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**SEABIRD MORTALITY IN CALIFORNIA
AS WITNESSED THROUGH 14 YEARS OF BEACHED BIRD CENSUSES**

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ABSTRACT

Between June 1971 and May 1985, volunteer censusers surveyed 91 beaches in California. Periods of coverage varied between beaches but several beaches, in the Gulf of the Farallones, on Monterey Bay, and in San Luis Obispo County, were surveyed monthly for over 8 years. Survey coverage was more extensive in these regions than to the north or south.

Censusers found 39,444 dead or dying marine birds. The most commonly found species were Common Murre from Monterey Bay north, Common Murre and Western/Clark's grebes in San Luis Obispo County, Sooty Shearwater, Western/Clark's grebes, and Common Murre in the Santa Barbara Channel region, and Northern Fulmar, Sooty Shearwater, and Western Gull from Los Angeles to San Diego counties. Carcass densities (birds/km walked) were highest in the Monterey Bay region for 15 taxa but for no more than 7 taxa in any other region of the coast. Carcass densities were lower south than north of Point Conception. Carcass densities were high enough to examine seasonal trends and annual variation for 19 species or taxa. For most of these taxa, seasonal trends in carcass density north of Point Conception generally tracked live bird occurrence. However, south of Point Conception seasonally highest carcass densities for some species coincided with spring and early summer periods when live bird population sizes were lowest in the area. The period of highest overall carcass densities in the Gulf of the Farallones was July through September, the post-breeding period for local resident species. On Monterey Bay and San Luis Obispo County beaches, carcass density peaks occurred throughout the year. South of Point Conception highest carcass densities occurred from March through June. Years of above average carcass densities coincided mostly with El Niño-Southern Oscillation episodes, other warm water periods, and a period of intensive gill net fishing in Monterey Bay and the Gulf of the Farallones.

Suspected causes of death that could be identified were almost entirely due to humans. Censusers ascribed a probable cause of death to 4713 (11.9%) of the carcasses. At least an additional 2.4% of the carcasses were obvious gill net casualties. Of the 4713 "known-cause" carcasses, 83.0% were oiled. Oiling rates varied between regions, between beaches, and between species groups. Highest rates of oiling were from beaches south of Point Conception. Among beaches with several years of coverage in the Gulf of the Farallones, highest oiling rates were from Ocean and Cronkhite beaches, near the Golden Gate entrance. Entanglement in fishing gear was the next most commonly implicated cause of death.

The impact of the T/V Puerto Rican oil spill was most severe for the Common Murre but also among the worst events since 1971 for the loons and Western/Clark's grebes. For the Common Murre, daily carcass deposition rates on eight beaches were estimated to be from 15 to 110 times greater than usual for the 3 to 5 initial days of the spill. Daily carcass deposition rates for the loon were 2.5 to 33 times greater than usual. Rates for Western/Clark's grebes were 2.5 to 10 times greater than usual.

INTRODUCTION

In January 1971 two oil tankers collided in the Golden Gate entrance of San Francisco Bay. The resulting spill of 840,000 gallons of crude oil spread quickly along the outer coast from southern San Mateo County to Point Reyes as well as inside the mouth of San Francisco Bay. In the days following the spill 4600-6000 oiled birds were taken to cleaning stations while uncounted numbers of birds that died were discarded during beach clean up efforts (Smail et al. 1972). One of the obvious questions that arose from the spill was how the mortality caused by such a catastrophic event compared to normal. At the time, nothing was known about normal patterns of mortality on the central California coast, although accounts of catastrophic mortality from the last major oil spill in the area in March 1937 were available (Aldrich 1938, Moffitt and Orr 1938).

It is not possible to directly measure the number of seabirds that die in our coastal waters. However, it is possible to monitor some portion of the mortality by regularly counting seabirds that are found dead or dying on the shoreline. Such counts were begun in England by the Royal Society for the Protection of Birds in 1952, with a major goal of monitoring mortality due to oil pollution (Barclay-Smith 1956). After the 1971 spill, Point Reyes Bird Observatory (PRBO) initiated a study for California similar to the English monitoring project. Both studies used volunteer observers to count beached carcasses.

