montara to Point Reyes.

The composition of bird populations here resembled that in sectors to the north. Large pulses of migration by Arctic Loons and California Gulls occurred near the coast during late November; in December these and many species nesting in the Pacific Northwest and Alaska entered the area to take up winter residency. Among locally-nesting species, Common Murres, Cassin's Auklets, Western Gulls, and cormorants were abundant here during winter. The earliest visits to nesting colonies of these species occurred during winter, though typically none begin egg-laying until April.

SOUTH-CENTRAL SECTOR
Spring—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0,003 ±0.003	0.024 ±0.012	0.236 ±0.263
Northern fur seal	0.263 ±0.118	0.103 ±0.044	0.020 *0.012
Steller sea lion	0.0	0.002 ±0.003	0.003 ±0.004
Harbor seal	0.0	0.002 ±0.004	0.005 *0.004
Northern elephant seal	0.003 ±0.003	0.021 *0.017	0.012 ±0.012
All Pinnipeds	0.269 ±0.119	0.152 ±0.058	0.276 ±0.243
Biomass (kg/km²)	16.61 ±7.38	17.91 ±6.82	59.54 ±52.34

Abundance on LAND (numbers counted)	5-7 May 1980	19-21 May 1981	3-5,19 May 1982
California sea lion	5,131 (47%)	8,611 (59%)	7,679 (54%
Steller sea lion	179 (2%)	386 (3%)	141 (1%
Harbor seal	1,846 (17%)	1,606 (11%)	2,025 (14%
Northern elephant seal	3,799 (35%)	3,936 (27%)	4,478 (31%
All Pinnipeds	10,954	14,539	14,323

Pinnipeds

From Point Lobos (36°31'N) to the Monterey Harbor breakwater (36°37'N) we counted 1,507 pinnipeds in May 1982; 83.5% (1,259) were California sea lions. Harbor seals (247, or 16.4% of the area total) were sighted at several locations on the Monterey Peninsula. A single juvenile Steller sea lion was seen on the Monterey Harbor breakwater. Pinnipeds in this area represented 6.3% of the survey total.

In May 1982, the pinniped population on Año Nuevo Island was 6,323, or 26.3% of the central and northern California total. Northern elephant seals predominated in numbers with a population of 3,623 females and juveniles hauled-out for their annual molt. These animals represented 57.4% of the Año Nuevo total and fully 15% of the central and northern California total. Most of the remaining animals on Año Nuevo Island in 19S2 were California sea lions, which numbered 2,373, or 38% of the island total. The May 1982 survey took place two weeks earlier than the 1981 survey. The 1981 survey, which coincided closely with the spring peak of southward-migrating sea lions, recorded *over* 5,oco California sea lions on Año Nuevo *Island.*

Second in use to Afro Nuevo Island were the Farallon Islands, with 17% of the central and northern California total. The Farallones are rapidly increasing in use as a hauling ground by California sea lions. The numbers of this species counted here more than doubled each year, from 648 in 1980 to 1,440 in 1981, and to 3,206 in 1982. California. sea lions accounted for 78% of the pinniped population on the Farallones in 1982, northern elephant seals for 20%, and Steller sea lions for 2%.

North of the Farallones, pinnipeds were found in Substantial: numbers from Double Point (37°57'N) to Point *Reyes.* In this area, harbor seals represented about 60% of the total and *were* found primarily at Double Point, where spring counts averaged 277 animals,

and in Drake's Estero, where counts varied from 40 to 523. In 1982, 33 harbor seals, 314 California sea lions, and 46 northern elephant seals were also found in the lee of Point Reyes. The combined pinniped population of the area was 869 in 1982, representing 3.6% of the survey total.

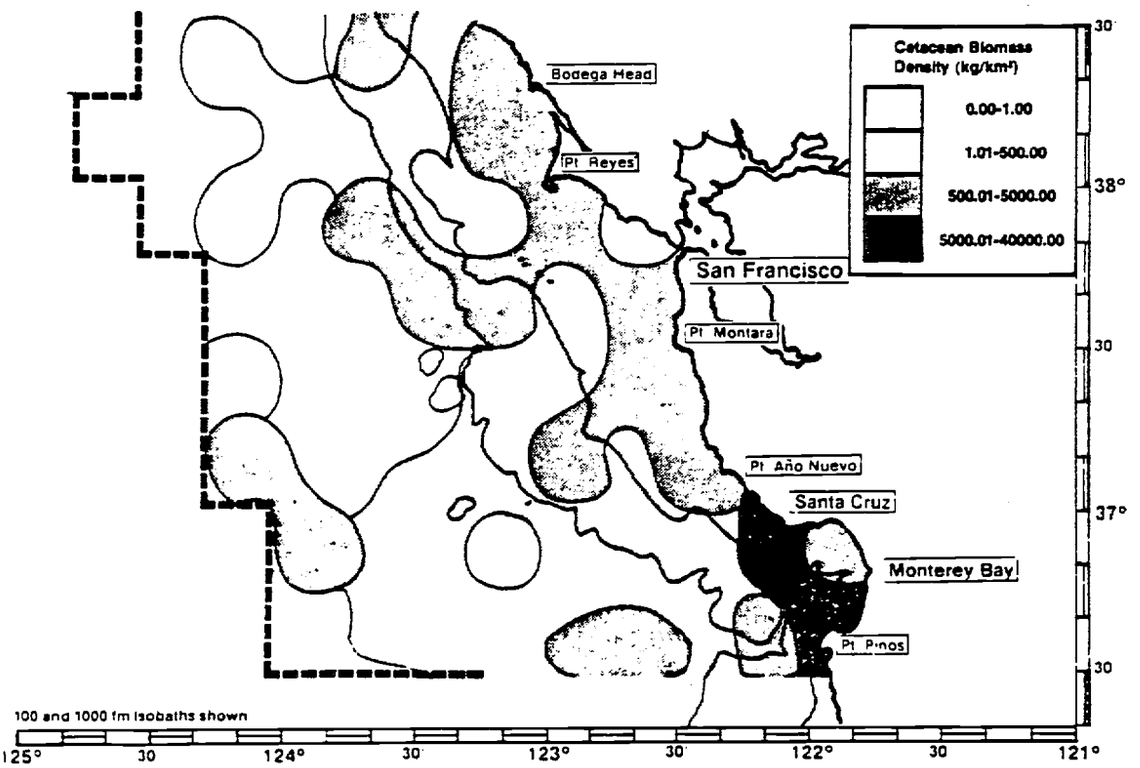
From Drake's Beach (38°00'N) to Bodega Rocks (38°17'N), 625 pinnipeds were hauled out during the May 1982 survey; 590, or 95% were harbor seals.

Pinniped sightings at sea in the south-central sector accounted for 54% of all sightings recorded on surveys in the spring months. Of 430 pinniped sightings recorded, northern fur seals {with 81% of the total) were numerically predominant; California sea lions and northern elephant seals comprised the remainder. Pinniped relative abundance in offshore waters was 56% of the total of sector-wide sightings; northern fur seals accounted for 98% of all sightings in this depth region. The overall mean density for offshore waters was 0.27 animals/km^2; mean density over the slope was 0.15 animals/km^2, with northern fur seals accounting for 80% of all sightings. The highest mean density of 0.28 animals/km^2 was reached over the shelf, where California sea lions represented 58% of all sightings. Most California sea lions occupied waters in Monterey Bay and the Farallon basin extending to, and including, the waters over Cordell Bank. Moderate densities were found in shelf and slope waters between Año Nuevo Island and the Farallones. Northern fur seals were found primarily over slope and offshore waters west of Point Reyes, west of Pioneer and Guide seamounts, and over the Monterey Seavalley.

Sea Otters

Approximately 28% of the California sea otter population is presently found north of Point Sur in winter and spring. Most sea otters are found in the lee of major points on the outer coast from Point Sur to Point Piños (36°38'N). Moderately large numbers are also found near Monterey and at Sequel Point *near* Santa Cruz. The Sequel Point raft has been declining in size since 19s0 when 59 animals were counted; the count of June 1983 was 33 sea otters. The decline in the size of this raft was accompanied by an advance of the northern front to Sandhill Bluff (about 6 mi north of Santa Cruz). and by a wider distribution of solitary sea otters in the nearshore waters of northeastern Monterey Bay. The raft at Sandhill Bluff numbered 16 animals on surveys conducted in spring 1963; a few wanderers were seen between Sandhill Bluff and Año Nuevo Point, Numbers from Monterey to Cypress Point have shown a clear decline from 119 counted in 1982 to 56 counted in 1983. Concurrently, the population inhabiting the nearshore waters frcm Cypress Point southward to Point Sur has shown an increase in size, representing 17% of the total California population recorded on aerial surveys in spring 1983. The present size of the population from Cypress Point to Point Sur, while not known with certainty, probably numbers slightly *more* than 200 independent animals. Pups *were commonly seen* from Point Sur to Point Pines along the outer coast on aerial surveys conducted in winter and spring 1983, but were never seen in Monterey Bay from Point Piños to the Monterey/Seaside area. Single mother-pup pairs were recorded in Sequel Cove and near the Sandhill Bluff raft in spring 1983.

SOUTH-CENTRAL SECTOR
Spring-Cetaceans



	Shelf (0-99 fm)	Slop (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.07 ±0.06	1.53 ±2.19	0.12 ±0.19
Mean Cetacean Biomass (kg/km²)	1,323.23	399.90	247.98
Mean Sea surface Temperature 'C (±SE)	11.7" ±0.6	12.1" ±0.5	12.2" ±0.3
Percentage of Observed Cetaceans x Depth	5.2%	89.2%	5.6%
Percentage of Biomass x Depth	67.3%	20.3%	12.4%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Pacific white-sided dolphin	Northern right whale dolphin
Grampus	Northern right whale dolphin	Grampus
Harbor porpoise	Grampus	Sperm whale
	Gray whale	Humpback whale

Although cetaceans observed in spring were widely distributed throughout the sector, highest densities of individual animals (89%) occurred on the continental slope. In contrast, the shelf region held only 5% of the population but almost 70% of the biomass. The offshore region supported approximately 6% and 12% of total cetacean numbers and biomass, respectively. Mean sea surface temperatures in all three depth regions were lower than those in the southern sector by as little as 0.2°c on the shelf to as much as 1.3°C in the offshore area.

Shelf. Relatively high numbers of migrating gray whales (130) traversing the nearshore waters of the shelf in spring contributed significantly to the biomass of the *region. Harbor porpoises,* grampus, Dan's porpoises, and Pacific white-sided dolphins were other cetaceans that constituted the nearshore population of the sector.

Harbor porpoises, while numerically subordinate to gray whales and grampus on the shelf, were moderately abundant *for* a species that is infrequently seen in pods *of any* magnitude. Except for a small subpopulation in the Morro Bay/Point Buchon area, only a light scattering of sightings occurred along the Big Sur coast to approximately Gamboa Point (36°03'N). There were none noted between Gamboa Point and Point Pines. The first significant numbers of the species began to appear at Monterey Bay, and the animals steadily

increased in abundance as one progressed northward along the coast. Two centers of concentration occurred north of Monterey Bay: one in the Point Montara/Pacifica area, and the other between Point Reyes and Port Ross (38°31'N).

Grampus, as well as Pacific white-sided dolphins, were present in relatively low numbers and widely scattered pods. Dall's porpoises, normally considered most prevalent in water depths between 100 fm and 1,000 fm, were moderately abundant on the shelf in this sector.

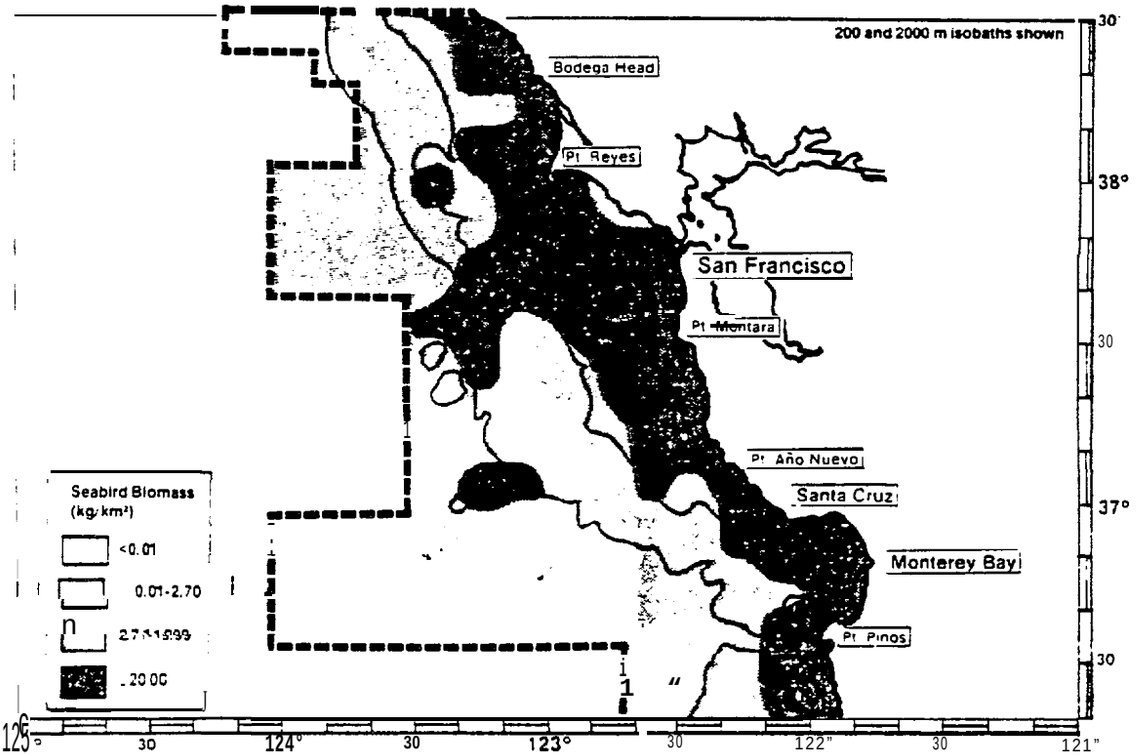
slope. As mentioned above, cetaceans were present in greatest numbers on the slope, with large schools of the gregarious Pacific white-sided dolphins, northern right whale dolphins, and grampus predominating. These three species accounted for 99% of the cetacean population on the slope. In spite of their relatively high individual count, these smaller animals represented only 22% of the total sector biomass.

The second largest school of grampus (900 animals), in three years of survey, was recorded 20 nm west of Monterey Bay. The remainder of the grampus *on* the slops were scattered in small groups to the west and south of Monterey Bay. Dan's porpoise numbers were approximately equal over the slope and offshore; in both instances their numbers were reduced by approximately one-third from that seen in shelf waters. Only a few gray whales were sighted entering the deeper waters of the slops region, usually as they were traversing open water between headlands.

Offshore. The offshore depth region supported a variety of cetacean species similar to those of the shelf and slope. However, totals were significantly reduced in most instances when compared to the slope.

Northern right whale dolphins and grampus predominated in the area, but total numbers of each were small. On numerous occasions the two species were observed closely associated, in moderately large schools. Mixed schools of different species were commonly observed throughout the three-year survey. Larger cetaceans in the offshore region included gray, humpback, and sperm whales. Sperm whales were sighted in the deep water region west of Santa Cruz near Guide Seamount, and humpback whales were seen offshore west of the Farallon Islands. Gray whales were also found in small numbers west of the Farallon Islands, close to the 1,000 fm isobath,

SOUTH-CENTRAL SECTOR
Spring-seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (0-199 In)
Mean Seabird Density (birds/km² ±SE)	13.29 ±4.47	31.73 ±8.43	94.92 ±17.61
Mean Biomass Density (birds/km² ±SE)	8.08 ±3.60	18.77 ±4.92	80.63 ±17.22
Mean Number of Species observed (±SD)	12.44 ±5.56	18.56 ±6.50	25.78 ±5.41
Mean Species Diversity Index (H' ±SD)	1.19 ±0.64	1.58 ±0.30	1.70 ±0.31

May Mean Population Ashore (±SD): 146,053 ±25,090
May Mean Surface-nesting Population Ashore (±SD): 113,650 *11,686

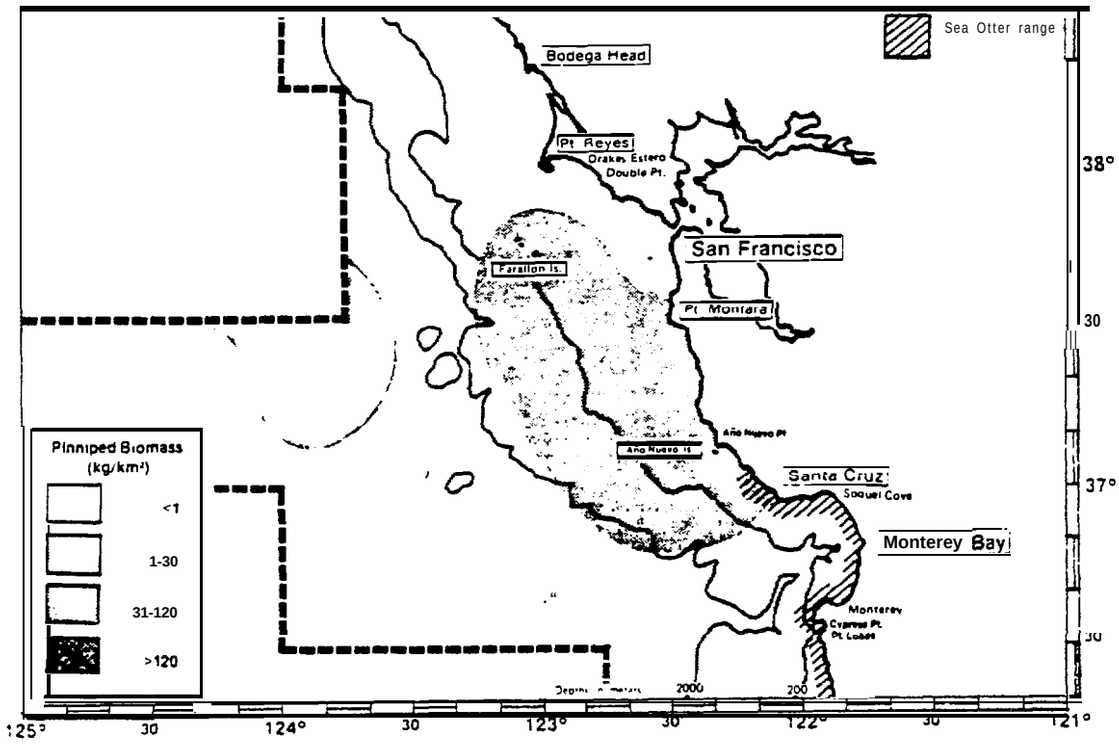
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
sooty Shearwater	sooty Shearwater	sooty Shearwater	Western Grebe
Phalaropes	Phalaropes	Phalaropes	Surf Scoter
Cassin's Auklet	Cassin's Auklet	Common Murre	Western Gull
		Bonaparte's Gull	Common Murre
		Western Gull	Cassin's Auklet

The shores *of* the Gulf of the Farallones, including the Farallon Islands, support almost half of the state's 0.8 million nesting total. Common Murre's and Cassin's Auklets each number over 100,000 birds at colonies here, and for Brandt's Cormorants, Western Gulls and Ashy Storm-Petrels the Farallon Islands harbor over a third of the state's nesting totals. Shelf and slope waters of this *sector* teem with migrants, nesting birds, and winter visitors, with zones of high biomass extending as far seaward as 90 km off Point Montara. *Over* 630,000 shearwaters *were* seen in flocks in northern Monterey Bay alone during June 1981.

This was the sector with the highest average bird densities and biomass densities *in* spring and where the numbers of species observed was highest. Owing to extreme abundance of shearwaters, phalaropes, murres, and auklets, however, the species diversity index averaged less than in the north-central sector and about the same as values elsewhere. Shoreline and shelf populations *were* dominated by numbers of Western Grebes, migrating Shearwaters and phalaropes, and by the nesting species. Over the slope, Shearwaters, phalaropes, murres, and auklets predominated while farther to seaward the same species plus storm-petrels, jaegers, and Arctic Terns predominated. Species numbers and diversity were least in June,

SOUTH-CENTRAL SECTOR
Summer—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.001 ±0.001	0.035 ±0.028	0.068 ±0.033
Northern fur seal	0,009 ±0.006	0.002 ±0.002	0.001 ±0.001
Steller sea lion	0.0	0.0	0.003 ±0.005
Harbor seal	0.0	0.0	0.003 ±0.005
Northern elephant seal	0.0	0.004 ±0.005	0.0
All Pinnipeds	0.010 ±0.006	0.041 ±0.026	0.075 ±0.036
Biomass (kg/km²)	0.606 ±0.356	13.71 ±8.79	15.92 ±7.61

Abundance on LAND (numbers counted)	1-3 July 1960	30 June, 1,8 July 1981	2S-30 July 1962
California sea lion	2,1s1 (37%)	3,532 (39%)	6,810 (56%)
Steller sea lion	1,477 (25%)	1,134 (12%)	1,155 (9%)
Harbor seal	1,607 (28%)	3,668 (40%)	3,470 (28%)
Northern elephant seal	563 (10%)	748 (8%)	811 (7%)
All Pinnipeds	5,828	9,0S2	12,246

Pinnipeds

From Point Lobos (36°31'N) to Monterey (36 °37'N), pinniped numbers increased from 280 in summer 1981 to 1,027 in summer 1982 (representing 4.1% of the survey total). California sea lions on Sea Lion Rocks near Point Lobos and at Bird Island (36°35'N) near Cypress Point, with a population of 773 in 1982, represented 75.3% of the pinnipeds counted in this area. Most of the 2S3 harbor seals present in 1902 were found near Cypress Point.

Año Nuevo Island continued to be the most important hauling ground in central and northern California. The 5,130 pinnipeds counted here in 1962 represented 20.4% of the survey total. The summer count at Año Nuevo showed a steady increase through the three survey years. The 1982 count represented a 56.9% increase over the count of 3,269 recorded in 1980. The Steller sea lion breeding colony here was the largest in the state, with 882 animals present in June 1982. Numbers had decreased somewhat since 1980 when 1,325 animals were counted, but the pup count had increased from 294 to 321. At present, we consider the population to be stable or growing slowly. Steller sea lions represented 17.2% of the Año Nuevo Island total in 1982. The great majority of pinnipeds on Año Nuevo Island were California sea lion juveniles. In 1982, 3,169 animals of this species were counted, representing 61.8% of the island total. The 1982 count was a 10.4% increase from the 2,871 animals counted in 1981. The population of northern elephant seals, consisting of 696 adult males, represented 13.6% of the Año Nuevo Island pinniped count in 1982, up from 673 in 1981 and 469 in 1980. The harbor seal population at this location also seemed to be increasing, from 158 in 1980 to 351 in 1981, and to 383 in 1982, when they represented 7.5% of the pinnipeds on the island in summer.

The pinniped population of the Farallon Islands increased from only 474 in 1980 and 1,066 in 1981 to 2,979 animals in 19132 — a sixfold increase in two years. In summer 1982 the pinnipeds on the Farallon Islands represented 11.8% of the central and northern California total. Most of the pinnipeds on land were California sea lions which, with a population of 2,543, accounted for 85.4% of the Farallones' total. Only 210 and 525 California sea lions *were* counted on the Farallon Islands on summer surveys in 1980 and 1981, respectively. The breeding population of Steller sea lions on the Farallones appeared to be growing, at least in the numbers of adult and subadult animals. We recorded 237 animals of this species in 1982, an increase of 64.6% from the 144 counted in 1981. Fourteen (14) pups were counted *in* 19S2. Only 31 Steller sea lions were seen on the North Farallones in 1982, compared with 24 in 1980 and 45 in 1981; no pups have been seen in aerial photographs of the North Farallones. Other species counted on Southeast Farallon Island in 1982 included 115 northern elephant 'seals (3.9% of the island total) and 84 harbor seals (2.8% of the total). A single male northern fur seal was seen on the island in each of the 1980 and 19S1 surveys.