The goal of the California beached bird project was to monitor oiling and other causes of death in seabirds under non-catastrophic

conditions, and to determine the "normal" numbers of carcasses that wash onto beaches. In particular, we wanted to know how these numbers varied in different regions of the state, in different seasons, and in different years. Variation between years was of particular interest because of another major PRBO research project, which was seeking to understand fluctuations in breeding population size and success of seabirds on Southeast Farallon Island. This seabird breeding colony, the largest in the 48 contiguous states (Sowls et al. 1980, Ainley and Boekelheide ms in prep.), is located 42 km west of the Golden Gate. The possibility of relating oceanographic conditions in different years in central California to breeding success from the Farallones and mortality data from the beached bird project provided PRBO with an unparalleled opportunity to interpret some major features of seabird ecology.

The number of seabird carcasses that wash onto a beach each day (i.e., the daily deposition rate) is a function of the number of live seabirds in the adjacent ocean, their distribution at sea, mortality rates, the birds' behavioral responses to impairment, and the net effectiveness of onshore deposition forces against factors that cause carcass loss at sea. Further, the number of carcasses found on a survey is a function of the daily deposition rate, the time since the previous survey, and the rate of carcass loss from the beach. We will discuss these factors in more detail in the report but mention here that we distinguish the number of carcasses found on a survey from actual mortality by referring to the former as carcass density.

Oil pollution of the sea was recognized as a threat to seabird

populations as early as 1872 (Stowe 1982) and interest in monitoring its effects on birds has risen with increased oil exploration and development at sea. Beached bird survey projects in Great Britain (Hope Jones 1980, Stowe 1982 and references cited therein, Heubeck 1987), in northern Europe (Joensen 1972a,b; Gorski et al. 1976; Joensen and Hansen 1977; Kuyken 1978), on the east coast of North America (Piatt et al. 1985, Simons 1985), on the Great Lakes (Lambert and Risley 1979, Lambert 1982), in Washington state (Wahl et al. 1981, Speich and Wahl 1986), and in New Zealand (Powlesland 1986) provide valuable perspective on carcass densities and oiling rates under non-catastrophic conditions. Reports on the numbers of birds killed during oil spills (e.g. Hawkes 1961, Bourne et al. 1967, Bourne 1968, Tanis and Mörzer-Bruyns 1968, Greenwood 1969, Hope Jones et al. 1970, Smail et al. 1972, Brown et al. 1973, Bibby and Bourne 1974, Dunnet 1974, Hope Jones et al. 1978, Powers and Ramage 1978, Barrett 1979, Heubeck and Richardson 1980, Pfister 1980, RSPB 1981, Baillie and Mead 1982, reviewed in Bourne 1969 and Stowe and Underwood 1984) provide disaster data complementary to the survey projects, although previously no attempt has been made to reconcile the carcass density data from these two sources of information on seabird mortality.

One of the most formidable barriers to a comparison of these two sources of data is the differing methods in which the data are collected. Beached bird surveys are usually conducted at regular or semi-regular intervals during which carcasses deposit on and disappear from beaches. In contrast, during oil spills or other catastrophic mortality episodes, birds usually are removed from beaches daily (or

more often) and little carcass turnover likely occurs between counts. In this report, we propose a method to compare beached bird survey data with thorough bird counts done for oil spills by comparing daily deposition rates for individual beaches. We use this method to estimate the relative magnitude of the 1984 T/V Puerto Rican oil spill in the Gulf of the Farallones (PRBO 1985).

In this report, we also provide a detailed data base on carcass numbers for beaches surveyed in the Gulf of the Farallones and Monterey Bay.