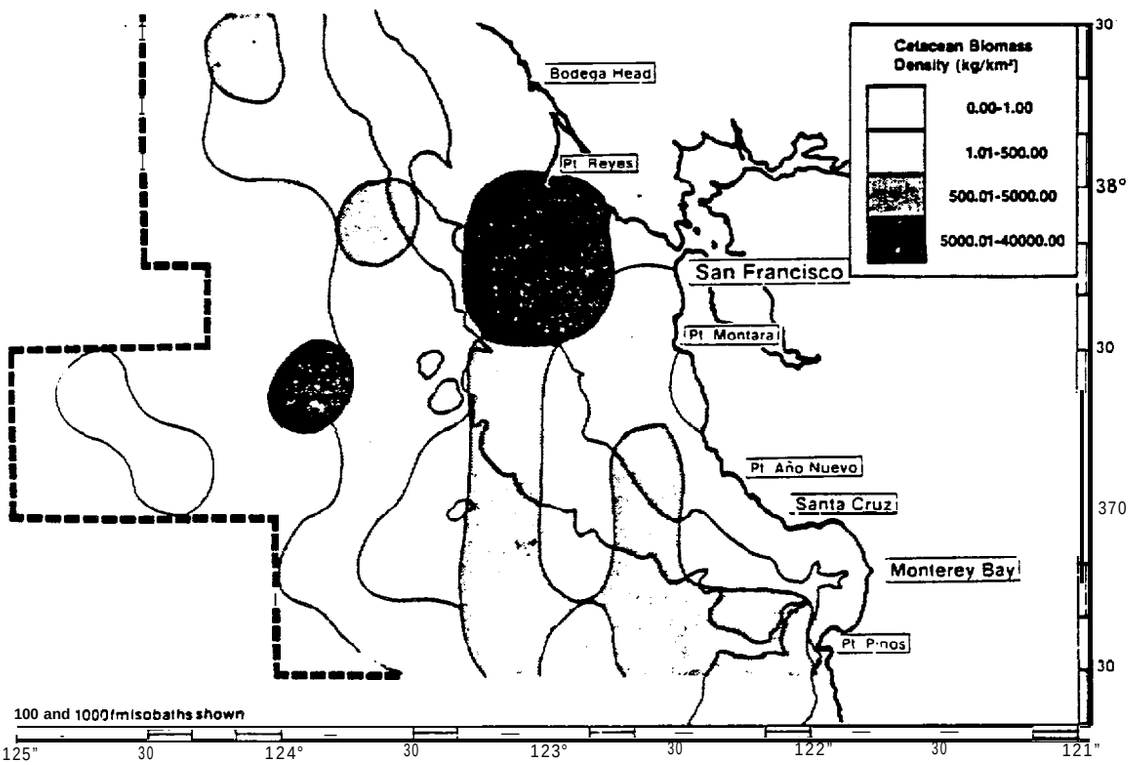
From Bolinas Lagoon (37°56'N) to Point Reyes (37°59'N) we counted 2,128 pinnipeds in summer 1982 (8.4% of the survey total). Of this number, 2,041 (95.9%) were harbor seals, which were found primarily in Bolinas Lagoon (137 in 1982), near Double Point (162 in 1982, down from 722 in 1981), and in Drake's Estero (659 in 1982). This area is one of the most important harbor seal hauling grounds in central and northern California. In addition to harbor seals, small numbers of other species haul out in the lee of Point Reyes; we counted 55 California sea lions, 32 Steller sea lions, and 7 northern elephant seals here in summer 1982. In the Tomales Bay area (including Bird Rock on the outer coast) we counted 530 harbor seals in 1982, down from 577 in 1981.

Summer sightings of pinnipeds at sea in the south-central sector fell to only 10% of the spring level due to the departure of most summer-breeding northern fur seals and California sea lions from the area. California sea lions represented 66% of all sightings at sea, and 79% of all sightings over the shelf. Mean density over the shelf was 0.075 animals/km^2; mean densities in slope and offshore depth regions fell to a yearly low of 0'.04 and 0.01 animals/km^2, respectively. Pinnipeds were widely distributed at sea at low to very low density. Moderate densities were recorded only in the shelf and slope waters beween Año Nuevo Island and the Farallones, and west of Pioneer Seamount. The latter sightings were predominantly northern fur seals, possibly associated with the San Miguel Island colony.

Sea Otters

In the summer and autumn breeding season, numbers of sea otters decline in the south-central sector as some males from the northern peripheral rafts move southward toward the center of the range. Surveys conducted in 1983 indicate that this seasonal movement begins as early as the month of June; from 25 May 1983 to 29 June 1983, numbers of independent sea otters declined about 20% in the south-central SeCtOr (Point Año Nuevo to Point Sur). The number of sea otters at Sequel Point and along the north coast of Santa Cruz County decreased from 57 to 34 independent animals (relative abundance of 3%); numbers in the vicinity of Monterey and along the outer coast of Monterey County to Cypress Point held steady at about 50 independent animals (relative abundance of 5%); numbers from Cypress Point to Point Sur declined 20% from 176 counted on 8 June to an estimated 140 independent sea otters by late June (relative abundance of 14%). These ccunts should be considered minimum population estimates.

SOUTH-CENTRAL SECTOR
Summer-Cetaceans



	Shelf (0-99 fm)	Slope (loo-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.21 ±0 .15	1.40 ±0.60	0.95 ±0.58
Mean Cetacean Biomass (kg/km²)	347.90	438.42	202.51
Mean Sea Surface Temperature °C (±SE)	13.1″ ±0.4	13.5° ±0.4	14.2° ±0.3
Percentage of Observed Cetaceans x Depth	11. 1%	51.4%	37.5%
Percentage of Biomass x Depth	35.2%	44.3%	20.5%

Predominant Species

Shelf	Slope	Offshore
Pacific white-sided dolphin	Northern right whale dolphin	Pacific white-sided dolphin
Dall's porpoise	Pacific white-sided dolphin	Northern right whale dolphin
Humpback whale	Grampus	Grampus
Grampus	Humpback whale	Humpback whale
Harbor porpoise		

High species diversity and numbers of animals characterized this sector. Although the continent- shelf supported slightly more than 35% of the area's biomass, it yielded only 11% of the total animals. High numbers of large baleen whales were present in nearshore areas of this sector, which contributed significantly to the total biomass. The slope held the highest percentage of individual animals as well as biomass.

Shelf, The Pacific white-sided dolphin became the dominant small cetacean in this sector, It was the most abundant species in both the shelf and offshore regions and the second most abundant on the slope, indicating its propensity for waters of the southern half of the study area in summer. Heaviest concentrations and largest schools of the species were encountered bet-ween Point Piños and Point Montara.

Dall's porpoises *were* moderately abundant in all three depth regions. They are not as gregarious as some of the other small cetaceans, and therefore did not aggregate into large schools along the coast. There were, instead, numerous small groups sighted inside the 100 fm isobath, especially between Point Año Nuevo and Point Arena.

Harbor porpoises were distributed along the entire coastal periphery of the sector except for a small area between Pigeon Point (37°11'N) and Point Montara and another near the mouth of San Francisco Bay. Several animals were also sighted up to 20 nm offshore in the Gulf *of* the Farallones.

Grampus, exhibiting their apparent affinity for warm waters, expanded their range northward into this sector as sea surface temperatures began their seasonal rise. Although present in all depth regions, only 4% of the animals were found over shelf waters, and then only south of the Farallon Islands, adjacent to the 100 fm isobath.

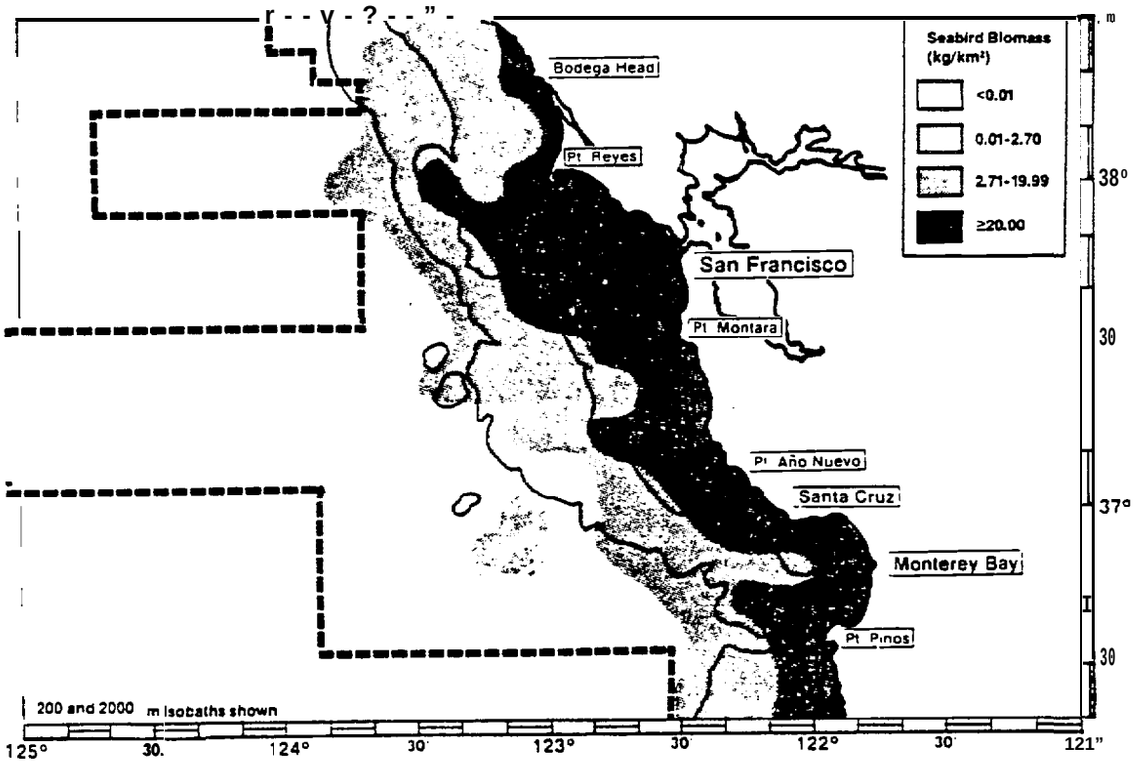
Baleen whales *were* also observed in all depth regions of this sector in summer. Scattered solitary gray whales, fin whales, and especially humpback whales were observed. Humpback whales were the most abundant of the group, totaling more than 100 individuals. There were 75 of these animals sighted in shelf waters near the Farallon Islands. A more detailed description of the historical distribution and the current patterns and status of the humpback whale, including its unique seasonal resurgence along the central and northern California coast, can be found in *Cetaceans of Central and Northern California*, 7980-1983: Status, Abundance, *and Distribution* (Dohl et al. 1983).

s lope. Northern right whale dolphins, Pacific white-sided dolphins, and grampus were the predominant species on the slope, representing 96% of all cetaceans in the area. Large schools of these gregarious animals (some associated with other species) were observed west of Point Arena, Fort Bragg, and Cape Vizcaino. Several smaller schools *were* observed southwest of cape Mendocino. Dall's porpoises were more abundant on the slope than in either of the other two depth regions. Even though the species was distributed throughout the area, their greatest concentrations were from Point Año Nuevo north to Point Reyes.

Humpback whales were scattered in the central portion of the sector, with most sightings occurring north, south, and west of the Farallon basin. More than three times the number found on the slope were concentrated on the mainland side of the islands in the Gulf of the Farallones. Fin whales were also observed utilizing the same general area as the humpback whales. Killer whales were present in modest numbers, but sighting locations were confined to the southern portion of the sector. Areas west of Point Pines and off Monterey Canyon were the most frequently occupied.

Offshore. Cetacean abundance continued high in the offshore region, with nearly the same species dominating the population as occurred on the slope, Pacific-white-sided dolphins replaced northern right whale dolphins as the most numerous cetacean in the offshore area, with northern right whale dolphins second. Schools of these two species were large, with major aggregations occurring in the 'southern and central portions of the sector. Small scattered groups were observed northwest of Bodega Head. Dan's porpoises and humpback whales were moderately abundant in the central offshore region west of Point Año Nuevo.

SOUTH-CENTRAL SECTOR
Summer-Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	6,09 ±1.83	35.92 ±8.13	105.98 ±16.14
Mean Biomass Density (kg/km² ±SE)	2.83 ±1.23	13.25 ±2.88	76.14 ±12.30
Mean Number of Species Observed (±SD)	10.44 ±3.56	21.00 *3.74	23.56 ±4.50
Mean Species Diversity Index (H' ±SD)	1.47 ±0.46	1.89 ±0.28	*1.60* ±0.28

July Mean Population Ashore (±SD): 191,544 ±13,247
July Mean Surface-nesting Population Ashore (kSD): 165,229 ±9.466

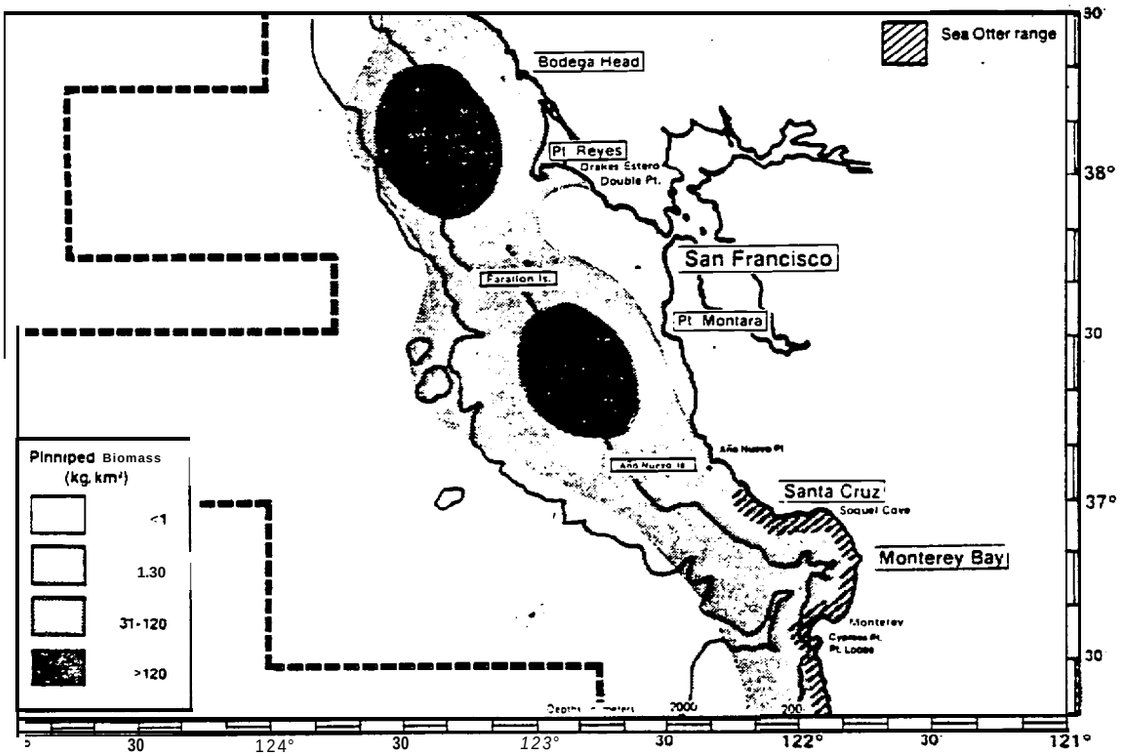
PREDOMINANT SPECIES

offshore	slope	Shelf	Shoreline
Sooty Shearwater	Sooty Shearwat er	sooty shearwater	Brown Pelican
Phalaropes	Cassin's Auklet	Phalaropes	Brandt's Cormorant
Common/Arctic Tern	Phalaropes	common Murre	Pelagic Cormorant
			Western Gull
			Common Murre
			Cassin's Auklet

Nesting activities of twelve species reach a peak at colonies near Point Sur, Monterey Bay, and the Gulf of the Farallones in early summer, with almost half the State's 0.8 million nesting population in attendance. The Farallon Islands harbor almost 0.3 million nesting birds and serve as the center of the world breeding ranges for Ashy Storm-Petrels, Brandt's Cormorants, and Western Gulls. Our data indicate a probable increase of ±16-17% in the Common Murre population nesting in this sector during 1960-1982. In addition to nesting species, shoreline and shelf populations are dominated by numbers of Sooty Shearwaters, Brown Pelicans, and phalaropes while those of waters seaward of the shelf are dominated by storm-petrels, auklets, phalaropes, Sooty Shearwaters, and Arctic Terns. Species numbers here were higher than in other sectors, a result of mixing of subarctic, subtropical, and California Current endemic faunas; the species diversity index reached the annual low in June due to numerical dominance by shearwaters, phalaropes, and a few nesting species.

A broad area of high biomass density extended from off Point Reyes to off Point Año Nuevo. The high density band followed continental slope contours, pinching in toward the coast where the Monterey Canyon bisected Monterey Bay. The shelf waters in northern Monterey Bay and from Point Año Nuevo to Point Reyes harbored up to 150 kg/km^2 of biomass in June and July; over 0.6 million shearwaters occurred in northern Monterey Bay alone during June 1981. Waters of the California Current, seaward of the slope, typically harbored birds in relatively low densities. Because small-bodied storm-petrels, phalaropes, and auklets often predominated in the offshore fauna, biomass was more than an order of magnitude below that of contiguous shelf waters.

SOUTH-CENTRAL SECTOR
Autumn—Pinnipeds, Sea Otters



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.004 ±0.004	0.207 ±0.124	0.244 ±0.123
Northern fur seal	0.008 ±0.004	0.005 ±0.004	0.001 ±0.002
Steller sea lion	0.0	0.007 ±0.006	0.0
Harbor seal	0.0	0.0	0.003 ±0.004
Northern elephant seal	0.0	0.028 ±0.018	0.002 ±0.003
All Pinnipeds	0.012 ±0.006	0.247 ±0.064	0.250 ±0.125
Biomass (kg/km²)	0,94 ±0.47	85.75 ±41.59	52.01 ±26.11

Abundance on LAND (numbers counted)	28-30 Oct. 1980	28-30 Sept. 1981	27-28 Oct. 1982
California sea lion	5,551 (61%)	8,620 (78%)	16,128 (78%)
Steller sea lion	341 (4%)	509 (5%)	183 (1%)
Harbor seal	1,519 (17%)	833 (8%)	2,714 (13%)
Northern elephant seal	1,733 (19%)	1,132 (lo%)	1,708 (8%)
All Pinnipeds	9,144	11,094	20,733

Pinnipeds

In the area from Lobos Rocks (36°27'N) to Monterey Harbor (36°37'N) we counted 2,461 pinnipeds in 1982, representing 7.9% of the survey tots?. This was a substantial increase from the counts of 1,056 in 1981 and 1,146 in 1980. Of the total, 2,333 (94.8%) were California sea lions and 127 (5.2%) were harbor seals; one juvenile Steller sea lion was also present. California sea lions were found at four locations: 243 were seen at Lobos Rocks, 397 at Sea Lion Rocks (36°31'N), 704 at Bird Rock (36°35'N), and 989 at the Monterey breakwater (36°37'N).

'l'he greatest number of pinnipeds was counted on Año Nuevo Island (37°06'N). The count of 8,573, Representing 27.4% of the survey total, wae a 36.4% increase over the count of 6,203 obtained in September 1991. California sea lions, with a population of 7,319, accounted for 85.4% of the total, up from counts of 4,960 *in* 1981 and 2,834 in 1990. Northern elephant seals, which numbered 1,140, represented 13.2% of the survey total; 94 Steller sea lions and 20 harbor seals were also present.

The counts made at Southeast Farallon Island (37°41'N) also showed a great increase over the counts obtained in the previous two years. We counted 5,687 pinnipeds, representing 18.2% of the survey total; in contrast, 2,255 *were* counted in 1981, and 1,461 were counted in 1980. of the total, 5,063 *were* California sea lions (89.0%), up from 1,988 in 19S1 and 1,058 in 1980. Northern elephant seals represented 8.9% of the total with a population of *507* animals on land. Sixty-five (65) harbor seals and 52 Steller sea lions were also counted here in 1982; an additional 30 Steller sea lions were present on the North Farallones.

Prom Bolinas Lagoon (37°56'N) to Point Reyes (37°59' N) we counted 996 pinnipeds in 1902, representing 3.2% of the survey total. Harbor seals, with a population of 876 animals, represented 88.0% of the total for this area. Harbor seals were found primarily at four locations: 133 were seen in Bolinas Lagoon (37°56'N), 126 at Duxbury Point (37°54'N), 77 at Double Point (37°57'N), and 480 in Drake's and Limantour esteros (38°01'N). On the lee side of Point Reyes 62 California sea lions and 58 northern elephant seals were observed hauled-out.

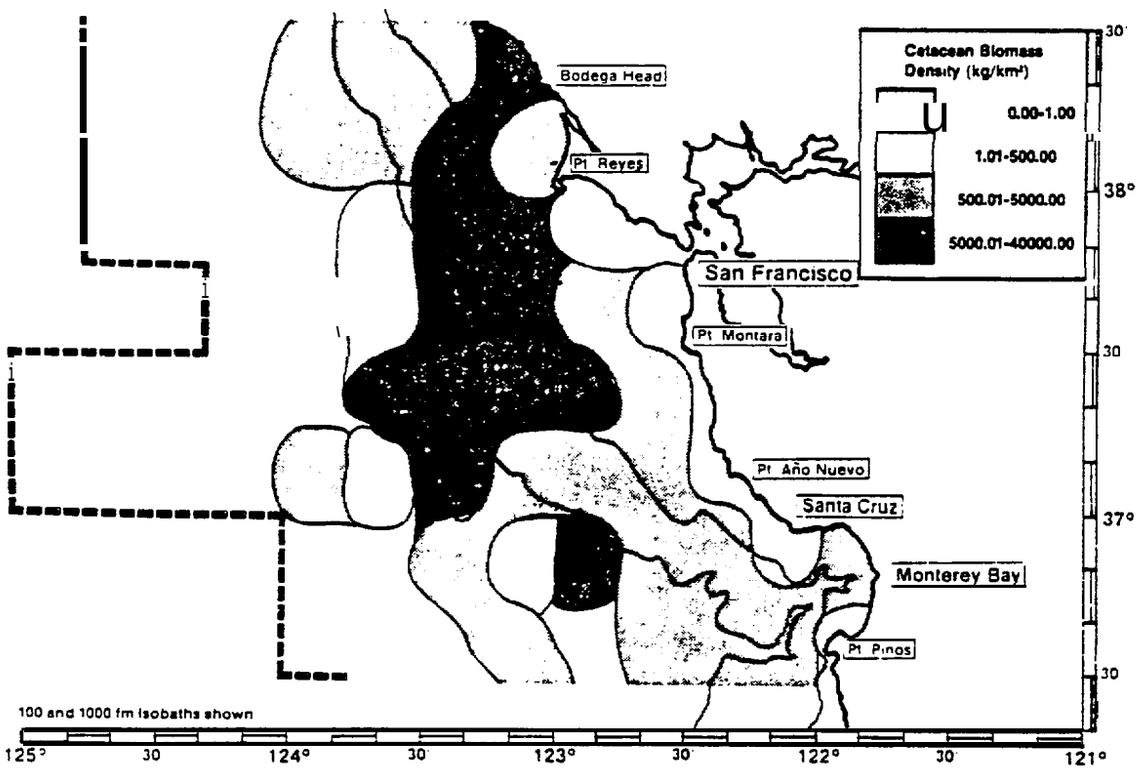
In the vicinity of Tomales Bay (38°14'N) we counted 1,804 pinnipeds in 1982, representing 5.8% of the survey total. A population of 1,077 California sea lions hauled-out on Bodega Rock (38°17'N) represented 59.7% of the total. The remaining 40.1% was comprised of 724 harbor seals counted in, or near, ToMales Bay.

Pinniped sightings at sea in the south-central sector represented 39% of the statewide total for the autumn months. California sea lions, accounting for 853 of 197 sightings recorded, were the numerically predominant species. Most sightings were recorded for the shelf (45% of the total) and slope (51% of the total) depth regions; sightings were rare in offshore waters. California sea lion sightings comprised 94% of all sightings recorded over the shelf, and 82% of all sightings recorded over the slope. Northern fur seals predominated in offshore waters. Identical mean densities of 0.25 animals/km^2 were found for shelf and slope waters. The most conspicuous feature of pinniped distribution in the autumn months was the appearance of two areas of high density occupied by California sea lions – the waters over Pioneer Canyon between Año Nuevo Island and the Farallones, and the waters over Cordell Bank west of Point Reyes.

Sea Otters

In the summer and autumn breeding season, numbers of sea otters decline in the south-central sector as some males from the northern peripheral rafts move southward toward the center of the range. Surveys conducted in 1983 indicate that this seasonal movement begins as early as the month of June; from 25 May 1983 to 29 June 1903, numbers of independent sea otters declined about 20% in the south-central sector (Point Año Nuevo to Point Sur). The number of sea otters at Sequel Point and along the north coast of Santa Cruz County decreased from 57 to 34 independent animals (relative abundance of 3%); numbers in the vicinity of Monterey and along the outer coast of Monterey County to Cypress Point held steady at about 50 independent animals (relative abundance of 5%); numbers from Cypress Point to Point Sur declined 20% frcm 176 counted on 8 June to an estimated 140 independent sea otters by late June (relative abundance of 14%). These counts should be considered minimum population estimates.

SOUTH-CENTRAL SECTOR
Autumn—Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Dens it y (cetaceans/km² ±SE)	0.43 *0.35	3.73 ±3 .61	0.29 ±0 .27
Mean Cetacean Biomass (kg/km²)	1,205.91	2,524.26	562.81
Mean Sea Surface Temperature "C (±SE)	14.4° ±0.3	15.2" 00.2	15.5" ±0.1
Percentage of Observed Cetaceans x Depth	13. 0%	80. 8%	6.2%
Percentage of Biomass x Depth	28.1%	58.8%	13. 1%

Predominant Species

Shelf	Slope	Offshore
Grampus	Pacific white-sided dolphin	Pacific white-sided dolphin
Pacific white-sided dolphin	Grampus	Northern right whale dolphin
Humpback whale	Northern right whale, dolphin	Humpback whale
Dall's porpoise	Dall's porpoise	Fin whale
Harbor porpoise	Humpback whale	Blue whale
Blue whale	Blue whale	

Shelf. The continental shelf is broad throughout this sector, widening to over 30 nm west of the Golden Gate to include the Farallon Islands and basin. The third highest seasonal mean cetacean density occurred during autumn along with the greatest annual species variation. Except for a void within the Gulf of the Farallones, all of the shelf waters were heavily utilized.

Harbor porpoises were found along the entire coastline from Bodega Head to Pillar Point (37°30'N) and again within Monterey Bay. Highest concentrations centered on Point Montara and decreased as one moved northward to about 37°40'N along the Great American Highway in San Francisco County.

Grampus, the most numerous small cetacean seen, occurred in greatest concentrations from Point Piños north to Point Montara, with scattered animals found in very shallow water along the Point Reyes beach north of Point Reyes. Pacific white-sided dolphins and Dan's porpoises, while found throughout this sector, tended to concentrate in the waters south of the Farallon Islands.

of the larger whales, humpbacks were the most prevalent (177) and were found mainly along the outer boundaries of the shelf surrounding the Farallon Islands. Blue whales, an uncommon occupant of shelf waters, contributed to the high biomass values found adjacent to the Farallon Islands. Although numerically insignificant, the presence of scattered killer, sperm, and gray whales also added to this high seasonal biomass.

Slope. Mean cetacean density and mean cetacean biomass reached their highest annual values this season for this sector. Indeed, the biomass in this season exceeded by 1.5 times the total recorded for the other three seasons. Four species, of the eleven encountered, recorded maximum numbers and contributed heavily to density and biomass figures.

Pacific white-sided dolphins numerically represented more than 80% of the cetaceans observed. They were distributed throughout the sector, with highest densities (>4.0 animals/km^2) occurring in a band across the shelf from offshore of Santa Cruz to the Farallon Islands. Numerous schools were sighted aligned along the outer margins of the slope adjacent to the 1,000 fm isobath. Slightly lower concentrations occupied the region from Point Reyes north to Bodega Head.

Dan's porpoises were another species which achieved their peak annual numbers during this season. Although distributed throughout the area, their greatest concentrations occurred from the Farallon Islands to the northern border of this sector, in contrast to the major Pacific white-sided dolphin distribution.

Grampus were found in two pockets of concentration: one due west of Monterey Bay and the other northwest of the Farallon Islands. The remaining waters of this sector held only small scattered schools.

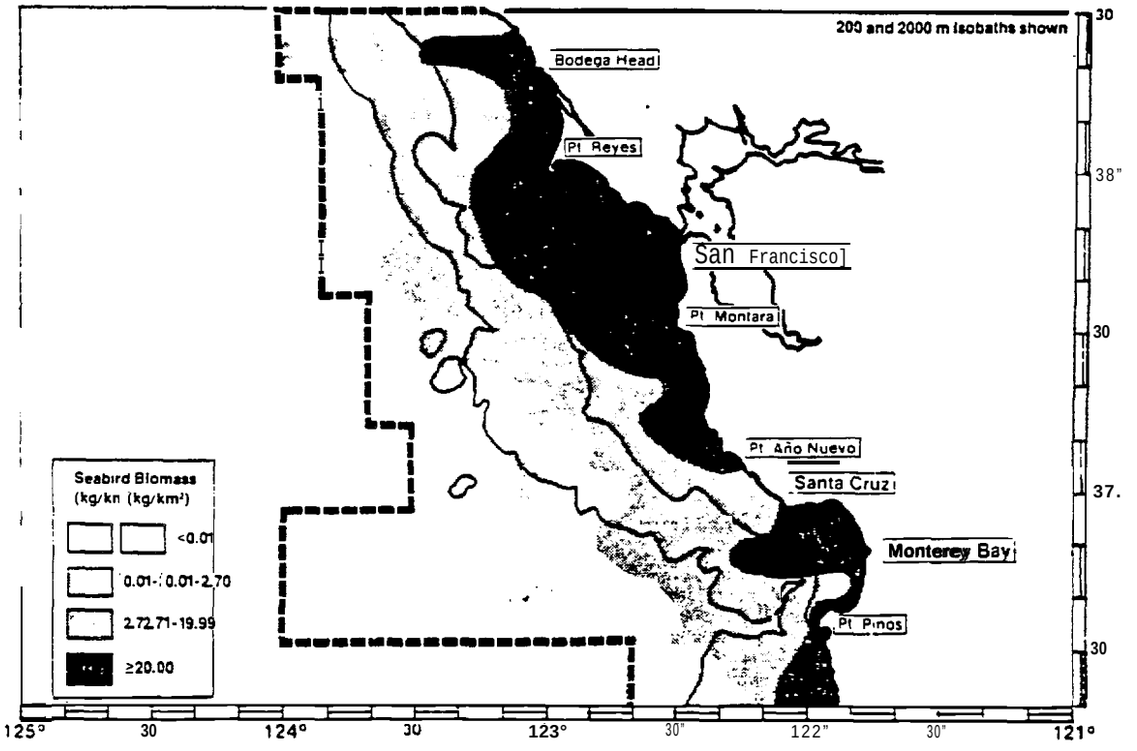
Northern right whale dolphins were at their lowest annual values in autumn. Distribution was limited to the southern one-third of this sector, with a complete absence north of Point Año Nuevo. Densities of 1-2 animals/km^2 occurred only off Santa Cruz Point and dropped to 0.5 animals/km^2 *or less* in scattered, patchy locations west and northwest of Point Pines.

Both blue (13) and humpback (90) whales were found in significant numbers, primarily west and south of the Farallon Islands, usually feeding close to the 100 fm isobath. Their distribution over the slope was essentially a continuation of that observed over shelf waters.

offshore. Deep-water cetacean distribution extended out to 124°00'W, with heaviest concentrations inside 123°30'W. A vertical band of nigh density extended along the margin of the 1,000 fm isobath southward from west of Point Reyes to due west of Point Año Nuevo. This band was occupied primarily by humpback, fin, killer, blue, and sperm whales. Mixed schools of Pacific white-sided and northern right whale dolphins *were* found at the southern and northern boundaries of this sector. More sparsely distributed grampus and Dan's -porpoise schools delineated the seaward-most observations west of the Farallon Islands.

sea surface temperatures demonstrated the highest annual figures with a 1°C warming gradient from the shelf to offshore waters.

SOUTH-CENTRAL SECTOR
Autumn-Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1, 999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	12.50 ±5.41	47.12 +11.97	256.7S ±133.03
Mean Biomass Density (kg/km² ±SE)	3.72 ±1.59	11.60 ±1.47	78.04 ±10.56
Mean Number of Species Observed (±SD)	14.67 ±2.98	23.33 ±2.68	29.67 ±3.68
Mean Species Diversity Index (H′ ±SD)	1.62 ±0.67	1.63 ±0.61	1.89 ±0.61

September/October Mean Population Ashore (±SD): **63,818 ±15,009**

PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Buller's Shearwater	**Cassin's Auklet**	**Phalaropes**	Arctic Loon
Cassin's Auklet	Rhinoceros	Common **Murre**	Western **Grebe**
Phalaropes	**Auklet**	**Cassin's Auklet**	Brown **Pelican**
Bonaparte's Gull	**Phalaropes**	Western Gull	Brandt's Cormorant
Western **Gull**	Western Gull		Pelagic Cormorant
			Surf **Scoter**
			Western Gull
			California Gull
			Heerman's Gull
			Bonaparte's Gull

During October and November the highest mean bird densities at all distances from the coast were found off Bodega to Monterey Bay, and except for neritic waters, biomass density was accordingly high. Essentially, all shelf and slope waters supported biomass densities exceeding 20 kg/km^2 and moderate biomass densities could be found out to 200 km from shore. The zone of high density was broadest off San Francisco, where the shelf is broadest, and was narrowest off Monterey, where the Monterey Canyon cuts into the shelf. Numbers of birds at coastal roosts were highest along Monterey, Santa Cruz, and Marin County shores, and at Afro Nuevo and the Farallon Islands.

Peak populations of Brown Pelicans appeared on central coast roosts in September or October: more than 13,000 in 1981 and 1982. Adding substantially to shoreline and shelf populations were a variety of gulls, scoters, cormorants, loons, and grebes. Murres, auklets and phalaropes were very important in total density and biomass figures everywhere more than 20 km from shore. In October, they were joined offshore and over the slope by Buller's Shearwaters, fulmars, and kittiwakes, and in November by Bonaparte's Gulls. Average species numbers were higher here than anywhere else at this time, but because of extremely large numbers of a few species such as phalaropes, murres, and auklets, values of the species diversity index were somewhat below maxima attained elsewhere.

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Figure 21. (facing page) North-central sector: Comparison of monthly mean sea surface temperatures, deviation of temperature from climatic (20-year) seasonal means, and upwelling index. Data are modified from Auer (cd., 1981-1983), A. Bakun (pers. comm.), and this study.

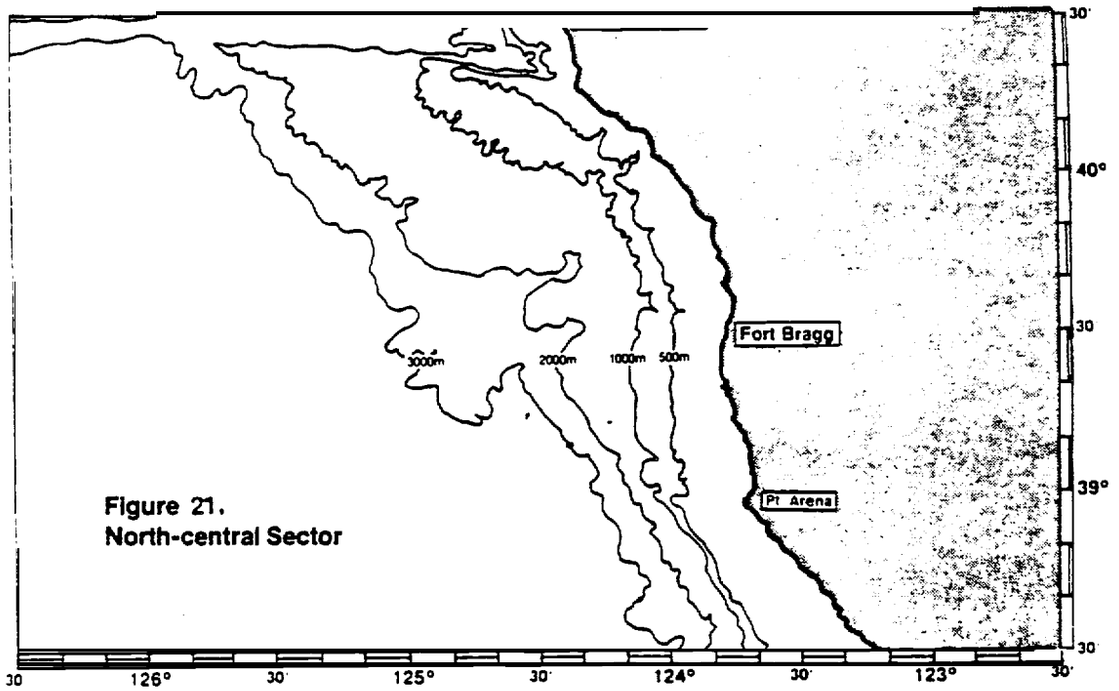
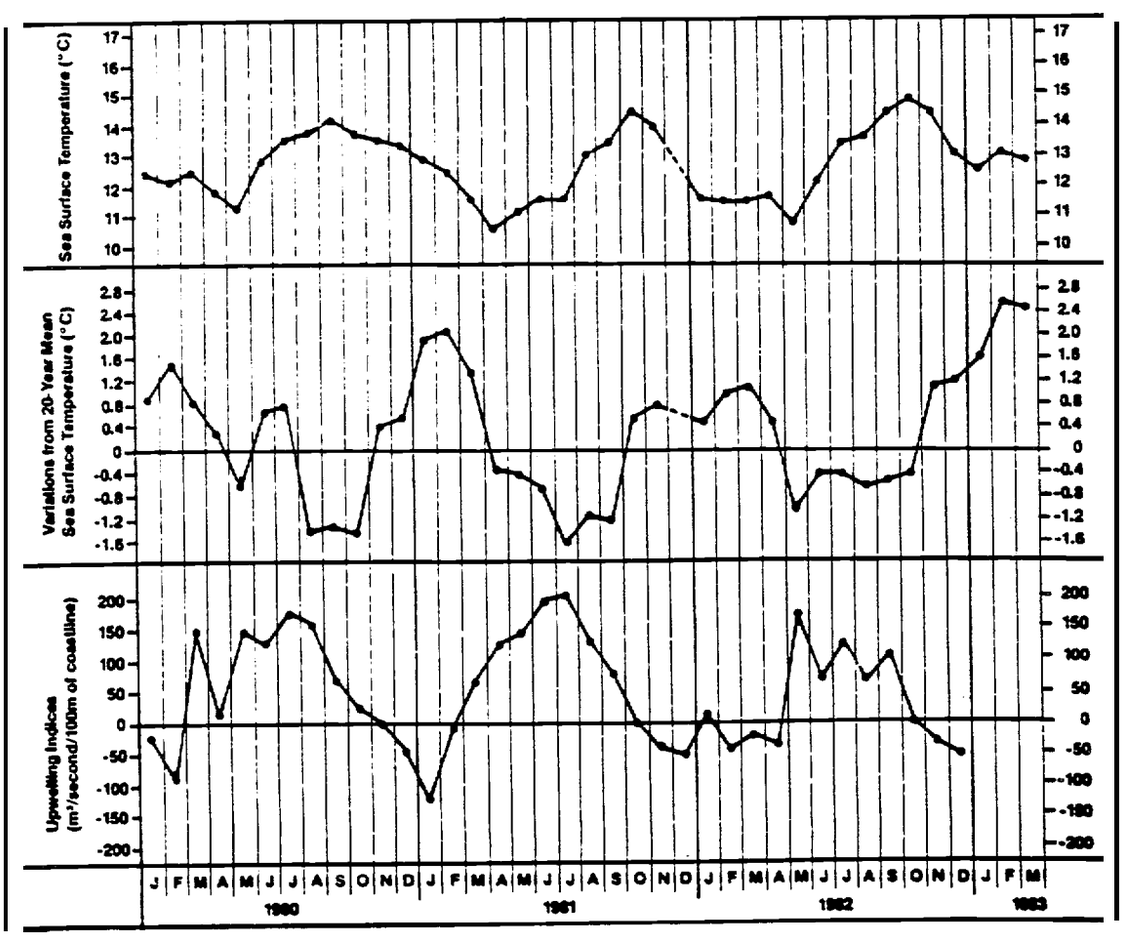
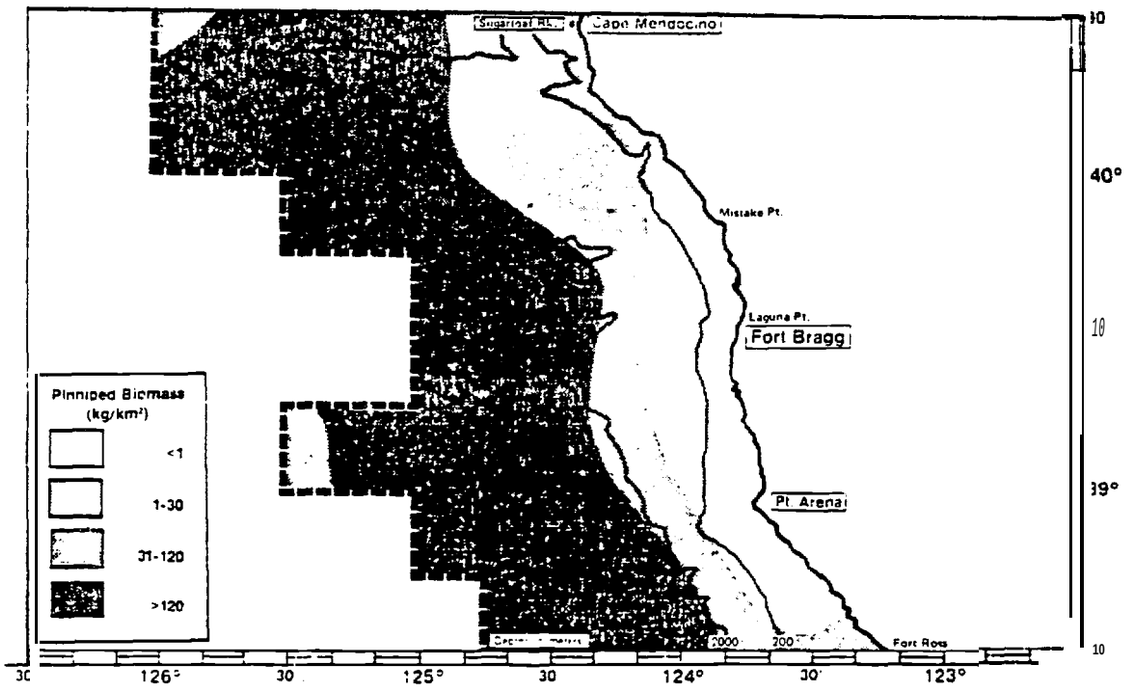


Figure 21.
North-central Sector



NORTH-CENTRAL SECTOR
Winter—Pinnipeds



Abundance at SEA (animals/km² ±SE)	offshore (>2,000 m)	slope (200–1,999 m)	Shelf (0-199 m)
California sea lion	0.003 ±0.006	0.059 ±0.08	0.024 ±0.016
Northern fur seal	0.143 ±0.042	0.059 ±0.033	0.0
Steller sea lion	0.0	0.001 ±0.002	0.0
Harbor seal	0.0	0.0	0.034 ±0.051
Northern elephant seal	0.01s ±0.012	0.005 *0.004	0.0
All Pinnipeds	0.164 ±0.050	0.124 ±0.063	0.058 ±0.052
Biomass (kg/km²)	22.76 ±6.90	17.16 ±8.75	7.66 ±6.83

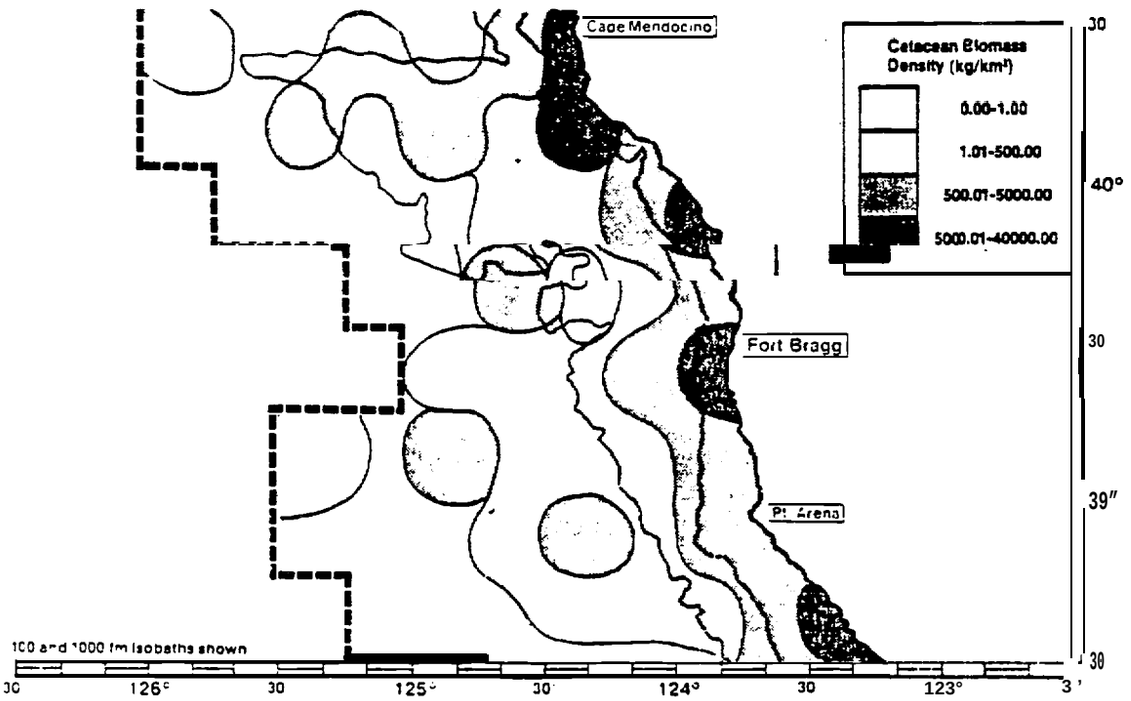
Abundance on LAND (numbers counted)	28–30 Jan. 1980	28-30 Jan. 19s1	25-27 Jan. 1982
California sea lion	175 (9%)	222 (13%)	276 (43%)
Steller sea lion	528 (27%)	807 (46%)	372 (57%)
Harbor seal	1,232 (64%)	707 (41%)	0
Northern elephant seal	0	0	0
All Pinnipeds	1,935	1,736	648

Pinnipeds

Along the northern California coast from Fort Ross Reef (38°30'N) to Sugarloaf at Cape Mendocino (40°26'N), we counted 1,736 pinnipeds on land in January 1982, representing 14.3% of the survey total. Most were Steller sea lions, which numbered 807 animals in this area, representing 46.5% of the total. The largest aggregations were found at Fort Ross Reef (38°30'N; 120 animals), Elk Rock (39°05'N; 42 animals), Soldier Prank (39°45'N; 162 animals), Sea Lion Gulch (40°14'N; 40 animals), Sea Lion Rock near the Mattole River (40°18'N; 260 animals), and Sugarloaf (40°26'N; 175 animals). The largest groups of harbor seals were found near Laguna Point (39°30'N; 123 animals) and at Jackass Gulch (39°53'N; 250 animals).