STUDY AREA, REGIONAL DEFINITIONS, AND SEASONAL DEFINITIONS

The study area included 82 shoreline segments along the outer coast of California; 8 segments on two of the Channel Islands off southern California, and a shoreline segment on the northeast side of Tomales Bay, Marin County. California's emergent coastline is mostly backed by cliffs of varying height, but is interrupted occasionally by pocket beaches at the mouths of creeks, sand spits at large river mouths, and large dune systems at a few locations. Sites surveyed for bird carcasses included bluff-backed rocky to sandy segments of coastline, pocket beaches, dune-backed beaches, and sandspits. We refer to all survey sites as beaches throughout this report. Due to predictable seasonal patterns of beach building and erosion (Bascom 1964), the extent of the beach zone suitable for carcass deposition varies seasonally on the different beach types. In general, beaches backed by bluffs lose most of their deposition zone due to beach erosion that usually begins with the first winter storms in October or November and

extends through February or March. Beaches of other types also lose depositional area, but usually not to the same extent as beaches backed by vertical bluffs. During the beach building period, which begins in March or April, high tide depositional areas are typically reestablished on all types of beaches.

We divided the outer coast into six regions to examine geographic variation in marine bird mortality .

Region 1, Northern California, included Del Norte, Humboldt, Mendocino and Sonoma counties. This region was relatively sparsely-populated by humans, except in the vicinity of Humboldt Bay, and there were no onshore or offshore oil facilities.

Region 2, the Gulf of the Farallones, included Marin, San Francisco, and San Mateo counties. Most urban development in this heavily-populated region was away from the outer coast. The mouth of San Francisco Bay, the most prominent coastline feature, was the destination for much of the outer coast shipping traffic, including vessels serving the oil refineries within San Francisco Bay. There were no offshore oil facilities. The largest breeding seabird population along the North American west coast, south of western Alaska, occurs in the section.

Region 3, Monterey Bay, included Santa Cruz County and Monterey County north of the Big Sur coast. This region was less heavily populated than the Gulf of the Farallones, although much of the urban development present here was along the shore. On the central Monterey Bay shoreline was an oil-burning power plant fueled from an offshore oil unloading facility for tankers. There were no other oil-related

facilities in the region.

Region 4, Estero Bay, included San Luis Obispo County and Santa Barbara County north of Point Conception, a relatively sparsely populated region of the coast. There were no offshore oil facilities but an oil well facility at the mouth of the Santa Maria River in southern San Luis Obispo County was in operation for the entire period of our study.

Region 5, Santa Barbara Channel, included mainland Santa Barbara County south of Point Conception, mainland Ventura County, Santa Cruz Island, and San Nicolas Island. There were 18 natural oil seeps located along the Santa Barbara county coastline from Point Conception east to Carpinteria, 1 off San Miguel Island, 2 off Santa Cruz Island, and 1 off Anacapa Island (Ventura and Wintz 1971). Numerous mainland onshore and offshore oil facilities existed in this heavily-populated region. Santa Cruz Island is located about 40 km south of the mainland coast and well within the influence of shipping and oil development in the channel. San Nicolas Island is located about 80 km south of Santa Cruz Island and 110 km southwest of the nearest mainland coast in Los Angeles County, well away from most of the human activity associated with the coastline.

Region 6, Southern California, included Los Angeles, Orange, and San Diego counties. This heavily populated region had much urban development along the coast. Natural oil seeps known from this region were two on the northwest side of the Palos Verdes Peninsula in Los Angeles County, one in San Pedro Channel between the peninsula and Santa Catalina Island, and two off Santa Catalina Island (Ventura and

Wintz 1971). Numerous onshore and offshore oil facilities occurred in Los Angeles and Orange counties.

The beach on Tomales Bay, Marin County, was not used in any of the regional, seasonal, or annual comparisons. However, to present the data on coverage, species composition, and carcass densities from this beach, Tomales Bay is labeled as a region in Tables 1, 2, 3, and 4.

To summarize and present the data, we defined study years from 1 June to 31 May and divided each study year into three seasons: "fall" from June through October, "winter" from November through February, and "spring" from March through May. These periods roughly correspond to some of the major regional oceanographic events and marine bird activities.