Pinniped sightings at sea in the north-central sector represented 24% of the statewide total for tne winter months, Sixty-two percent (62%) of all sightings *were* recorded on transects over offshore waters, and 94% of all sightings were of northern fur seals. Thirty-five percent (35%) of all sightings were recorded over the slope, where northern fur seals represented 82% of the total, Sightings of northern fur seals accounted for 87% of all sightings recorded for this sector in winter months. The mean densities for offshore, slope, and shelf depth regions were 0.16, 0.12, and 0.06 animals/km^2, respectively. Northern fur seals were found in a broad band beginning about 50 km west of the shoreline, with the areas of greatest abundance in waters over Vizcaino Knoll and the Gorda Escarpment. Occupation of waters over the slope was confined to the Mendocino Ridge.

NORTH-CENTRAL SECTOR
Winter—Cetaceans



	Shelf (0-99 fm)	slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.17 *0, 13	0.29 ±0.18	0.07 *0.04
Mean Cetacean Biomass (kg/km²)	4,923.58	325,07	198.81
Mean Sea Surface Temperature "C (±SE)	13.8° ±0.6	14.0° ±0.6	14.2° ±0.6
Percentage of Observed Cetaceans x Depth	24.8%	65.2%	9.9%
Percentage of Biomass x Depth	90. 4%	6.0%	3.6%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Northern right whale dolphin	Grampus
Harbor porpoise	Grampus	Dan's porpoise
Grampus	Pacific white-sided dolphin	Pacific white-sided dolphin
	Dan's porpoise	Northern right whale dolphin
	Killer whale	Sperm whale
	sperm whale	

Shelf. Southern migrating gray whales were mainly responsible for the very high biomass values along the coastline. Harbor porpoises were found, as well, along the entire coastline with pockets located off Cape Mendocino, south of Point Delgada (approximately 40°00'N), Laguna Point (39°40'N), and Fort Ross (37°30'N). Grampus, in scattered pods of 2 or 3 animals, were often found in extremely shallow water (c10 fro).

Slope. Slope waters accounted for the majority of the animals observed in this sector. Distribution was fairly *even* throughout the area, with a few sites of moderate concentration. School size was usually low and no one species dominated. Grampus and northern right whale dolphins were the most commonly observed species. With one exception, no Pacific white-sided dolphins *were* recorded north of Fort Bragg in this season; however, they were frequently found west and southwest of Point Arena. Dan's porpoises were also noted in this area, as well as farther north off Cape Mendocino. Sperm whales frequented Noyo and Vizcaino canyons (approximately 39°30'N) and

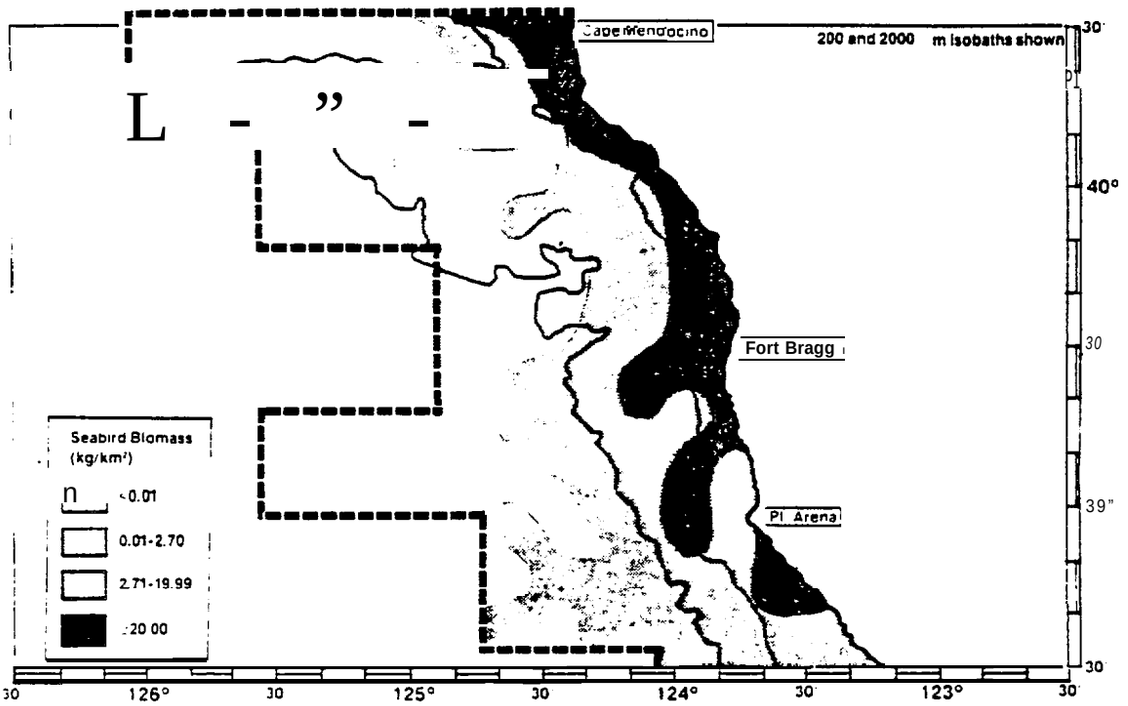
occasionally the lip of the Gorda Escarpment west of Cape Mendocino. Killer whales, as well, were located over the Noyo and Vizcaino canyons. Gray whales occasionally strayed into slope waters when rounding Point Arena on their journey south.

Offshore. Offshore the winter season was characterized by high species diversity, small widely scattered schools, and few areas of concentrated occupancy. Distribution favored clustering along the 1,000 fm isobath, with areas farther offshore practically void of animals. The Dall's porpoise was the only species to be found west of 125°15'W in significant numbers, Sperm whales *were* found in the deeper waters adjacent to Vizcaino Canyon, as were the infrequently sighted Baird's beaked whales.

Of interest, but of small importance from the viewpoint of biomass or consistency of occupancy, was a single winter sighting of 9 pilot whales 30 nm west of Point Arena. This was the northernmost sighting of this species over the three-year period of this study.

Mean sea surface temperatures demonstrated a slight upward gradient from the coastline towards offshore, However, seasonal northwesterlies insured a higher degree of water column homogeneity than found in the other seasons.

NORTH-CENTRAL SECTOR
Winter-Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope (200-1,999 m)	Shelf (1-199 m)
Mean Seabird Density (birds/km² ±SE)	7.59 ±1.66	19.36 ±5.18	34.54 *10.09
Mean Biomass Density (kg/km² ±SE)	3.18 ±0.83	11.21 ±2.89	26.42 ±7.14
Mean Number of Species Observed (±SD)	11.08 ±4.46	16.92 ±2.02	18.50 ±3.07
Mean Species Diversity Index (±SD)	1.70 ±0.37	2.12 ±0.23	2.24 ±0.32

January Mean Population Ashore (±SD): 9,821 ±3,324

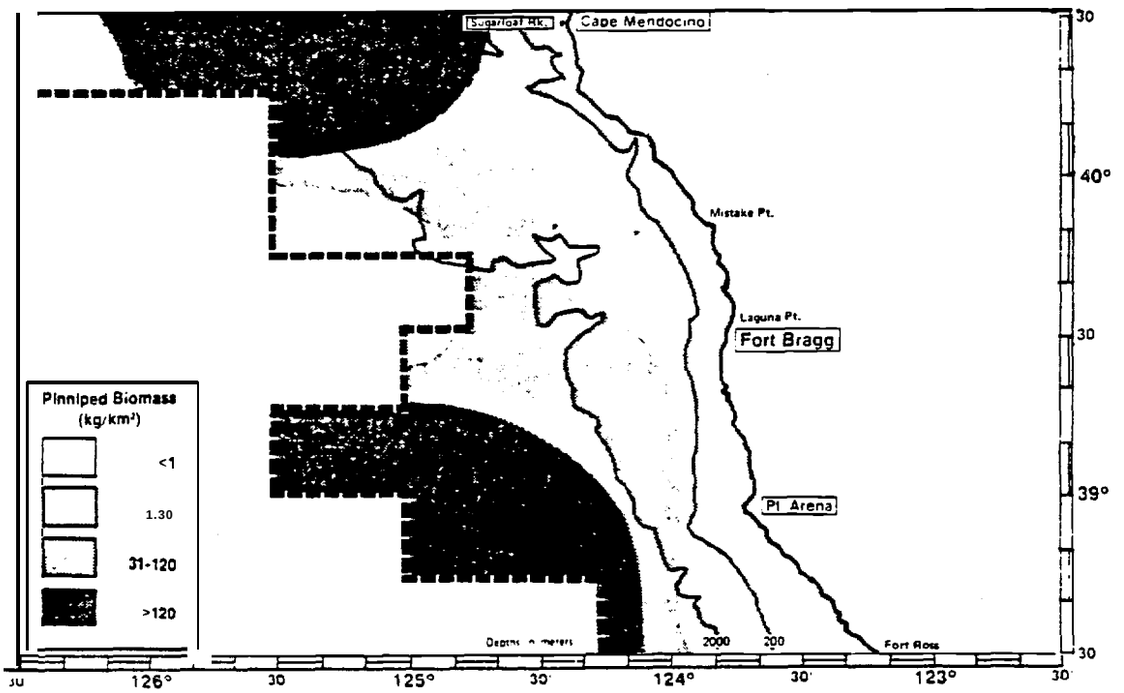
PREDOMINANT SPECIES

Offshore	slope	Shelf	Shoreline
Phalaropes	**Phalaropes**	**Cassin's Auklet**	Western Grebe
Cassin's Auklet	Northern **Fulmar**	Common **Murre**	Pelagic Cormorant
Rhinoceros	**Cassin's Auklet**	California Gull	surf **Scoter**
Auklet	Rhinoceros	Herring Gull	White-winged
Black-legged	**Auklet**	Western **Gull**	**Scoter**
Kittiwake	Common **Murre**		Western **Gull**
	Black-legged		Herring Gull
	Kittiwake		California Gull
	California Gull		Common **Murre**

Populations of seabirds found over the shelf here during winter were smaller than in sectors to the north and south, primarily due to lack of high densities of alcids and gulls. A zone of high density (20 to 513 birds/km^2) extended seaward for about 10 to 40 km between Cape Mendocino and Point Arena. Populations of slope and offshore waters were about 40% to 75% less densely concentrated than those of the shelf but these values were fairly comparable to those found in similar depth regions elsewhere. Species numbers and diversity were above those found here in the autumn and were comparable to winter figures for other sectors.

The fauna of this sector was very similar to that of adjacent areas. Near-coastal waters supported a variety of gull species, scoters, cormorants, and grebes, and waters lying near the shelfbreak harbored murres and auklets. The fauna farther offshore was dominated by gulls, alcids, phalaropes and fulmars, the great majority of which nested in the Pacific Northwest and Alaska. The nesting colony affinities of Cassin's Auklets and murres found here are uncertain; birds from both California and Pacific Northwest colonies probably were present,

NORTH-CENTRAL SECTOR
Spring-Pinnipeds



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.0	0.004 ±0.003	0.050 ±0.048
Northern fur seal	0.152 ±0.058	0.058 ±0.018	0,002 ±0.004
Steller sea lion	0.0	0.0	0.007 ±0.011
Harbor seal	0.0	0.0	0.018 ±0.015
Northern elephant seal	0.003 ±0.004	0.0	0.0
All Pinnipeds	0.155 *0.059	0.062 ±0.019	0,077 ±0.047
Biomass (kg/km²)	7.76 ±2.98	3.40 ±1.02	15.88 ±9.64

Abundance on LAND (numbers counted)	5-7 May 1980	19-21 May 1981	3-5,19 May 1982
California sea lion	248 (14%)	764 (25%)	*926* (24%)
Steller sea lion	333 (19%)	871 (28%)	*694* (18%)
Harbor seal	1,194 (67%)	1,455 (47%)	*2,187* (57%)
Northern elephant seal	0	0	0
All Pinnipeds	1,775	3,090	3,807

Pinnipeds

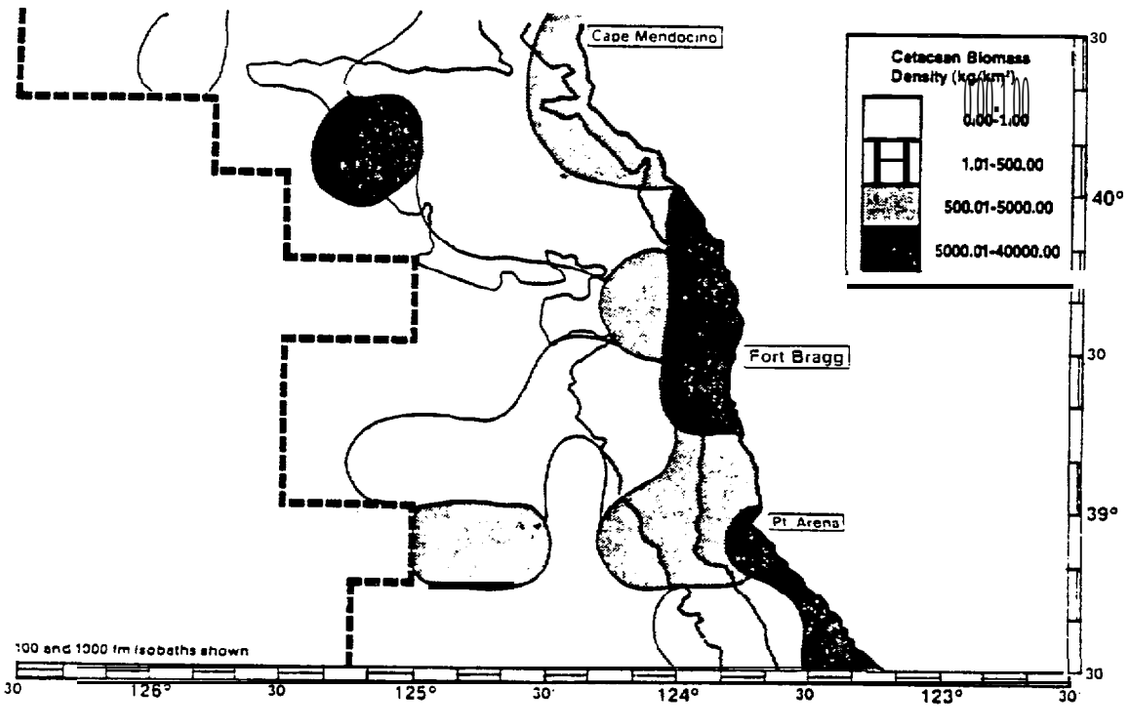
From Fort Ross Reef (38°30'N) to Fish Rocks (38°48'N), 1,018 harbor seals and California sea lions were counted in May 1982. Harbor seals, with a population of 577 representing 56.7% of the total, were seen at 22 specific locations along this stretch of the coast. California sea lions, with a population of 328 representing 32.2% of the total, were found only at Fish Rocks. The combined pinniped population in this area represented 4.2% of the survey total in May 1982,

Harbor seals were found in substantial numbers at 32 locations between Fish Rocks and Mistake Point (39°51'N). In 1982, 775 were seen along this stretch; an additional 262 California sea lions were counted at Mistake Point. Pinnipeds in this area represented 4.3% of the 1982 survey total.

By May 1982 the Steller sea lion rookery at Sugarloaf on Cape Mendocino was occupied by 430 animals. Another 152 California sea lions were on nearby rocks. The combined count of 582 for this area . represented 2.4% of the May 1982 total.

Pinniped sightings at sea in the north-central sector represented 17% of the statewide total for the spring months. Northern fur seals were the numerically predominant species, accounting for 91% of all sightings in this sector, The highest mean density of 0.15 animals/km^2 was found in offshore waters; 98% of all sightings in this depth region were northern fur seals. The distribution of pinnipeds at sea in the spring was much like that seen in the winter months, with concentrations appearing over the Mendocinc Ridge, west and north of the Gorda Escarpment, and the offshore waters beginning about 50 km west of Point Arena.

NORTH-CENTRAL SECTOR
Spring-Cetaceans



	Shelf (0-99 fm)	S lope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.25 ±0.30	0.49 ±2.59	0.007 *o, 02
Mean Cetacean Biomass (kg/km²)	10,549.63	789.47	45.79
Mean Sea Surface Temperature °C (±SE)	10.6″ *0.5	11.2″ ±0.3	11.9° ±0.3
Percentage of Observed Cetaceans x Depth	20. 7%	78.4%	0.9%
Percentage of Biomass x Depth	92. 7%	6.9%	0.4%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Pacific white-sided dolphin	Grampus
Pacific white-sided dolphin	Northern right whale dolphin	Sperm whale
Harbor porpoise	Grampus -	
	Sperm whale	
	Baird's beaked whale	

Cetacean biomass on the continental shelf in this sector continued, as in the other three sectors, to greatly exceed that of either the slope or offshore regions. In contrast, the slope supported almost twice the population density of the shelf. Sea surface temperatures were cooler when compared to the adjacent south-central sector by as much as 1.1°C on the shelf, 0.9°C on the slope, and 0.3°C in the offshore region. Temperatures to the north were between 0.3°C and 0.6°C higher.

Shelf. Migrating gray whales were the major species influencing high biomass numbers in the shelf region. Numerically, the species accounted for more than half the total cetacean population, attaining their highest seasonal numbers in this sector. Harbor porpoises, Pacific white-sided dolphins, and Dan's porpoises were each represented in the nearshore waters but in moderate numbers.

Harbor porpoise density declined slightly from levels reached in the adjacent south-central sector. Their occupation of the nearshore habitat continued in this sector, with individuals seldom straying more than .25 nm to .5 nm beyond the shoreline. Areas of the shelf most heavily utilized by both gray whales and harbor porpoises were

between Little River and the Mendocino County/Humboldt County line, and between Fort Ross and Point Arena.

Slope. Pacific white-sided dolphins were the most numerous toothed whales occupying the slope and comprised almost 74% of the cetacean fauna. Northern right whale dolphins, grampus, and Dan's porpoises ranked second, third, and fourth behind the Pacific white-sided dolphin in abundance. Numerous small- to medium-sized schools of these three species were recorded southwest of Cape Mendocino, near the Mendocino Canyon.

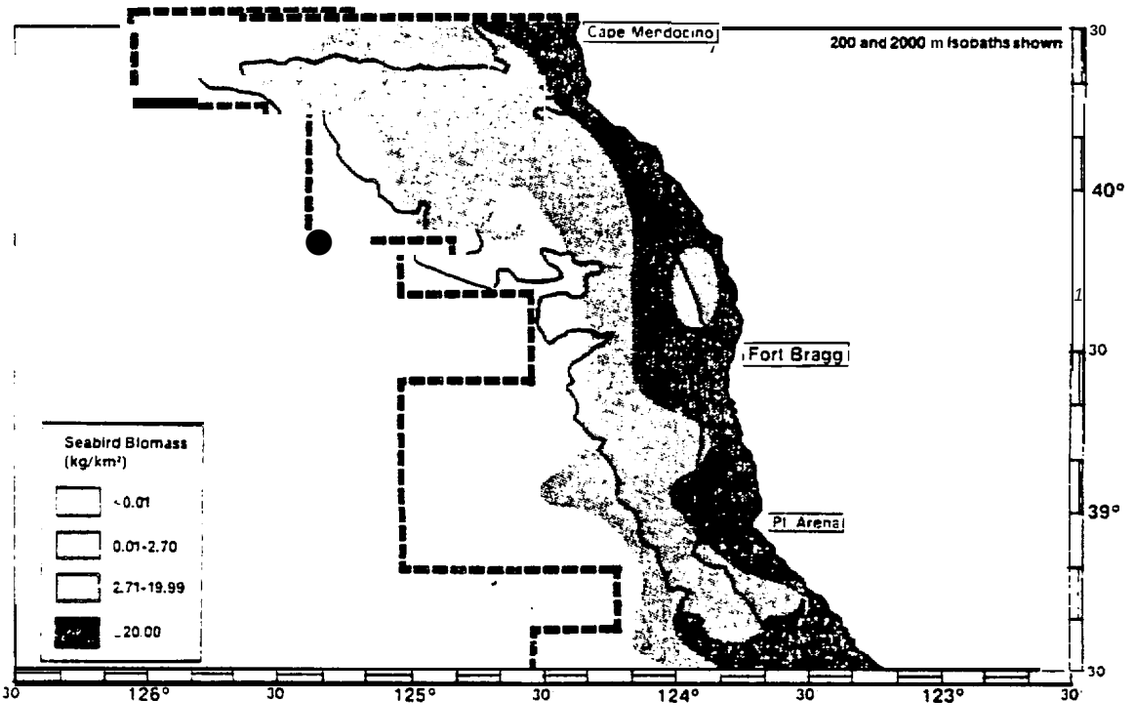
Sperm whales totaled 14 individuals, with 13 of the animals in a single pod traversing the outer edge of the slope near the 1,000 fm isobath. This relatively large aggregation was observed west of Cape Mendocino adjacent to the Mendocino Ridge.

Killer whales and Baird's beaked whales were also on the slope, but numbers of each were small. The killer whale sightings consisted of three small 'widely scattered pods, plus a solitary individual offshore. A single sighting of Baird's beaked whales in this sector was a pod of 6 individuals encountered northwest of Port Bragg.

Offshore. The offshore region supported six cetacean species, none of which were especially abundant. The two most commonly seen were grampus and sperm whales. The grampus were widely scattered offshore in four schools. The sperm whales were observed in deep water well beyond the 1,000 fm line.

Four other species noted in the region were Pacific white-sided dolphins, Dan's porpoises, humpback whales, and killer whales. However, numbers of these species were individually and collectively low.

NORTH-CENTRAL SECTOR
Spring-Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope 200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	4.27 *1.62	17.53 ±5.34	44.46 ±9.60
Mean Biomass Density (kg/km² ±SE)	1.82 ±0.51	10.35 *2.22	31.98 ±6.93
Mean Number of Species Observed (±SD)	8.11 ±5.55	17.33 ±8.11	17.00 ±6.46
Mean Species Diversity Index (H' *SD)	1.57 ±0.64	1.77 ±0.54	1.83 *0.42

May Mean Population Ashore (±SD): 13,831 ±2,568

May Mean Surface-nesting Population Ashore (±SD): 8,953 ±2,849

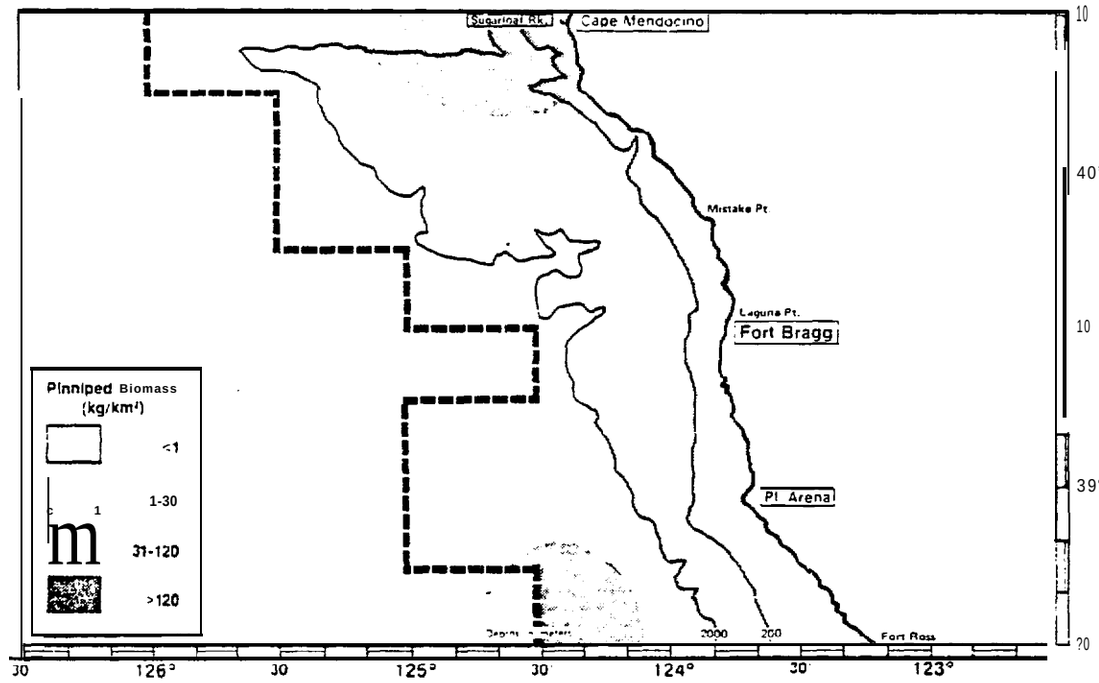
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
sooty Shearwaters	sooty Shearwaters	Sooty Shearwater	Brandt's Cormorant
Phalaropes	Cassin's Auklet	Phalaropes	Pelagic Cormorant
Cassin's Auklet	Phalaropes	Common Murre	Western Gull
		Bonaparte's Gull	Common Murre
		Western Gull	Bonaparte's Gull

Of the four latitudinal sectors, this is the one with the heaviest winds and coolest waters from mid-spring through summer. Overall abundance and biomass of seabirds was considerably lower here than in adjacent sectors to the north and south and, except near the Russian River and Fort Bragg, zones of high average bird density were closely restricted to waters just off the coast. Species numbers observed here were comparable to those in adjacent areas, but species diversity was fairly high due to lack of overwhelming populations of shearwaters, phalaropes, and murres. Except for sizeable murre and cormorant colonies near Cape Mendocino, the colonies in this sector were relatively small, consisting primarily of scattered aggregations of Brandt's and Pelagic Cormorants, Western Gulls, and Pigeon Guillemots.

The fauna near and along the-coast was dominated in spring by migrant populations of Arctic Loons, shearwaters, phalaropes, and various gulls, and by numbers of the nesting residents. Farther offshore we encountered a diverse assemblage of Black-footed Albatross, Fork-tailed and Leach's Storm-Petrels, Sooty Shearwaters, phalaropes, kittiwakes, and alcids (murres, auklets and puffins). Species composition was strongly seasonal; offshore, species numbers dropped from 15 or 16 in April to 2 or 3 in June, while over the shelf the figures were 18 to 28 species in April and 10 or 12 in June.

NORTH-CENTRAL SECTOR
Summer—Pinnipeds



Abundance at SEA (animals/km² ±SE)	offshore (>2,000 m)	Slope (200–1,999 m)	Shelf (0-199 m)
California sea lion	0.0	0.004 ±0.005	0.018 ±0.013
Northern fur seal	0.004 ±0.004	0.006 ±0.008	0.0
Steller sea lion	0.0	0.0	0.0
Harbor seal	0,0	0.0	0.007 ±0.010
Northern elephant seal	0.0	0.003 ±0.002	0.0
All Pinnipeds	0.004 ±0.004	0.013 ±0.008	0.025 ±0.015
Biomass (kg/km²)	0.23 ±0.23	1.25 ±0.79	4.27 ±2.64

Abundance on LAND (numbers counted)	1-3 July 19s0	30 June, 1,8 July 1981	28-30 June 1982
California sea lion	2 (<1%)	0	1 (<1%)
Steller sea lion	1,215 (35%)	941 (46%)	971 (22%)
Harbor seal	2,225 (65%)	1,122 (54%)	3,404 (78%)
Northern elephant seal	0	0	0
All Pinnipeds	3, 442	2,063	4, 376

Pinnipeds

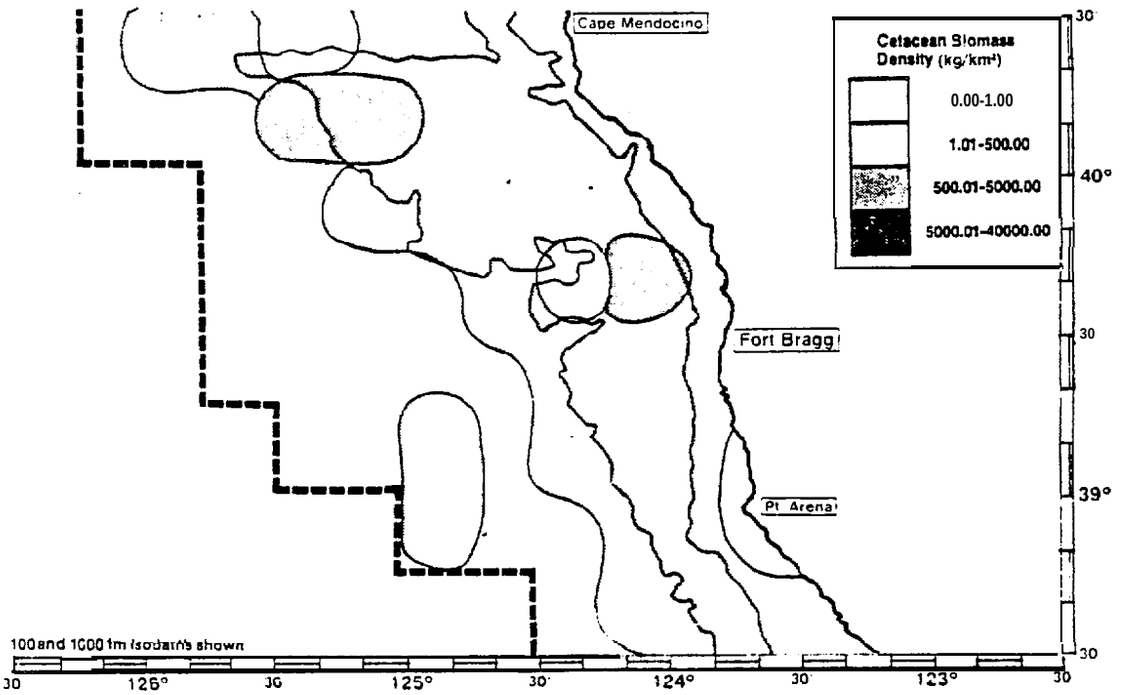
In 1982 great numbers of harbor seals were seen from Fort Ross Reef (38°30'N) to Laguna Point (39°30'N), four miles north of Fort Bragg. This total of 1,927 represented a 2.4-fold increase over the 1981 count. In addition to harbor seals, we counted 36 Steller sea lions in this area in summer 1982. Most were hauled out on the rocks of the Fort Ross Reef.

A major nonbreeding haul-out of Steller sea lions is found at Sea Lion Rock near Soldier Frank Point (39°45'N); 97 animals were counted here in June 1982, down from 121 in 1980. One of the largest harbor seal hauling grounds in central and northern California is located at Mistake Point (39°51'N); we counted 839 animals here in 1982, and 809 in 1980 (this stretch of the coast-line could not be surveyed in 1981 due to fog).

Sugarloaf at Cape Mendocino is the second largest Steller sea lion rookery in California. We counted 832 animals here in 1982 (including 128 pups). Previous counts were slightly higher: 923 (including 137 pups) in 1981, and 976 (including 117 pups) in 1980. The Steller sea lion breeding population at Sugarloaf is presently considered to be stable in size.

Pinniped sightings at sea in the north-central sector represented only 7% of the statewide total for the summer months. Of sixteen sightings recorded, five were of northern fur seals, indicating this species' year-round presence in northern California waters. All but one sighting were recorded on waters over the narrow shelf and the Mendocino Ridge. Harbor seals were the most frequently seen pinniped over the shelf. Despite the proximity of the surveyed waters to the large Steller sea lion rookery at Sugarloaf Rock near Cape Mendocino, no sightings of this species were recorded.

NORTH-CENTRAL SECTOR
Summer--Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.07 ±0.06	0.21 ±0.21	0.04 ±0.08
Mean Cetacean Biomass (kg/km²)	23.22	139.70	52.57
Mean Sea Surface Temperature °C (±SE)	12.4° ±0.4	13.5° *0.4	14.7″ *0.5
Percentage of Observed Cetaceans x Depth	13.3%	75.8%	10.9%
Percentage of Biomass x Depth	10.8%	64.8%	24.4%

Predominant Species

Shelf	Slope	Offshore
Harbor porpoise	Grampus	Grampus
Dan's porpoise	Pacific white-sided dolphin	Dan's porpoise
Grampus	Dan's porpoise	Northern right whale dolphin
	Baird's beaked whale	
	Sperm whale	

Although species diversity and numbers of animals varied in each of the three depth regions in summer, the waters of the slope dominated both categories with almost 76% of individual animal totals and 65% of the biomass. Due to the absence of significant numbers of gray whales on the shelf, the previously high springtime biomass values dropped precipitously in summer.

Shelf. Harbor porpoises comprised 75% of the shelf population in this sector. The animals were, with few exceptions, located very close to shore (less than .5 nm beyond the surfline). The population tended to aggregate along the open coastline between Fort Bragg and Cape Mendocino. Dan's porpoises and grampus were also observed in low numbers on the shelf. Both species were seen in greater numbers on the slope and to a lesser degree offshore,

Slope. Numerous small groups of grampus combined to make it the most abundant cetacean located on the slope. Of the almost 800 individual cetaceans counted in this depth region, 62% were grampus. This is a significant increase over totals of the preceding season when they accounted for less than 8% of the slope population in this sector, Significant concentrations of this species occurred between Fort Bragg 'and Cape Mendocino.

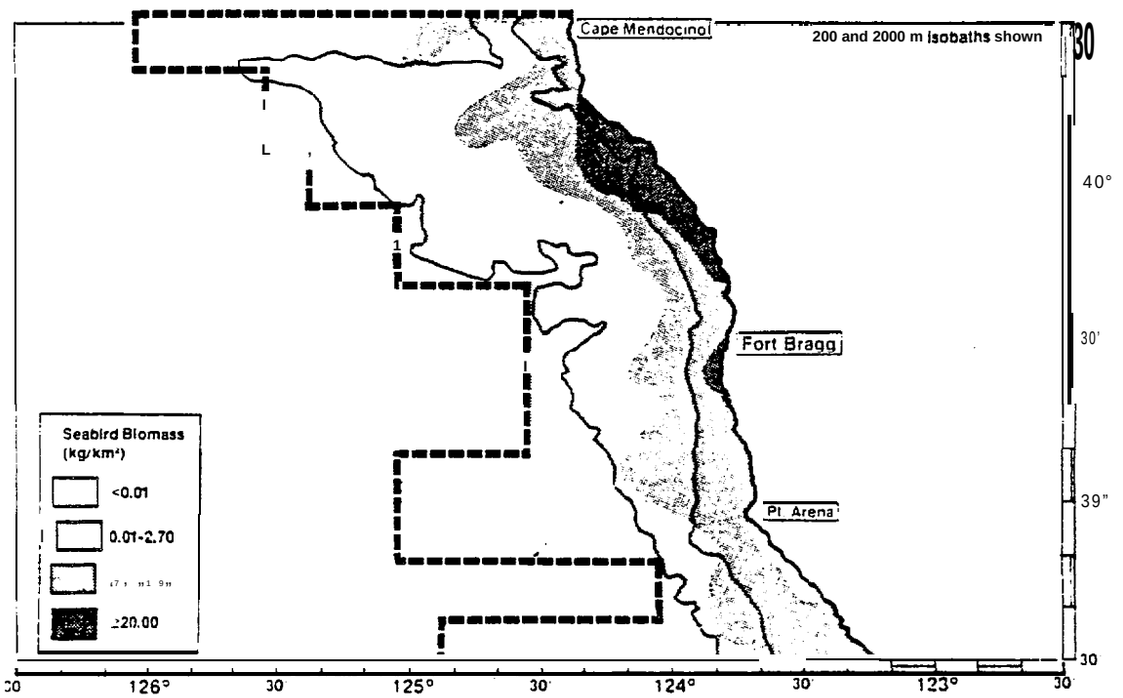
Pacific white-sided dolphins *were* also observed in this sector, but in unusually low numbers. Only 125 individuals were recorded in the three depth regions. In contrast, they were the most abundant species encountered in spring.

Dan's porpoises were the third most prevalent species, and sightings were widely scattered in typically small groups throughout the northern and central parts of the sector. The number of animals observed on the slope was the highest recorded in any sector during summer and spring.

A small *number* of scattered sightings of Baird's beaked and sperm whales were also recorded on the slope.

offshore. Grampus, Dall's porpoises, and a single small school of northern right whale dolphins were the major components of the offshore cetacean population. A single sperm whale and 2 Baird's beaked whales added to the offshore biomass.

NORTH-CENTRAL SECTOR
Summer—Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds km² ±SE)	5,50 ±2.31	7.88 ±1.65	24.29 ±4.23
Mean Biomass Density (kg/km² ±SE)	2.56 ±1.29	3.09 ±0.48	1S.08 ±4.38
Mean Number of Species Observed (±SD)	6,33 ±3.71	15.00 ±3.56	15.22 ±3.79
Mean Species Diversity Index (H' ±SD)	1.35 *0,57	1.87 ±0.35	1.83 ±0.40

July Mean Population Ashore (±SD): 23,730 ±2,932

July Mean Surface-nesting Population Ashore (±SD): 19,333 ±2,235

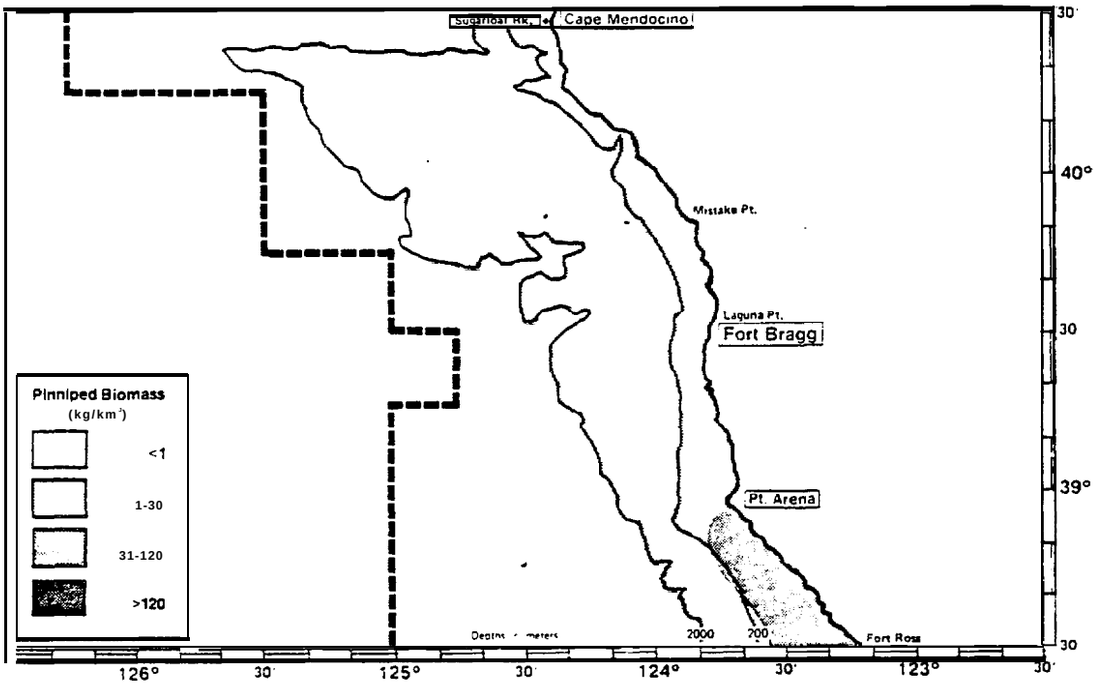
PREDOMINANT SPECIES

offshore	Slope	Shelf	Shoreline
Sooty Shearwater	Sooty Shearwater	Sooty Shearwaters	Brandt's Cormorant
Phalaropes	Cassin's Auklet	Phalaropes	Pelagic Cormorant
Common/Arctic Tern	Phalaropes	Common Murre	Western Gull
			Common Murre

The populations of nesting species reached annual maxima along the shoreline here in July. Except for a few moderate-sized (>10,000) murre colonies near cape Mendocino, numbers of birds at colonies were relatively low, though many sites were occupied. Brandt's and Pelagic Cormorants, Western Gulls, and Pigeon Guillemots all added to the numbers of murres; additional large numbers of Sooty Shearwaters, Brown Pelicans, phalaropes, and Cassin's Auklets occurred here just off the shoreline, In slope and offshore waters shearwaters, phalaropes, and auklets predominated throughout summer and were joined in late summer by Buller's Shearwaters, Pomarine Jaegers, and Arctic/Common Terns. Species numbers and diversity were relatively low in summer and were comparable to values found in the other sectors.

High biomass density generally was found only over the shelf for about 55 km south of cape Mendocino, while moderate biomass densities occurred elsewhere over the shelf and slope.

NORTH-CENTRAL SECTOR
Autumn—Pinnipeds



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.027 ±0.028	0.035 ±0.033	0.046 ±0.030
Northern fur seal	0.002 ±0.001	0.005 ±0.004	0.0
Steller sea lion	0.0	0.0	0.0
Harbor seal	0.0	0.002 ±0.003	0.014 ±0.013
Northern elephant seal	0.0	0.012 ±0.011	0.018 ±0.023
All Pinnipeds	0.029 ±0.025	0.054 ±0.029	0.078 ±0.032
Biomass (kg/km²)	*5.21* ±4.42	24.34 ±13.10	36.41 ±15.04

Abundance on LAND (numbers counted)	28-30 Oct. 1980	28-30 Sept. 1981	27-28 Oct. 1982
California sea lion	698 (44%)	661 (45%)	875 (46%)
Steller sea lion	527 (33%)	670 (45%)	586 (31%)
Harbor seal	363 (23%)	150 (lo%)	452 (24%)
Northern elephant seal	0	0	0
All Pinnipeds	1,588	1,481	1, 913

Pinnipeds

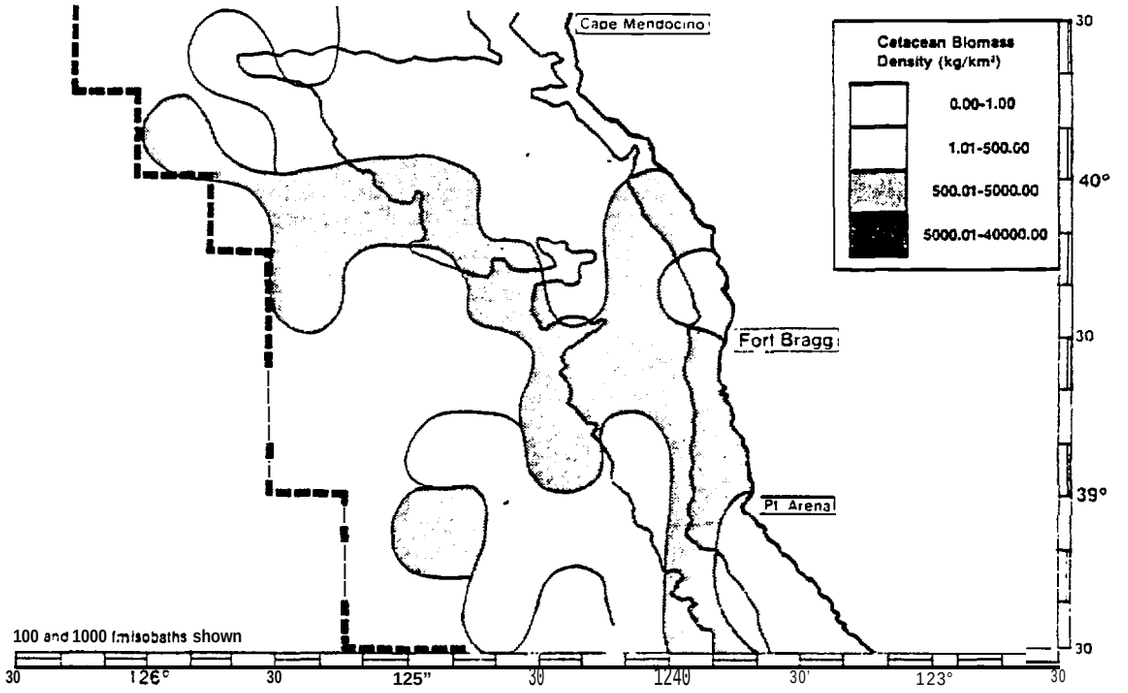
From Fort Ross Reef (38°30'N) north to Laguna Point (39°30'N) we counted 692 pinnipeds in 1982, representing 2.2% of the autumn survey total.. Most were California sea lions hauled-out on Fish Rocks (38°48'N), where we counted 383 animals (55,3% of the total for this area). Harbor seals accounted for 36.5% of the total, with a population of 252 hauled-out at 26 scattered locations. In addition, 57 Steller sea lions were sighted on the Fort Ross Reef (8.2% of the area total).

Several locations from Soldier Frank (39°45'N) northward were used by substantial numbers of pinnipeds in autumn. At Sea Lion Rock near Soldier Frank we counted 62 Steller sea lions. At Mistake Point (39°51'N) we counted 390 California sea lions and 126 harbor seals. These counts were close to those made in the previous two years. From Sea Lion Gulch (40°14'N) to Hair Seal Rock (40°19'N) we counted 350 Steller sea lions in 1982 (384 in 1981; 199 in 1980), plus 74 harbor seals and 61 California sea lions. On Sugarloaf at Cape Mendocino, 113 Steller sea lions were counted in October 1982, along with 41 California sea lions. The Steller sea lion count of September 1981 was 273 animals. In all, the pinniped count along the south coast of Cape Mendocino represented 3.9% of the survey total; counts in this area were similar in each of the three survey years: 1,221 in 1982, 1,202 in 1981, and 1,088 in 1980.

As in the summer months, the surveys showed very sparse occupation of the waters of the north-central sector in the autumn months; sightings in this sector represented only 5% of the statewide total in autumn. LOW to very low densities were recorded for most areas over the shelf and slope; few sightings were recorded in offshore waters. Of 27 sightings recorded, California sea lions and northern fur seals accounted for 41% and 30%, respectively. Most sightings were recorded on transects over the continental slope (52%).

The results suggest that California sea lions rarely venture this far north in either summer or autumn, that a few northern fur seals are found here year-round, and that the modest populations of Steller sea lions known to haul out at coastal sites generally forage elsewhere or during nighttime hours.

NORTH-CENTRAL SECTOR
Autumn-Cetaceans



	shelf (o-99 fm)	slope (100-999 fm)	Offshore (1,000+ fin)
Mean Cetacean Density (cetaceans/km² ±SE)	0.38 ±0 ,27	0.91 ±0.65	0.19 ±0.28
Mean Cetacean Biomass (kg/km²)	641.25	284.80	588.05
Mean Sea Surface Temperature "C (±SE)	13,5° ±0.4	14,5° *0.4	16.0° *0.4
Percentage of Observed Cetaceans x Depth	16.3%	70. 4%	13.3%
Percentage of Biomass x Depth	42 .4%	18.8%	38.8%

Predominant Species

shelf	Slope	Offshore
Grampus	Pacific white-sided dolphin	Pacific white-sided dolphin
Northern right whale dolphin	Northern right whale dolphin	Dan's porpoise
Harbor porpoise	Dan's porpoise	Sperm whale
Humpback whale	Grampus	Baird's beaked whale
	Killer whale	
	Baird's beaked whale	
	Humpback whale	
	Sperm whale.	

Shelf. The variety of cetacean species (nine) observed over the shelf, coupled with their numbers, made autumn the season of highest mean cetacean density. Animal utilization of these nearshore waters increased fivefold over summer and produced annual maximums for five species.