Spring encompassed the beginning of the upwelling period in central California, when northwesterly winds are usually strongest (Lynn 1967, Schwartzlose and Reid 1972). Marine birds breeding locally lay and incubate eggs at this time, and species breeding to the north migrate through the area.

Fall encompassed the end of the upwelling period from June through August, and the warm-water, low-wind period in September and October (Bolin and Abbott 1963). This period included the fall migration of some species breeding to the north, the fledging period of most locally breeding marine species, the time during which species breeding in Mexico and on islands off the southern California coast migrate or disperse north, and the main period of occurrence for several procellariiforms that breed in the Southern Hemisphere.

Winter encompassed the period during which the Davidson Current

flows northward along the coast, displacing the SE flowing California Current over 80 km offshore (Lynn 1967, Schwartzlose and Reid 1972); this is also the period of intermittent storms. Many locally breeding seabirds and species that breed to the north overwinter during these months.

The study period included several distinct oceanic events, a period of high gill net fishing mortality in two regions, and one major oil spill. From about June 1972 through fall of 1973, from June through December of 1976, and from about June 1982 through February 1984 warm surface water, associated with El Nino-Southern Oscillations, resided along the coast causing anomalous weather patterns and changes in the birds' food resources (Ainley and Boekelheide ms in prep.). From March through June of 1978, warm water encroached into the study area from the Aleutian region, with similar changes in the oceanic resources (Ainley and Boekelheide ms in prep., McLain and Thomas 1983). From spring 1980 through 1983 in Monterey Bay, and in the falls of 1982 to 1985 in the Gulf of the Farallones, a gill net fishery exacted a high mortality in marine birds, many of which washed onto beaches (Wild 1984, 1986; Carter in Appendix B, Heneman in Appendix C). On 31 October 1984, the oil tanker T/V Puerto Rican exploded just outside the Golden Gate. In the subsequent days, the tanker was towed to a point about 17 km south of Southeast Farallon Island, where it broke in half and released approximately 1.5 million gallons of petrochemicals. The ensuing slick moved north to Point Reyes, the Bodega Bay area, and eventually broke up off the Mendocino coast.

METHODS

Field Work

Data were collected from 91 beaches on the California coast between June 1971 and May 1985 (Table 1). The surveys were coordinated by the Point Reyes Bird Observatory (PRBO). Volunteer observers selected beaches for coverage, conducted the surveys, and submitted their results to PRBO. Observers were instructed to select a beach or segment of beach that they would walk once a month. For each beach walk they recorded the date and the extent of oil or tar found on the beach. As they walked the beach, they searched for carcasses or ailing beached marine birds. For each bird found they recorded the species, degree of decomposition, any evidence of cause of death, presence of oil on the plumage, age, sex, color phase, and subspecific identity, if known. Identifications of carcasses were facilitated by a manual prepared specifically for that purpose (Ainley et al. 1980), but before it was available observers used standard avian field guides to birds (eg. Peterson 1961) for common species and sent difficult-to-identify specimens to PRBO for verification. We suspect some misidentifications of common species such as small loons, small grebes, large cormorants, and large gulls occurred, particularly in early years of the study. Accordingly, we have combined these species in some analyses. Carcasses were removed from the beaches or marked distinctively so that they would not be counted again on subsequent surveys.

Survey frequency varied on different beaches, although censusers were urged to cover their beaches once each calendar month. In cases

Table 1. Summary of total coverage on beaches in California.