Harbor porpoises were found along the entire coastline in 50% greater *numbers* than in any other season. Their greatest densities, as in every season, occurred between Cape Vizcaino (39°44'N) and Point Delgada (40°02'N), particularly inshore of Talo Bank.

Grampus, not usually associated with the nearshore shallows, were found in annual maximum numbers within a very narrow *range* near Fort Bragg. A lesser concentration was located south of Point Delgada, with the remainder of the nearshore sector void of grampus.

Northern right whale dolphins, another species not usually associated with shallow water, were also found in large numbers over the shelf south of Fort Bragg. The only other nearshore site of concentration was Point Arena, with the remainder of the coastal shallows free of significant numbers.

Moderate numbers of humpback, fin. and gray whales, found just south of Point Delgada and Point Arena, added to the coastal biomass.

Slope. Highest seasonal mean cetacean density and biomass occurred over the slope in autumn. High species diversity, with moderate to high animal numbers, made this possible.

Three of the smaller cetaceans, Pacific white-sided dolphins, northern right whale dolphins, and Dall's porpoises all reached annual high numbers in this season. All were recorded repeatedly in four locations: over the Mendocino Ridge.. west of Point Delgada, Fort Bragg, and Point Arena. In addition, these locations were favored by the larger whales: killer, Baird's, humpback, and sperm. Pew other places throughout the state demonstrated such seasonal site fidelity.

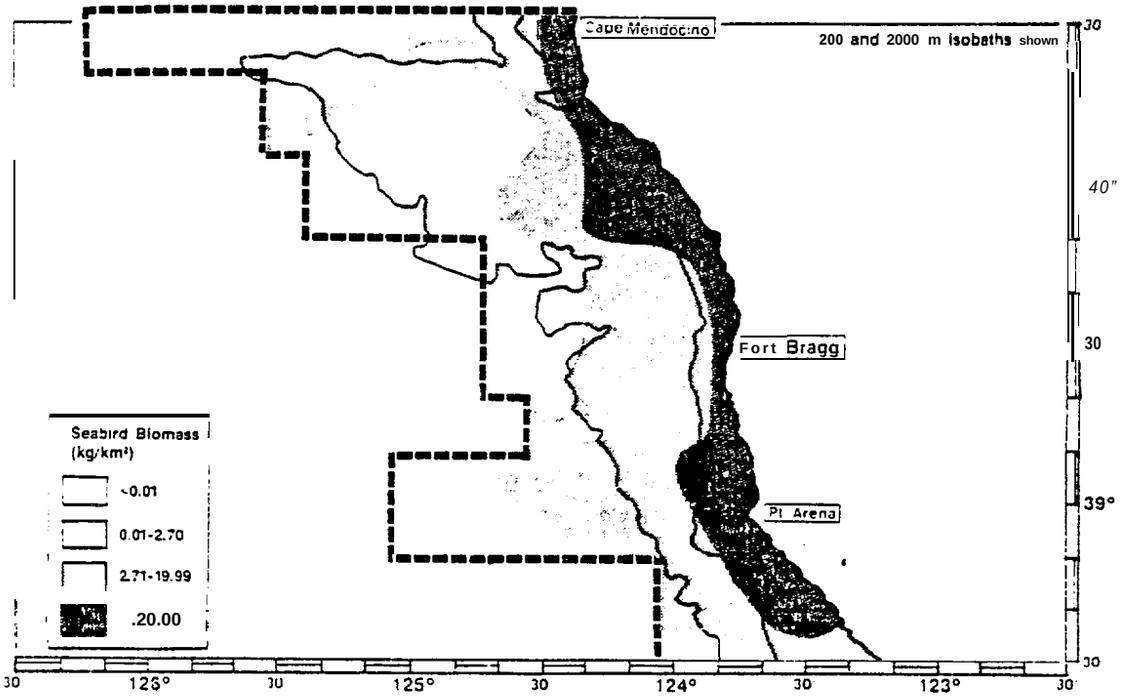
Offshore. Autumn, again, was the season of maximum offshore values for mean cetacean density and biomass.

Pacific white-sided and northern right whale dolphins were found mostly in the southern portion of the sector offshore of Point Arena. In contrast, Dan's porpoises were congregated along the outer margin of the Mendocino Ridge in the north.

Sperm whales and Baird's beaked whales also selected the deep water edge of the Mendocino Escarpment. Insignificant numbers of blue and humpback whales, important because of their biomass, were also noted in the same area.

The greatest seasonal temperature gradients from the shoreline to offshore are recorded in this season.

NORTH-CENTRAL SECTOR
Autumn—Seabirds



POPULATION INDICES	Offshore (22,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	7.35 ±2.35	20.97 ±2.08	121.54 ±53.49
Mean Biomass Density (kg/km² ±SE)	2.66 ±0.81	8.33 ±1.35	75.68 ±39.82
Mean Number of Species Observed (±SD)	9,00 ±3.92	21.50 ±3.69	23.50 ±2.06
Mean Species Diversity Index (H' ±SD)	1.58 ±0.46	2.16 *0,43	2.19 ±0.25

September/October Mean Population Ashore (±SD): 19,031 ±5,215

PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Northern Fulmer	Phalaropes	Phalaropes	Western Grebe
Cassin's Auklet	Cassin's Auklet	Cassin's Auklet	Brandt's Cormorant
	California Gull	Common Murre	Pelagic Cormorant
	Western Gull	Bonaparte's Gull	Surf Scoter
		California Gull	White-winged Scoter
		Herring Gull	Western Gull
		Western Gull	California Gull
			Bonaparte's Gull

With the conclusion of nesting activities in late summer, murres and guillemots nesting here moved offshore and cormorants declined in abundance, probably moving north into Oregon, or south into central California, Along the shoreline they were replaced by large numbers of migrant gulls, loons, and scoters, many of which began winter residency late in this period. Populations of loons, grebes, and scoters were highest south of major-promontories, particularly over sandy substrate. These same species, plus phalaropes, murres, and Cassin's Auklets predominated in waters of the shelf and slope. Farther offshore, seabird populations consisted mainly of Northern Fulmars, Black-legged Kittiwakes, Bonaparte's Gulls (which occurred in abundance clear in to the coast), and Cassin's Auklets.

This was the period of the highest mean bird densities and biomass densities in this sector. A band of high biomass density extended from 10 to 40 km offshore the length of this area, and moderate densities (2 to 20 kg/km^2) occurred for another 50 km to seaward. This was the only period when biomass figures were not substantially below those of the adjacent sectors (North and South-central). Species numbers were higher in autumn than in any other season, and the mean species diversity index was equal to or above that of other sectors at this time. Numbers of birds along the shoreline here were higher during this period than in winter or spring, but compared to numbers along the shore elsewhere, populations here in autumn were low.

Figure 22. (facing page) Northern sector: Comparison of monthly mean sea surface temperatures, deviation of temperature from climatic (zO-year) seasonal means, and upwelling index. Data are modified from Auer (cd., 1981-1903), A. Bakun (pers. comm.), and this study.

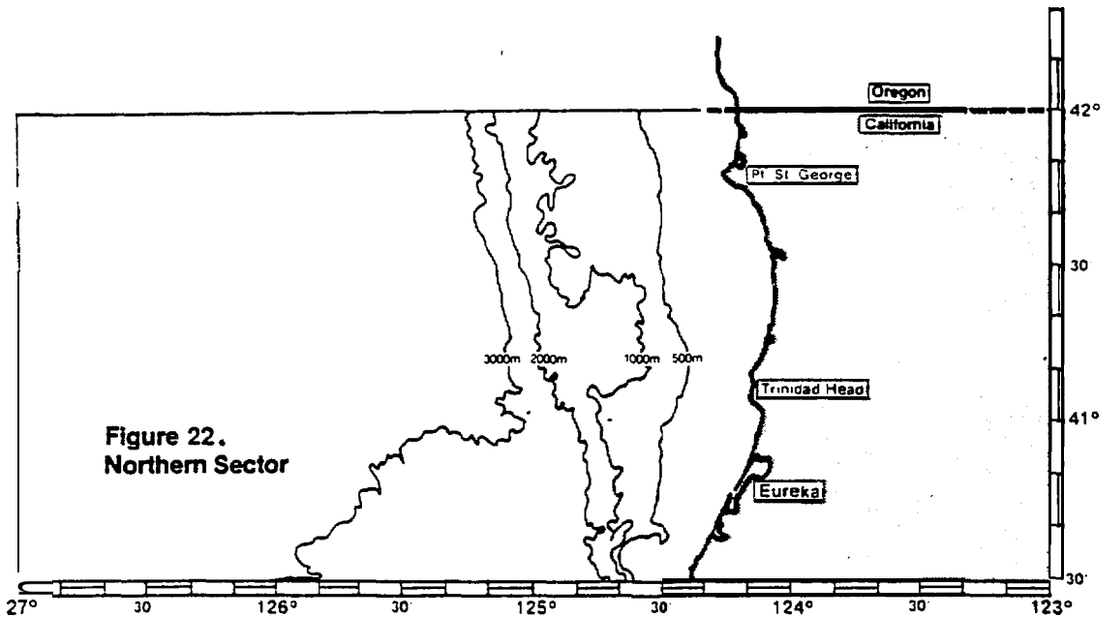
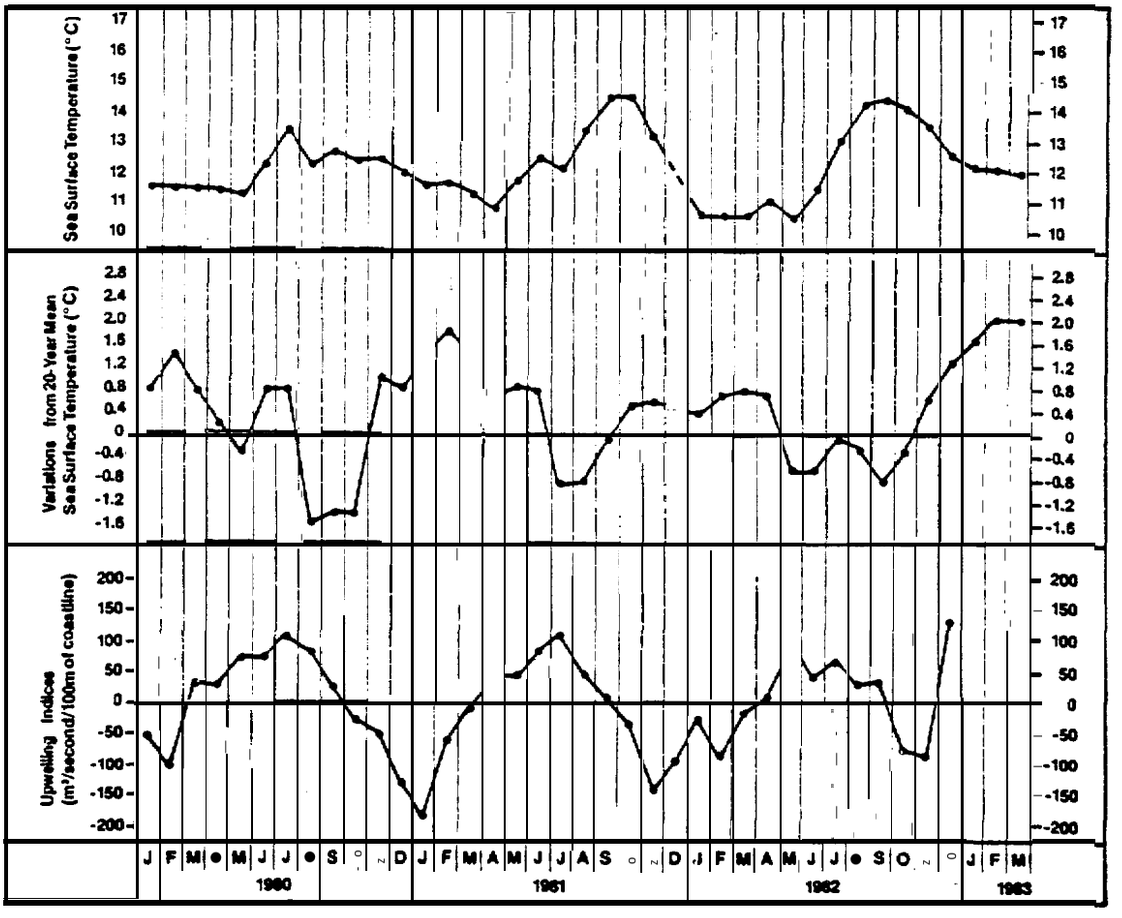
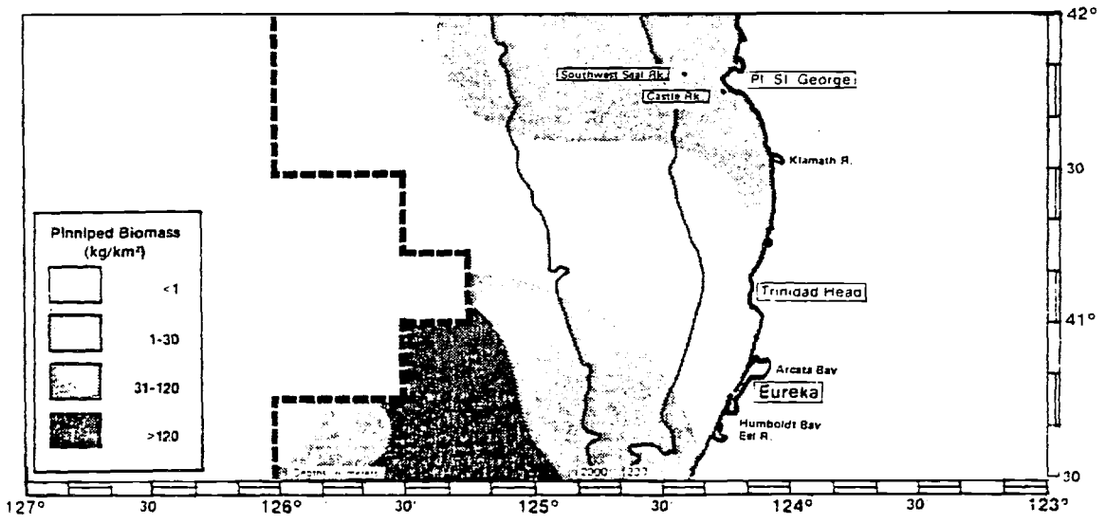


Figure 22.
Northern Sector



NORTHERN SECTOR "
Winter-Pinnipeds



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lien	0.0	0.005 *0.005	0.065 ±0.029
Northern fur seal	0.030 ±0.014	0.033 ±0.014	0.009 ±0.005
Steller sea lion	0.0	0.002 ±0.002	0.011 ±0.009
Harbor seal	0.0	0.0	0.008 ±0.007
Northern elephant seal	0.0	0.0	0.004 ±0.005
All Pinnipeds	0.030 ±0.014	0.040 ±0.016	0.097 ±0.025
Biomass (kg/km²)	1.51 ±0.71	3.19 ±1.28	26.22 ±6.84

Abundance on LAND (numbers counted)	28-30 Jan. 1980	28-30 Jan. 1991	25-27 Jan. 1982
California sea lion	660 (51%)	1,255 (56%)	140 (51%)
Steller sea lion	287 (22%)	358 (16%)	131 (48%)
Harbor seal	354 (27%)	640 (28%)	0
Northern elephant seal	4 (<1%)	0	4 (<1%)
All Pinnipeds	1, 305	2,253	275

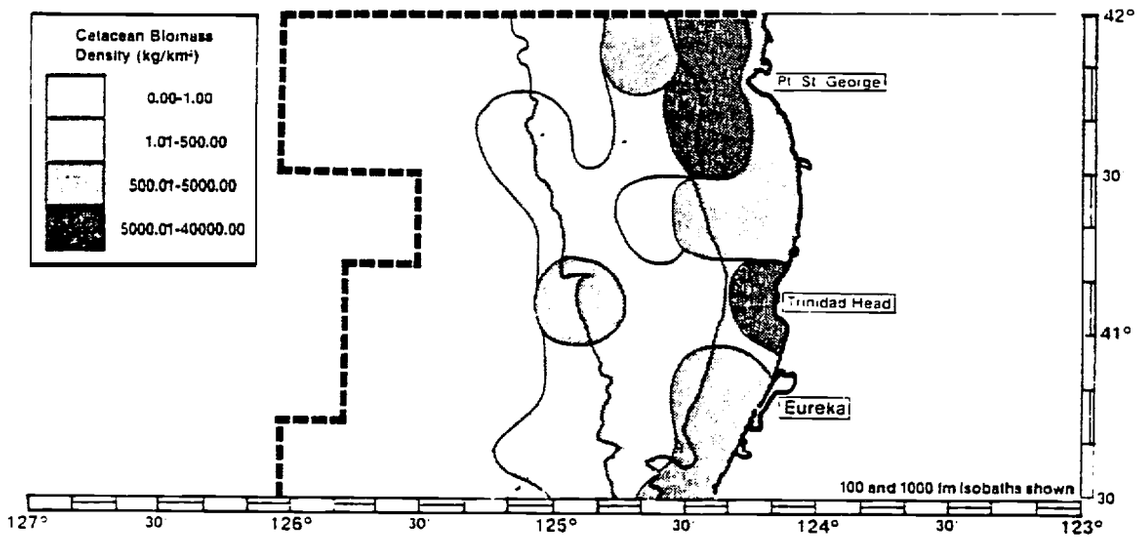
Pinnipeds

Substantial numbers of pinnipeds were counted on the rocks from Trinidad Head (41°03'N) to Patrick's Point (41°08'N) in 1981. The 401 animals counted represented 3.3% of the winter survey total. All of the 63 Steller sea lions and 190 of the 217 California sea lions counted were on Flatiron Rock (41°03'N).

On the St. George Reef (41°45'N), 1,776 pinnipeds were counted in 1981, representing 14.6% of the winter count. of the total, 1,038 (58.4%) were California sea lions; all of these animals were on Castle Rock and the nearby Inner castle Reef. Steller sea lions, with 97 animals on Castle Rock and 185 on Southwest Seal Rock, represented 16.0% of the total. Harbor seals were found in large numbers at two locations -- 317 on Inner Castle Reef and 120 about 9 km farther south near Midway Point (41°40'N); they accounted for 24.6% of the area total .

Pinniped sightings at sea in the northern sector represented only 8% of the statewide total for the winter months. Northern fur seals were the numerically predominant species with 73% of all sightings; California sea lions accounted for 17% of total sightings. The sighting abundance was more equally divided among depth regions than in other sectors, with 38% and 35% recorded for the slope and offshore, respectively. Northern fur seals were the only species sighted in the offshore region, and accounted for 88% of the sightings over the slope. California sea lions were the most frequently seen pinnipeds in waters overlying the shelf (50% of all sightings). The highest mean density of 0.1 animals/km^2 was found over the shelf. The only specific area of high density was that occupied by northern fur seals in the offshore waters over, and north of, the Gorda Escarpment. Moderate densities were recorded over the shelf and slope west of the Eel River and Point St. George.

NORTHERN SECTOR
Winter-Cetaceans



	Shelf (0-99 flu)	Slope (100-999 fm)	Offshore (1,000+ fin)
Mean Cetacean Density (cetaceans/km^2 ±SE)	0.09 ±0 ,06	0.09 *o. 12	0.34 ±0 .26
Mean Cetacean Biomass (kg/km^2)	2,161.51	50.45	24.37
Mean Sea Surface Temperature 'C (±SE)	13.4" ±0.7	13.7° *0.7	13.8° ±0.7
Percentage of Observed cetaceans x Depth	21. 4%	24,5%	54.2%
Percentage of Biomass x Depth	96.6%	2.3%	1.1%

Predominant Species

Sheif	Slope	Offshore
Gray whale	Grampus	pacific white-sided dolphin
Harbor porpoise	Pacific white-sided dolphin	

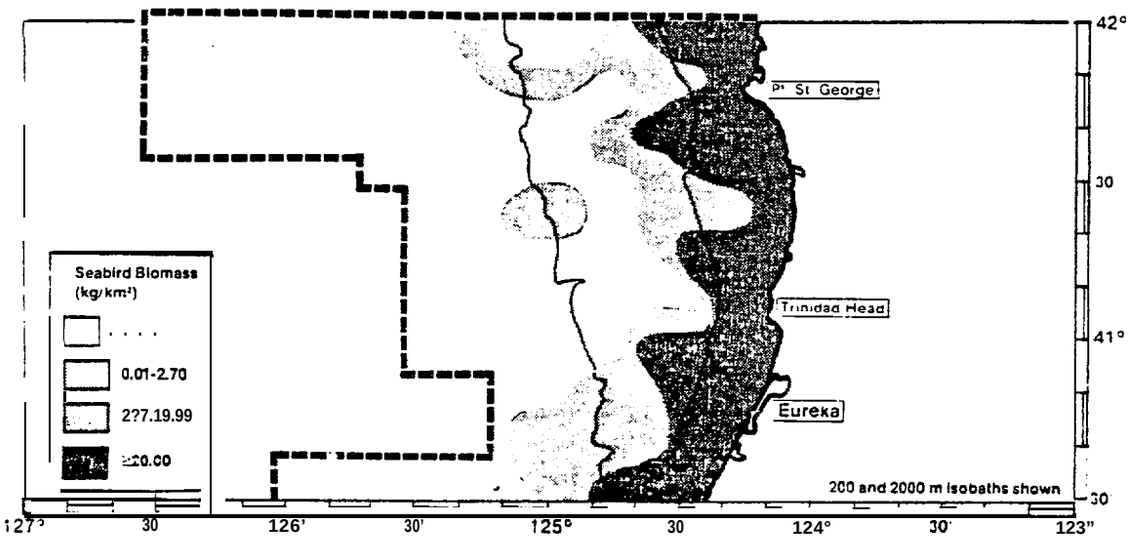
Shelf. Winter is a period of low diversity, with minimal numbers of animals in this sector. Shelf waters are dominated by the gray whale on its annual southern migration. The only other species found in significant numbers was the harbor porpoise; this species was found along the entire coastline in some numbers, with the highest densities occurring off Trinidad Head, then tapering off along the coast north to Point St. George.

Slope. Slope waters, as well, exhibited low diversity and small pods . Grampus was the dominant species, with the larger concentrations found west of Trinidad Head and Point St. George. Pacific white-sided dolphins were completely absent north of Eureka, and found only in low numbers to the south. The northern right whale dolphin, normally seen in moderate to high numbers in this sector, was missing during this season.

Offshore. Offshore waters held the greatest numbers of animals, predominantly Pacific white-sided dolphins, all of which were located south of Eureka and east of 125°15'W along the northern edge of the Gorda Escarpment, Grampus, and widely dispersed pods of 2 and 3 Dan's porpoises, were found over the 1,000 fm isobath west of Trinidad Head.

Mean sea surface temperatures were slightly cooler inshore, and were virtually the same over the slope and offshore areas.

NORTHERN SECTOR
Winter-Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (0-193 m)
Mean Seabird Density (birds/km² *SE)	4.63 ±0.66	16.87 ±3.35	104.18 *44,92
Mean Biomass Density (kg/km² ±SE)	1.74 ±2.92	12.16 ±2.88	93.63 ±38.84
Mean Number of Species Observed (±SD)	7.67 ±2.75	13: 75 ±2.65	19.32 ±3.59
Mean Species Diversity Index (H' ±SD)	1.48 ±0.37	1.81 ±0.41	1.86 ±0.31

January Mean Population Ashore (±SD): 18,023 ±13,136

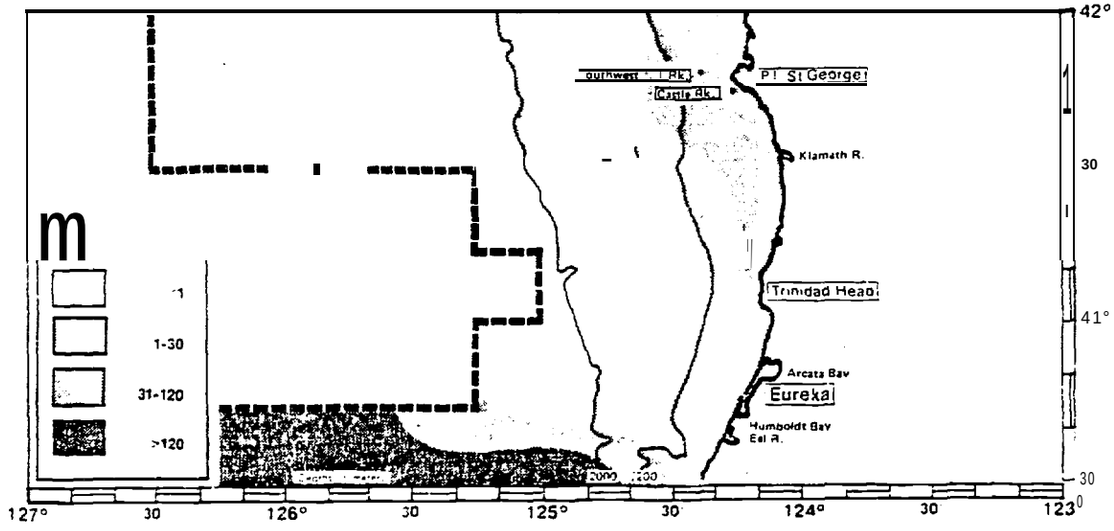
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Northern Fulmar	Northern Fulmar	Western Grebe	Western Grebe
Leach's	Cassin's Auklet	Common Murre	Pelagic Cormorant
Stern-2etxel	Rhinoceros Auklet	White-winged	Surf Seater
Cassin's Auklet	Common Murre	Scoter	White-winged
Phalaropes	Black-legged	Herring Gull	Scoter
Black-1egged	Kittiwake		Western Gull
Kittiwake	Herring Gull		Herring Gull
			Common Murre

Seabird populations in the northern sector were dominated in numbers by a mixture of locally-nesting species and species nesting primarily in Alaska to Washington. Among the local populations, murres, Western Gulls, and storm-petrels were most numerous. Cassin's Auklets also nest here but most of the birds present during winter return to central California or Alaska-Oregon to nest. Prominent among the Alaskan nesting species were fulmars, kittiwakes, phalaropes, Rhinoceros Auklets, scoters, and Herring Gulls, The faunas of the slope and offshore regions were quite similar indicating that these species behaved more or less as a community, varying in abundance, but not composition with distance to shore. The predominant species near shore included murres, grebes, scoters, and gulls and a few thousand Pelagic Cormorants remained close to the coast here through winter. The presence of Western Gulls, cormorants, and murres along the shoreline in winter probably resulted from early visits to nesting colonies that were reoccupied in greater numbers in spring. Similarly, Leach's Storm-Petrels occurring offshore in March were probably early arrivals among nesting individuals.

During winter we found higher average density and biomass of birds here than in the shelf area of any portion of the study area, while these abundance measures for slope and offshore waters averaged at or below values for sectors to the south. On a similar scale, species numbers and diversity averaged somewhat less here than to the south, particularly in waters seaward of the shelf. The zone of high average biomass density varied in width from 10 to 40 km, with a 'scalloped' outer margin.

NORTHERN SECTOR
Spring—Pinnipeds



Abundance at SEA (animals/km² *SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.0	0.002 ±0.002	0.074 ±0.062
Northern fur seal	0,032 ±0.033	0.024 *0.008	0.0
Steller sea lion	0.0	0.007 ±0.008	0.027 ±0.024
Harbor seal	0.0	0.004 ±0.005	0.0
Northern elephant seal	0.0	0.0	0.0
All Pinnipeds	0.032 ±0.033	0.037 ±0.013	0.101 ±0.060
Biomass (kg/km²)	1.60 ±1.60	4.46 ±1.52	32.63 ±19.49

Abundance *on LAND* (numbers counted)	5-7 May 1980	19-21 May 1981	3-5,19 May 1982
California sea lion	127 (7%)	1,092 (42%)	479 (31%)
Steller sea lion	441 (26%)	443 (17%)	306 (20%)
Harbor seal	1,0'30 (64%)	1,020 (39%)	746 (48%)
Northern elephant seal	36 (2%)	30 (1%)	36 (2%)
All Pinnipeds	1,694	2,585	1,567

Pinnipeds

About 300 harbor seals were counted on the mudflats of the Eel River mouth (40°37'N) and in Humboldt and Arcata bays (40°45'N) in May 1982. Counts of this species vary greatly with tide and time of day. We counted 507 harbor seals in this area in May 1980, and 484 in May 1961.

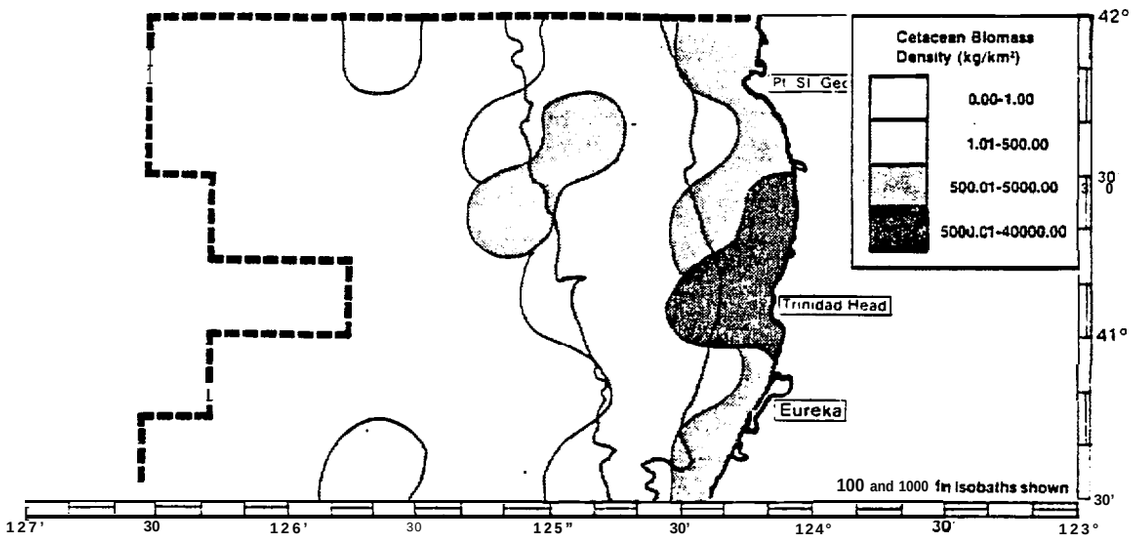
Sea lions are typically found in substantial numbers *on* the rocks near Trinidad Head (41°03'N). In May 1982 we counted 355 animals here (1.2% of the survey total); 75% were California sea lions, and 25% were Steller sea lions.

Harbor seals haul out at a number of locations along the coast from False Klamath (41°35'N) to Midway Point (41°38'N). We saw only 22 in this area in 1982, but counted 340 in 1981.

Pinnipeds hauled-out on the St. George Reef (41°45'N) represented 3.4% of the survey total in May 1982. The total of 825 included 196 California sea lions (24%), 180 Steller sea lions (22%), 413 harbor seals (50%), and 36 northern elephant seals (4%).

Pinniped sightings at sea in the northern sector represented less than 7% of the statewide total for the spring months. Northern fur seals were numerically predominant with 65% of all sightings, They were the only pinnipeds seen in offshore waters, and accounted for 90% of all pinnipeds sighted over the slope. In waters overlying the shelf, California sea lions accounted for 59% of the sightings, and Steller sea lions accounted for 35% of the sightings. Mean densities for each depth region were much like those recorded in winter, with a high mean density of 0.1 animals/km^2 found for waters overlying the shelf. The only specific area of high density was that occupied by northern fur seals in the vicinity of the Gorda Escarpment.

NORTHERN SECTOR
Spring-Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0,11 ±0 . 0S	1.81 ±1. 43	0,02 ±0.03
Mean Cetacean Biomass (kg/km²)	3,320.13	148.31	42.58
Mean Sea Surface Temperature °C (*SE)	11.1° *0.3	11.8″ *0.2	12.2° *0.3
Percentage of Observed Cetaceans x Depth	5.2%	94.2%	0.6%
Percentage of Biomass x Depth	94.6%	4.2%	1.2%

Predominant Species

Shelf	Slope	Offshore
Gray whale	Northern right whale dolphin	Sperm whale
Harbor porpoise	Pacific white-sided dolphin	
	Grampus	

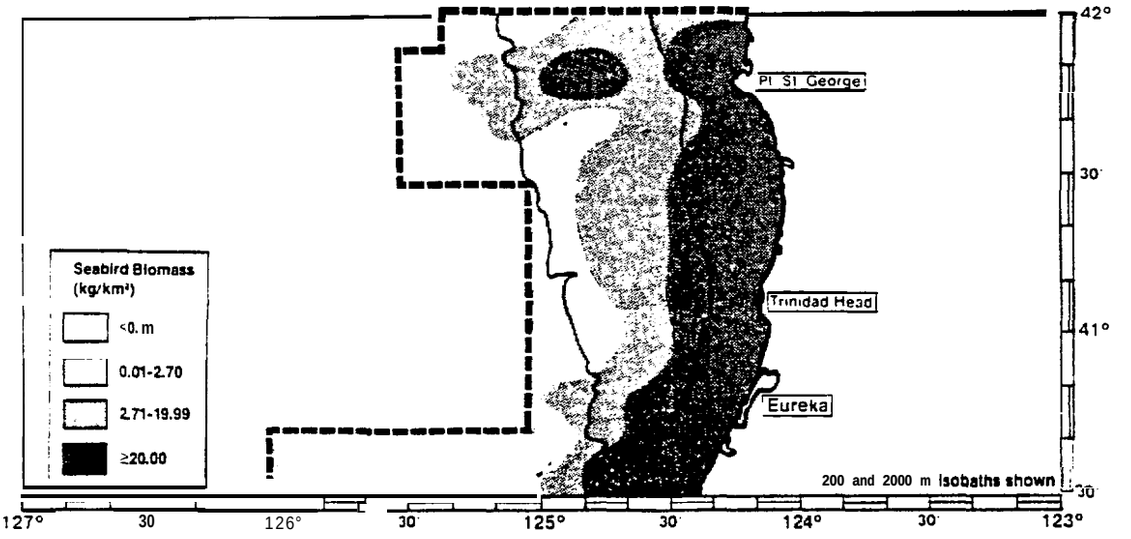
Distribution of cetacean fauna was confined primarily to shelf and slope waters, where over 99% of sightings occurred. Offshore waters supported relatively few animals. Mean sea surface seasonal temperatures were highest in this sector when compared to the remainder of the study area.

Shelf. Harbor porpoises were the most abundant cetacean sighted in shelf waters exceeding in total numbers even the seasonally abundant gray whale. Harbor porpoises comprised more than 50% of the cetacean fauna in the shelf region, and density was greatest between Patricks Point and Crescent City. Gray whales were largely responsible for the high biomass values on the' shelf. The population consisted not only of migratory elements moving through the area but also included numerous "summering" animals that are residents of the Klamath River and Big Lagoon/Patricks Point areas. In addition to the shove two species, the shelf area also supported small numbers of Pacific white-sided dolphins, Dan's porpoises, and three *Keg/a* species. Dan's porpoises were present in very low numbers on the shelf, but increased significantly on the slope, declining in the offshore region.

Slope. The highest seasonal percentage of observed cetaceans and mean cetacean density occurred over the slope in spring. In spite of large numbers of small cetaceans, there was almost a five-fold decrease in biomass values when compared to the adjacent shelf. Northern right-whale dolphins were the most abundant species, followed by Pacific white-sided dolphins and grampus. The high-northern right whale dolphin numbers result primarily from one large school of 3,000 animals off Trinidad Head in April of year I. This large school also held approximately 100 juvenile animals. Insignificant numbers of larger toothed cetaceans (sperm and killer whales) also contributed to the region's biomass values. These two species were observed as either solitary or paired individuals scattered along the outer edge of the slope, on or near the 1.000 fm isobath.

Offshore. The offshore population consisted of just over 7% of the biomass for the sector and less than 1% of individual animals. Only four species were represented in the region--Dall's porpoise, harbor -porpoise, grampus, and the sperm whale. The most abundant was the Dan's porpoise with group sightings ranging between 2 and 5 individuals each. Several sperm whales encountered in the offshore area were observed in a single loosely organized pod northwest of Trinidad Head. The animals were in deep water just beyond the outer edge of the continental slope.

NORTHERN SECTOR
Spring-Seabirds



POPULATION INDICES	Offshore (>2,000 m)	slope (200-1,999 m)	Shelf (0-199 m)
Mean Seabird Density (birds/km² ±SE)	6.58 ±2.01	20.61 ±7.02	63.83 ±17.46
Mean Biomass Density (kg/km² ±SE)	1.80 ±0.54	16.66 ±5.91	55.61 ±13.50
Mean Number of Species Observed (±SD)	6,33 ±4.06	17.33 ±5.87	18.33 ±6.02
Mean Species Diversity Index (H' ±SD)	1.18 ±0.62	1.82 ±0.46	1.58 ±0.32

May Mean Population Ashore (±SD): 106,695 ±15,847

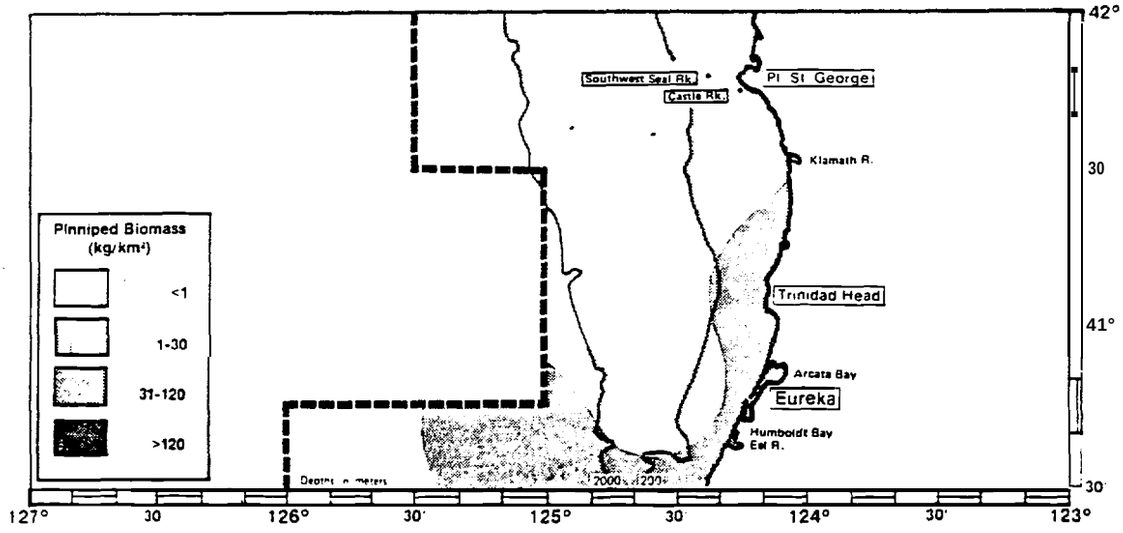
May Mean Surface-nesting Population Ashore (±SD): 99,756 316,106

PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Leach's Storm-Petrel	Phalaropes	Phalaropes	Common Murre
Phalaropes	Cassin's Auklet	*Common* Murre	Surf Scoter
	Leach's Storm-Petrel	Surf Scoter	White-winged Scoter
	Common Murre	Bonaparte's Gull	Western Grebe
			Western Gull
			Brandt's Cormorant
			Pelagic Cormorant

Seabirds were quite abundant and biomass density was high north of Cape Mendocino during April through June. Early in the period winter residents, including grebes, fulmars, scoters, gulls, and auklets were still numerous, as were the breeding species, especially murres and auklets on shelf and slope waters and Leach's Storm-Petrels farther offshore. Colonies of these species were located at Cape Mendocino and from Trinidad Head to the Oregon Border. More than half the state's population of murres nested at about eight sites here, including the largest colony at castle Rock (142,000 murres). Our data indicate that combined populations of surface-nesting species (cormorants, Western Gulls, murres) increased substantially over the course of our study as a result of murre population growth. During spring migration, the nesting species remained abundant, while winter residents were replaced principally by Bonaparte's Gulls near shore, Sooty Shearwaters over the shelf and slope, and phalaropes throughout the sector. By June, when overall abundance reached yearly lows, only the latter two species plus murres, Cassin's Auklets, and Leach's Storm-Petrels were still numerous. Throughout the period, abundance, biomass, and species number were greatest over the shelf, while species diversity was slightly higher over the slope than elsewhere. High densities also occurred in slope waters seaward of Crescent City,

NORTHERN SECTOR
Summer—Pinnipeds



Abundance at SEA (animals/km² ±SE)	Offshore (>2,000 m)	Slope (200-1,999 m)	Shelf (0-199 m)
California sea lion	0.0	0.003 ±0.004	0.0
Northern fur seal	0.002 ±0.002	0.0	0.002 ±0.002
Steller sea lion	0.0	0.0	0.019 ±0.023
Harbor seal	0.0	0,0	0.007 ±0.008
Northern elephant seal	0.0	0.003 ±0.004	0.0
All Pinnipeds	0.002 *0.002	0.006 ±0.005	0.028 ±0.023
Biomass (kg/km²)	0.10 ±0.10	5,87 *4.70	12.13 ±10.04

Abundance on LAND (numbers counted)	1-3 July 1980	30 June, 1,8 July 1981	28-30 June 1982
California sea lion	212 (12%)	0	C
Steller sea lion	341 (19%)	288 (26%)	323 (17%)
Harbor seal	1,236 (69%)	826 (74%)	1,602 (83%)
Northern elephant seal	1 (<1%)	2 (<1%)	6 (<1%)
All Pinnipeds	1,790	1,116	1,931

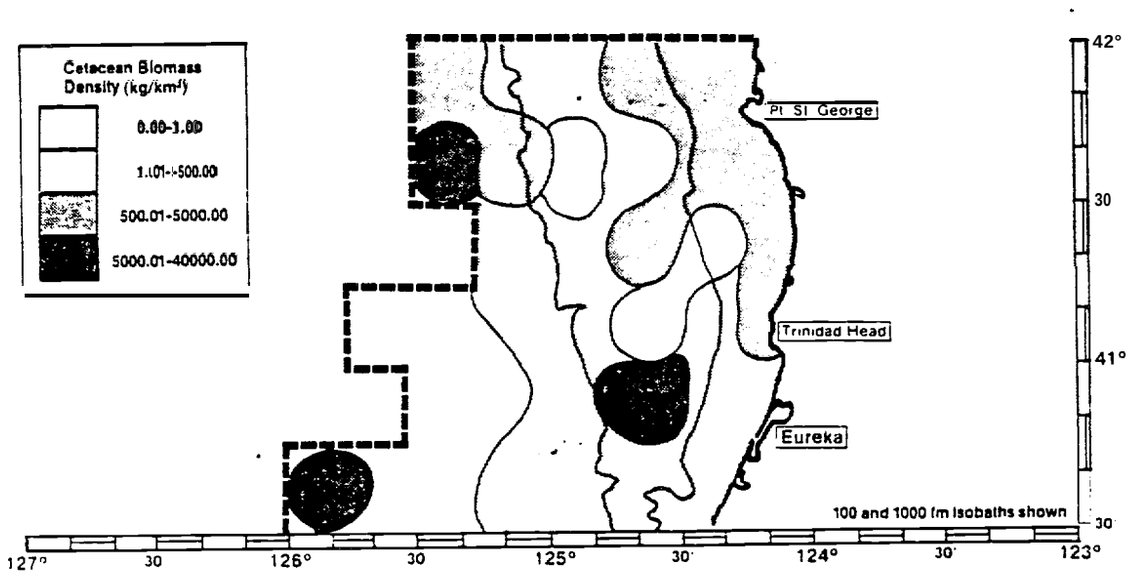
Pinnipeds

Substantial numbers of harbor seals are found in summer at the mouth of the Eel River (40°37'N) and on the mudflats of Humboldt and Arcata bays (40°52'N). We counted 1,084 in 1982, representing 4.3% of the total pinniped count for the survey. This was a 26.8% increase over the 855 animals counted in 1980.

Sizeable numbers of harbor seals, as well as a small breeding colony of Steller sea lions, are found on the rocks of the St. George Reef (41°45'N) in summer. We counted 621 pinnipeds in 1982 (2.5% of the survey total). Most of the harbor seals were found on the *inner* reef of Castle Rock — we counted 354 in 1982. We also noted 6 northern elephant seals *on* Castle *Rock.* Steller *sea* lions breed farther offshore *on* Southwest Seal Rock. Here we counted 261 animals, including 25 pups, in 1982. Counts of 269 with 10 pups and 182 with 9 pups were obtained in 1981 and 1982, *respectively.*

Pinniped sightings at sea in the northern sector represented slightly more than 5% of the statewide total for the summer months. Only twelve sightings were recorded, of which four were northern fur seals, four were Steller sea lions, two were California sea lions, and one each of harbor seals and northern elephant seals. The highest mean density of 0.03 animals/km^2 was found for waters overlying the continental shelf. Densities were low to very low throughout the sector, with the exception of nearshore waters from Trinidad Head to cape Mendocino which were occupied at moderate density levels.

NORTHERN SECTOR
Summer-Cetaceans



	Shelf (0-99 fm)	Slope (100-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.06 ±0 .06	0.05 ±0. 04	0.03 ±0 .04
Mean Cetacean Biomass (kg/km²)	824.87	253.25	343,23
Mean Sea Surface Temperature "C (±SE)	13.7° ±0.4	14,4° ±0.6	14.9° ±0.6
Percentage of Observed Cetaceans x Depth	41.7%	39.8%	18.6%
Percentage of Biomass x Depth	58.0%	17.8%	24.2%

Predominant Species

Shelf	Slope	Offshore
Harbor porpoise	Dall's porpoise	Sperm whale
Gray whale	Sperm whale	
	Grampus	
	Killer whale	

Shelf. Harbor porpoises, numerically, represented more than 49% of the cetaceans observed. They were sighted exclusively in nearshore waters, with highest densities *occurring* between Trinidad Head and Point St. George. Randomly distributed singles and pairs were encountered in the area between the Eel River and Trinidad Head.

The major northward thrust of migrating gray whales had passed by late summer, and most of the animals recorded in the northern sector were stragglers, some mother/young pairs, and a few resident animals of the north coast. The "easing" of the gray whale migratory pressures on the shelf was reflected by a corresponding reduction in biomass.

Pacific white-sided dolphins, Dan's porpoises, grampus, and a single humpback whale collectively accounted for 11% of the shelf population. These four species *were* widely dispersed along the outer edge of the shelf near the 100 fm isobath. The sightings were bounded on the south by Patricks Point and in the north by the California/Oregon border.

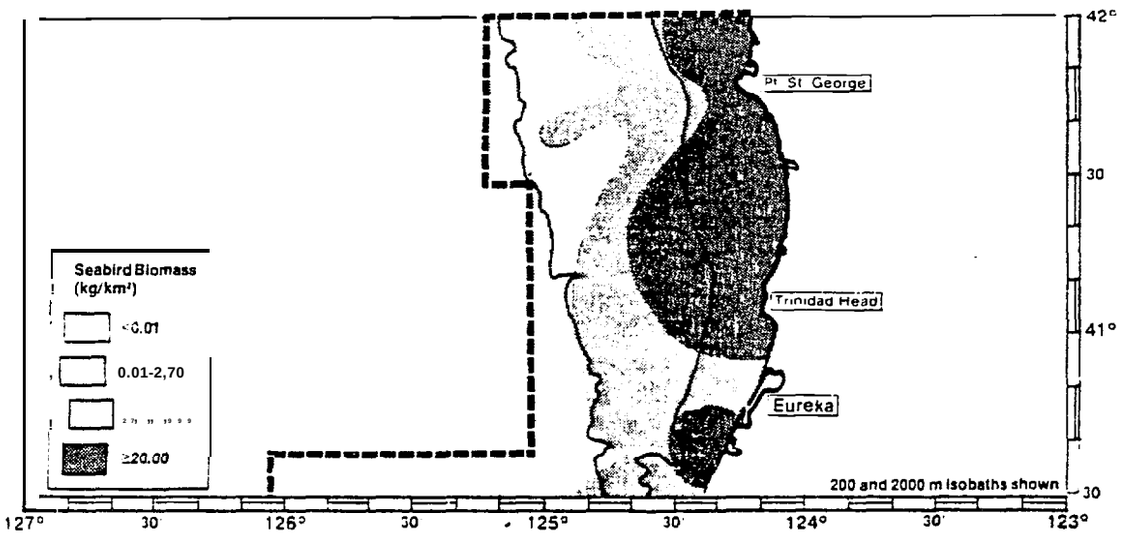
Slope. Dan's porpoises were the only species in this sector to be represented in all three depth *regions.* On the continental slope, they were the most abundant animals of the six species present.