REGION-NORTHERN CALIFORNIA					
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED
DIE LAGOON	HUMBOLDT	39.2	17	17	3
CEMENTVILLE	HUMBOLDT	40.0	15	15	3
CLAN	HUMBOLDT	169.6	53	42	6
DORAN	HUMBOLDT	212.0	80	75	10
GOAT ROCK	SOMONA	25.6	14	16	2
GOLD BLUFF	SOMONA	234.6	23	23	4
JUGHANDLE	HUMBOLDT	3.1	31	26	4
MACKENRICHER	MENDOCINO	33.6	21	21	4
MAD RIVER, NORTH	MENDOCINO	58.4	37	31	3
MAD RIVER, SOUTH	MENDOCINO	48.0	30	30	4
MANCHESTER	HUMBOLDT	68.6	14	60	9
PELICAN	MENDOCINO	86.4	21	24	3
SALMON CREEK	DEL NORTE	221.1	62	56	9
SOMONA COAST (GUALALA)	SONOMA	33.2	30	30	3
IRIMIGAO	SONOMA	3.2	4	4	1
WRIGHTS	HUMBOLDT	33.2	16	16	2
REGION-GULF OF THE FARALLONES					
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED
AMO NUEVO	SAN MATEO	200.0	29	18	3
BOLINAS	MARIN	310.6	110	93	13
CROKNITE	MARIN	144.0	160	151	14
DILLON	MARIN	202.4	72	83	11
DOUBLE POINT	MARIN	297.3	93	11	0
GRAKES	MARIN	81.6	34	23	3
COGENAB	MARIN	29.9	23	20	3
FORT POINT	SAN MATEO	102.4	64	62	0
HALF MOON BAY, NORTH	SAN FRANCISCO	259.2	81	73	11
HALF MOON BAY, SOUTH	SAN MATEO	117.1	32	31	3
LIMANTOUR	SAN MATEO	840.1	151	128	13
LINDA MAR	MARIN	20.0	16	12	3
MONTARA	SAN MATEO	33.6	21	16	3
MUIR	SAN MATEO	137.0	214	160	13
OCEAN	MARIN	488.0	62	146	14
PESCADERO	SAN FRANCISCO	111.6	42	130	0
POINT REYES, A	SAN MATEO	331.0	79	64	10
POINT REYES, B	MARIN	79.3	13	11	3
POINT REYES, C	MARIN	42.0	14	13	3
POINT REYES, D	MARIN	59.0	13	12	3
RCA	MARIN	486.0	194	133	13
SEABRIFT	MARIN	144.9	191	151	13
SHARP PARK	MARIN	64.3	43	40	9
STINSON	SAN MATEO	23.2	18	18	2
	CAN MATEO	238.0	110	97	12

Table 1, continued (page 2 of 3).

REGION-TOMALES BAY						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
CYPRESS GROVE	MARIN	88.5	39	33	8	
REGION-MONTEREY BAY						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
DAVENPORT, EAST	SANTA CRUZ	51.5	103	87	8	
DAVENPORT, WEST	SANTA CRUZ	5.0	10	9	1	
DEL MONTE	MONTEREY	223.6	141	116	12	
JETTY	MONTEREY	173.6	109	103	11	
LAQUINA CREEK	SANTA CRUZ	109.2	156	93	8	
MAJORS CREEK	SANTA CRUZ	78.8	99	81	8	
MARINA	MONTEREY	301.1	59	59	5	
PAJARO DUMES	MONTEREY	264.8	102	162	14	
RIO DEL MAR	SANTA CRUZ	174.0	88	86	8	
SALINAS RIVER	MONTEREY	44.8	4	4	1	
SCOTT CREEK	SANTA CRUZ	98.4	20	13	2	
SEASCAPE-APTOS	MONTEREY	24.6	92	90	10	
SEASIDE	MONTEREY	211.2	30	50	5	
SUNSET	SANTA CRUZ	83.2	113	64	6	
WILCOX	SANTA CRUZ	82.6	104	61	6	
YELLOW BANK CREEK	SANTA CRUZ	57.6	110	90	8	
ZWUDOWSKI	MONTEREY		32	31	3	
REGION-ESTERO BAY						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
ATASCADERO	SAN LUIS OBISPO	84.6	94	98	10	
CAMBRIA	SAN LUIS OBISPO	271.8	151	131	14	
WALARD CREEK	SAN LUIS OBISPO	233.3	96	93	11	
NORRIS BAY	SAN LUIS OBISPO	201.4	38	30	3	
PURISIMA POINT	SANTA BARBARA	158.4	22	21	6	
SAN SIMON	SAN LUIS OBISPO	46.8	26	16	3	
REGION-SANTA BARBARA CHANNEL						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
ARROYO GUERO	SANTA BARBARA	124.8	18	64	6	
DEVERAUX	SANTA BARBARA	121.9	33	40	4	
LAS VAAS RANCH	SANTA BARBARA	118.4	37	33	4	
MCCRATH	VENTURA	134.4	28	28	3	
HUGO ROCK	VENTURA	120.0	23	23	3	
PITAC POINT (FARIA)	VENTURA	54.4	32	29	4	
		54.4	24	24	3	