Sightings were widely scattered in all portions of the depth region. The animals were rarely seen in groups of more than five individuals, with pairs, threes, and fours most common.

Sperm whale numbers increased significantly in summer when compared to this sector in spring. In a single 15'x15' quad west of Eureka 24 individuals were recorded. Three other relatively large groupings of the species were observed in the offshore depth region. Killer whales, Pacific white-sided dolphins, and Baird's beaked whales were also present in waters of the slope in summer. The killer whales were typically scattered throughout the region, in sightings of small groups of twos and threes. A single pair was also observed in the offshore region near the 1,000 fm isobath.

Offshore. Sperm whales dominated offshore waters in both number and biomass. A total of 26 individuals were recorded in the region. Other large cetaceans in the area were killer whales and humpback whales. These sightings were made west of the Klamath River near the 1,000 fm isobath. Scattered Dan's porpoises were a minor constituent of the offshore region, observed in typically small groups not exceeding 4 individuals.

NORTHERN SECTOR
Summer—Seabirds



POPULATION INDICES	Offshore (≥2,000 m)	Slope (200-1,999 m)	Shelf (<200 m)
Mean Seabird Density (birds/km² ±SE)	*8.21* ±2.82	*29.66* ±15.6	83.13 ±17.94
Mean Biomass Density (kg/km² ±SE)	1.06 ±0.39	20.37 ±14.43	52.28 ±12.42
Mean Number of species Observed (±SD)	4.78 ±2.57	13.89 ±3.48	18.89 ±3.54
Mean Species Diversity Index (H' ±SD)	1.11 ±0.45	1.'74 ±0.25	1.81 ±0.27

July Mean Population Ashore (±SD): 170,032 ±12,351

July Mean Surface-nesting Population Ashore (±SD): 155,370 ±18,280

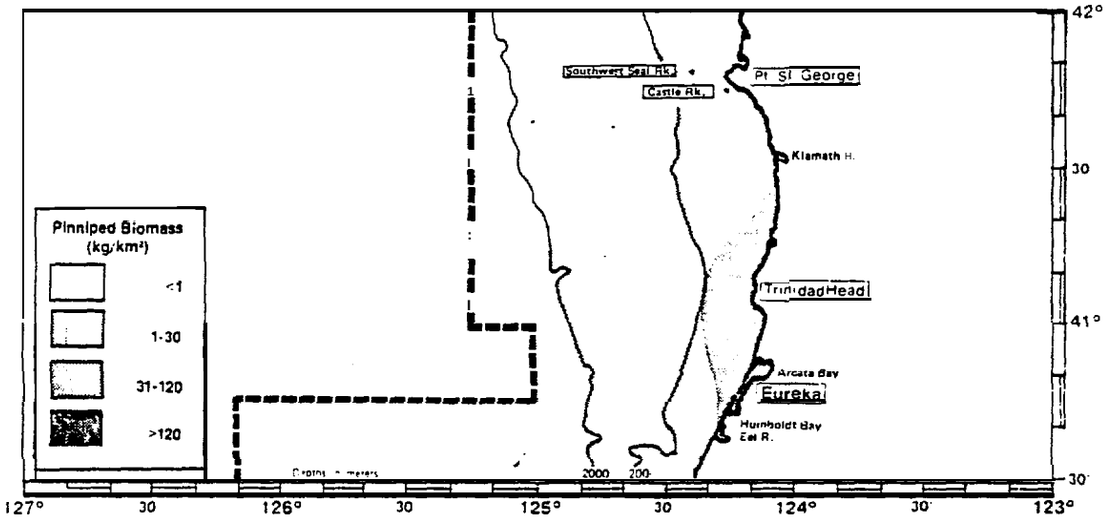
PREDOMINANT SPECIES

Offshore	Slope	Shelf	Shoreline
Leach's Storm-Petrel	**Phalaropes**	Cassin's **Auklet**	Leach's Storm-Petrel
Phalaropes	Sooty Shearwater	**Phalaropes**	**Brandt's** Cormorant
	Leach"s Storm-Petrel	Common **Murre**	Pelagic Cormorant
	Black-footed Albatross	Western Gull	Western Gull
			Common **Murre**

Peak populations at nesting colonies are reached here in June and July, with more than 40% of the state's 0.8 million nesting birds in attendance. The extremely dense colonies of murres at Castle Rock, False Klamath Rock, Green/Flatiron Rock are especially noteworthy. Our data indicate that combined populations of surface-nesting species (cormorants, Western Gulls, murres) increased substantially over the course of our study as a result of murre population growth. By September all seabirds have fledged young (except perhaps for storm-petrels), and densities of nesting species swell in shelf and slope waters, In addition to local nesters, populations of phalaropes, shearwaters, albatrosses, and Cassin's Auklets are high in this sector throughout summer, and early southbound migration brings additional large *numbers* of scoters to nearshore waters and jaegers far offshore. Species numbers and diversity average somewhat below figures for sectors to the south, reflecting the substantial contributions to total populations by the relatively small *number* of nesting species, shearwaters, and phalaropes.

Except off Eureka, a *zone* of high biomass density extended in summer from the shoreline to the edge of the shelf: intermediate biomass densities occurred over the slope and low densities *were* found offshore.

NORTHERN SECTOR
Autumn-Pinnipeds



Abundance at SEA (animals/km² ±SE)	offshore (>2,000	Slope m) 200-1,999 m)	Shelf (0-199 m)
California sea lion	0.002 ±0.002	0.023 ±0.024	0.039 ±0.025
Northern fur seal	0.0	0.0	0.0
Steller sea lion	0.0	0.0	0.0
Harbor seal	0.0	0,003 *0.004	0.0
Northern elephant seal	0.0	0.0	0.003 ±0.004
All Pinnipeds	0.002 ±0.002	0.026 ±0.023	0.042 ±0.025
Biomass (kg/km²)	0.52 *0.49	4.87 ±4.33	3.3.91 ±8.22

Abundance on LAND (numbers counted)	28–30 Oct. 1980	28-30 Sept. 1981	27-28 Oct. 1982
California sea lion	2,304 (72%)	1,979 (83%)	3,521 (85%)
Steller sea lion	521 (16%)	390 (16%)	520 (13%.)
Harbor seal	360 (11%)	6 (<1%)	102 (2%)
Northern elephant seal	0	1 (<1%)	J, (<1%)
All Pinnipeds	3,185	2, 376	4,144

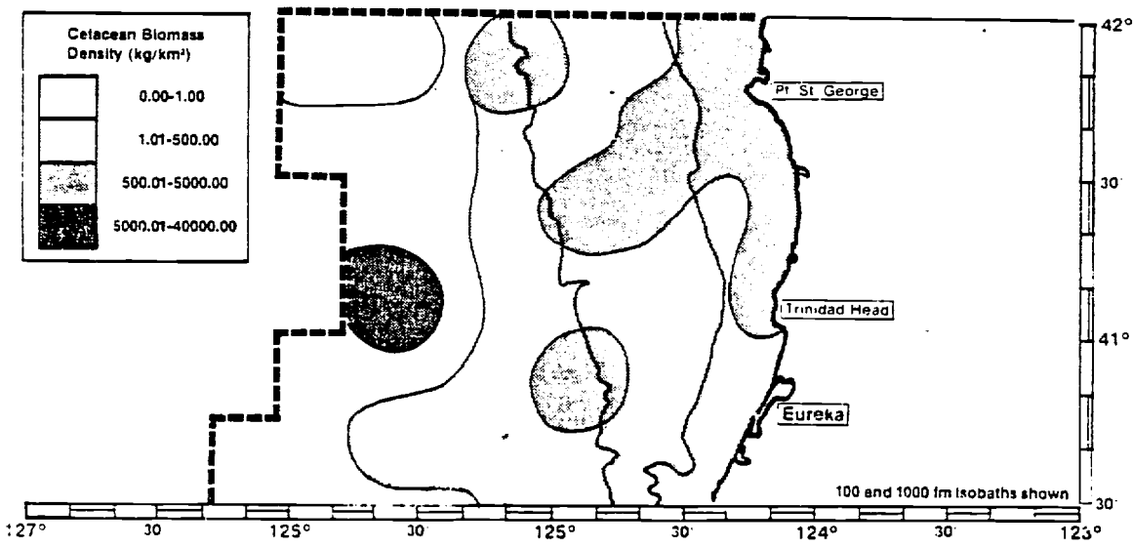
Pinnipeds

On the rocks near Trinidad Head (41°03'N) we counted 1,482 pinnipeds in October 1982, representing 4.7% of the survey total. California sea lions, which numbered 1,068 animals, represented 72.1% of the count, while the 365 Steller sea lions counted represented 24.6%. In 1982 most of the sea lions were found on Flatiron Rock (786 California sea lions and 187 Steller sea lions).

On the St. George Reef (41°45'N) we counted 2,637 pinnipeds in October 1982, representing 8.4% of the survey total. California sea lions, numbering 2,451, accounted for 92.9% of the total. All but 167 (hauled-out on Northwest Seal Rock) were on castle Rock and the Inner Castle Reef. Steller sea lions (145), harbor seals (40), and northern elephant seals (1) were also present in October 1982.

Pinniped sightings at sea in the northern sector represented less than 3% of the statewide total for the autumn months. Of the fourteen sightings recorded in this sector, twelve (86%) were of California sea lions. Reflecting the coastal habits of this species, 93% of all sightings were recorded on transect surveys over the shelf (50%) and slope (43%). Mean densities were low to very low throughout the sector, with the highest mean density of 0,04 animals/km^2 found for waters overlying the shelf. Some moderate densities were found for nearshore waters from Trinidad Head to the Eel River.

NORTHERN SECTOR
Autumn—Cetaceans



	Shelf (0-99 fm)	Slope (loo-999 fm)	Offshore (1,000+ fm)
Mean Cetacean Density (cetaceans/km² ±SE)	0.10 *0.08	0.83 ±0.29	1.12 ±0.82
Mean Cetacean Biomass (kg/km²)	500.40	131.47	136.21
Mean Sea Surface Temperature "C (±SE)	14.2° ±0.7	14.9° *0.7	15.5° ±0.7
Percentage of Observed Cetaceans x Depth	5.5%	48.6%	45.8%
Percentage of Biomass x Depth	65.2%	17.1%	17.7%

Predominant Species

She if	Slope	Offshore
Harbor porpoise	Pacific white-sided dolphin	Northern right whale dolphin
Gray whale	Northern right whale dolphin	Pacific white-sided dolphin
Dan's porpoise	Grampus	Dan's porpoise
	Dan's porpoise	Sperm whale

Shelf. Harbor porpoises were present along the entire coast of this sector in their greatest numbers for any season. Dan's porpoises were found in their highest annual numbers, primarily frcm Trinidad Head southward. Resident gray whales, plus the first of those migrating south, were responsible for the higher biomass values found from Point St. George south to Trinidad Head.

Mean cetacean density was never high on the shelf in this sector. Few species were found in these waters; those. seen were generally found in widely scattered pods of only 2 or 3 animals.

Slope. Mean cetacean density was greatly improved over the summer averages, but was still minimal when compared with the remainder of the state in autumn. Pacific white-sided dolphins, at their highest seasonal level, represented the major population element (70%) of the seven species observed.

Northern right whale dolphins, frequently absent from this sector, were distributed in linear array along the 1,000 fm isobath. Mean school size of approximately 20 animals was considerably lower than the statewide average (122.), but numerous pods occupied the slope.

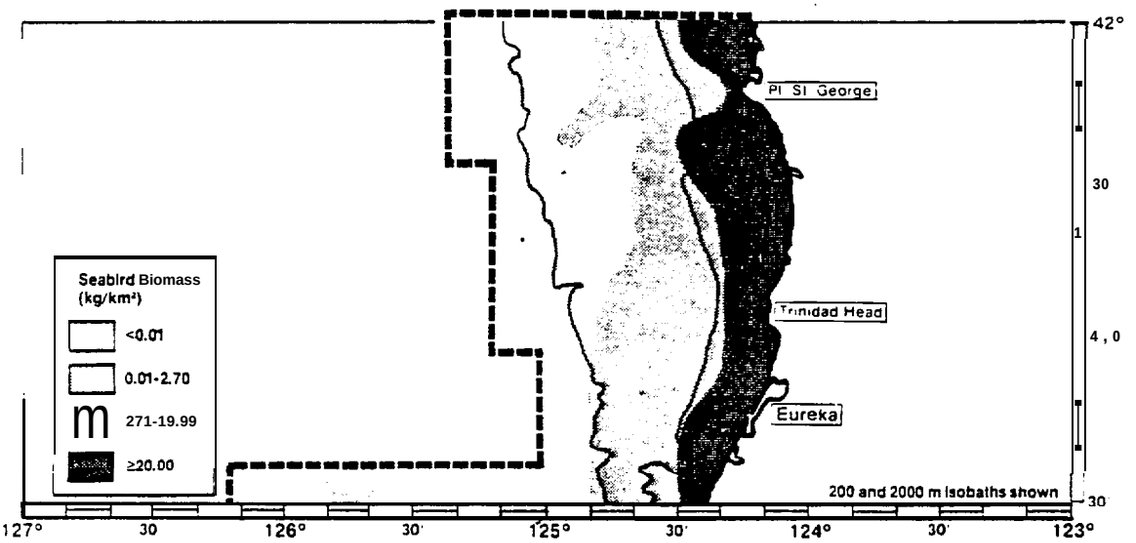
Grampus were found clustered in two areas: over the Eel Canyon (40°40'N) and at the head of Trinity Canyon (41°15'N) northwest of Eureka. Dan's porpoises, whose sightings were more dispersed, also tended to center near these drowned canyons. ,

No significant numbers of large whales were found over the slope in this season.

offshore. Highest seasonal mean cetacean densities were recorded in autumn. Northern right whale dolphins, not seen here in other seasons, represented 80% of the cetaceans observed. Numerous small pods (l-2 animals) of Dan's porpoises were noted along the southern boundary of this sector. Pacific white-sided dolphins, frequently mixed within larger northern right whale dolphin schools, occupied the central portion of this *sector.*

Repeated sperm whale sightings, along with the occasional minke or beaked whale, heavily influenced biomass values in a small area (41"10,'N x 125°40'W) well offshore (90 nm) of Trinidad Head. No significant underwater topographic feature is evident to explain these sightings.

NORTHERN SECTOR
Autumn-Seabirds



POPULATION INDICES	Off *shore* (22,000 m)	Slope (200-1,999 m)	She lf (0-199 m)
Mean Seabird Density (birds/km^2 ±SE)	4.26 ±1.05	14.63 ±5.07	143,51 ±15.92
Mean Biomass Density (kg/km^2 ±SE)	1.69 ±0.44	6.22 ±1.96	114.98 ±11.07
Mean Number of Species Observed (±SD)	8.17 *6.01	16.00 ±5.23	25.83 ±1.95
Mean Species Diversity Index (H' ±SD)	1.48 ±0.88	2.16 ±0.35	2.15 ±0.25

September/October Mean Population Ashore (±SD): 37,784 ±13,362

PREDOMINANT SPECIES

Offshore	Slope	She lf	Shoreline
Cassin's Auklet	Phalaropes	Arctic Loon	Western Grebe
Rhinoceros Auklet	Northern Fulmar	Western Grebe	Brandt's Cormorant
	Cassin's Auklet	Cassin's Auklet	Pelagic Cormorant
	Rhinoceros Auklet	common Murre	Surf Scoter
	Black-legged Kittiwake	Surf Scoter	White-winged Scoter
	Bonaparte's Gull	White-winged Scoter	Western Gull
	California Gull	Bonaparte's Gull	California Gull
		California Gull	Herring Gull
		Western Gull	Bonaparte's Gull

The annual influx of migrants and winter residents to northern California was seen here first in September and October with large numbers of Alaskan and inland nesting species in evidence. Joining these visitors were populations of locally-nesting species, especially murres, now relieved of the ties to land imposed by spring-summer breeding activities. Coastline and neritic waters supported extremely large populations of loons, grebes, scoters, cormorants, and a variety of gulls and alcids; compared with sectors to the south, density and biomass were relatively high over the shelf and were about average over waters farther from land. Species numbers here were comparable to those elsewhere, while values of H' were relatively high. This was the season in the north when numbers and species diversity over the shelf were highest. Shoreline numbers were much lower than in summer, but were about twice those encountered in January.

Seaward of the shelf, the species typical of the coastal waters (loons, grebes, scoters, cormorants) were unimportant while gulls, alcids, phalaropes, and fulmars were numerous. Only the two auklet species were prominant well offshore, where overall numbers, biomass and diversity were fairly low. Cassin's Auklets seen here probably derived from nesting populations both to the north and the south. As was the case in most other time periods, a zone of high average biomass density extended about 20 to 40 km seaward from the shoreline in October and November. This zone was broadest north of Trinidad and narrowest near Cape Mendocino. Lower density bands lay farther to seaward, with some areas of moderate density (to 19.99 kg/km^2) extending as far out as 7s km from point St. George.

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6. APPENDIX

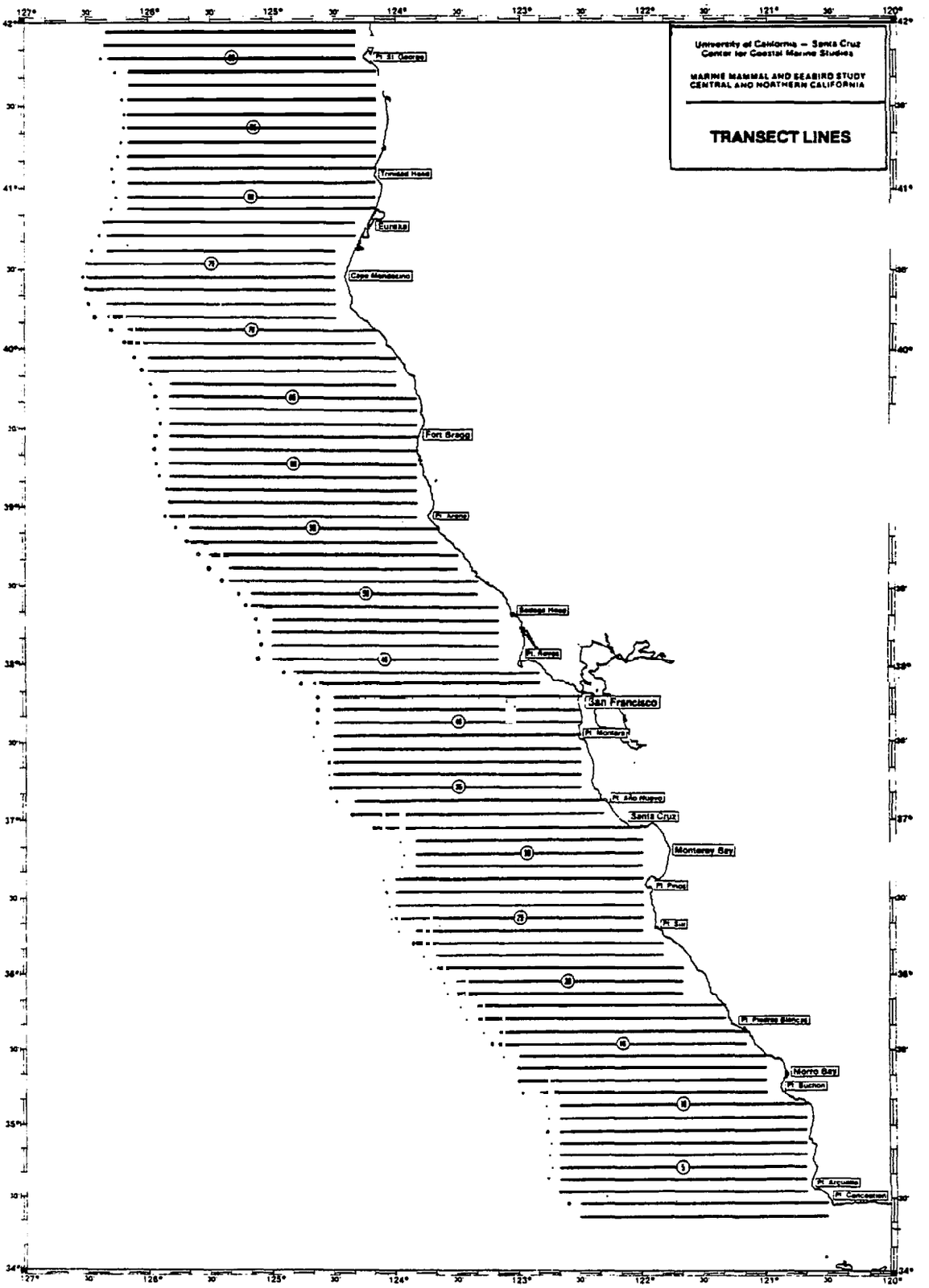

Figure Al. **Aerial survey transect lines, separated by 5' of latitude and extending 90' of longitude**

Table A1. Population size and status of the more common marine mammals in central and northern California.

Species	Status	Central and Northern California Population Size	Seasonal Occurrence	World Population
Southern sea otter[1]	Endemic	1,300 independents	Year-round	1,300 independents[2]
California sea lion	Non-breeding visitor	40,000 in autumn	Year-round	170,000 including Galapagos (20,000)
Steller sea lion	Breeding resident	?,000 in summer	Year-round	232,000 to 262,000[2]
Northern elephant seal	Breeding resident	5,000 in winter/spring	Year-round	77,000
Harbor seal	Breeding resident	12,000 in spring/summer	Year-round	388,000 to 407,000[3]
Northern fur seal	Non-breeding visitor	25,000 to 33,000 in winter/spring	Winter/spring[4]	1,938,000[3]
Gray whale[5]	Migrant[6]	16,000 in winter/spring	Winter/spring[4]	16,000[3] (Pacific coast)
Humpback whale[5]	Visitor	500 in autumn	Summer/autumn	5,700 to 6,300[3]
Blue whale[5]	Migrant	unknown	Summer/autumn	11,200[3]
Fin whale[5]	Migrant	unknown	Summer/autumn	2:7,000 to ?20.300[3]
Sperm whale[5]	Resident	unknown	Year-round	732,000[3]
Pacific white-sided dolphin	Resident	86,000 in autumn	Year-round	30,000 to 50,000[3] (Pacific coast)
Northern right-whale dolphin	Resident	61,500 in winter	Year-round	unknown[3]
Risso's dolphin	Resident	30,000 in winter	Year-round	unknown[3]
Dall's porpoise	Resident	8,750 in autumn	Year-round	920,000[3]
Harbor porpoise	Resident	3,000 in winter	Year-round	unknown[3]

[1] The southern sea otter is designated a Threatened Species (USFWS).

[2] USFWS estimate; does not include dependent pups.

[3] Population estimates from NMFS, Marine Mammal Protection Act of 1972, Annual Report 1981/1982.

[4] A few animals are present year-round in central and northern California.

[5] These species are designated Endangered by NMFS.

[6] Small resident populations exist at four locations in central and northern California.

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