Table 1, continued (page 3 of 3).

REGION-SANTA BARBARA CHANNEL						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
SAN NICHOLAS I., SN 10	SANTA BARBARA	20.7	23	23	3	
SAN NICHOLAS I., SN 40	SANTA BARBARA	27.6	23	23	3	
SAN NICHOLAS I., SN 60	SANTA BARBARA	14.7	21	21	3	
SAN NICHOLAS I., SN 80	SANTA BARBARA	62.4	24	24	3	
SAN NICHOLAS I., SN 00	SANTA BARBARA	22.3	23	23	3	
SAN NICHOLAS I., SN 130	SANTA BARBARA	82.0	23	23	3	
SANTA CRUZ I., SC-NORTH	SANTA BARBARA	94.0	20	20	3	
SANTA CRUZ I., SC-SOUTH	SANTA BARBARA	81.6	24	24	3	
SANTA CRUZ I., SC-WEST	SANTA BARBARA					
REGION-SOUTHERN CALIFORNIA						
BEACH	COUNTY	KMS WALKED	SURVEYS	MONTHS COVERED	YEARS COVERED	
BOLSA CHICA	ORANGE	216.0	40	40	3	
BORDER FIELD	SAN DIEGO	104.0	40	40	6	
CAMP PENDLETON	SAN DIEGO	302.4	27	23	4	
CRYSTAL COVE	ORANGE	72.0	20	23	3	
HERMOSA	LOS ANGELES	76.7	39	33	3	
HUNTINGTON BEACH	LOS ANGELES	40.3	21	21	2	
LEUCADIA	ORANGE	32.0	22	22	2	
REDONDO	SAN DIEGO	13.0	3	3	3	
SAN ONOFRE BLUFFS	LOS ANGELES	229.7	37	31	3	
SILVER STRAND	SAN DIEGO	92.0	23	22	2	
TORRANCE	LOS ANGELES	827.0	207	101	9	

when a month was missed but two surveys were conducted in either the previous or next month, we assigned the closest of the latter surveys to the month missed. The "assigned" month (in most cases, this was the actual month of the survey) was used in analyses. We defined the coverage on a given beach in a given year to be complete for fall if at least one survey was conducted in (or assigned to) at least four of the five fall months, to be complete for winter if at least one survey was conducted during each of the four winter months, and to be complete for spring if at least one survey was conducted in each of the three spring months.

During the 1984 Puerto Rican oil spill (PROS), biologists and volunteers of PRBO counted and removed all dead birds and any live birds that could be captured, from Marin County beaches between 7 and 11 November 1984. Included among the beaches for which we had daily counts during the PROS were eight beaches with prior data from the 1971-1985 survey project: Bolinas, RCA, Limantour, Drakes, and Point Reyes A, B, C, and D.

Treatment of the Survey Data

We were most interested in examining how seasonal trends, variation between regions, variation between beaches, and variation between years affected the number of carcasses found and the percent of carcasses oiled. However, beached bird data typically are not suited to the standard linear model approach due to the preponderance of zero counts and conspicuous outliers. Further, because of great variability in the coverage of beaches, we were concerned with the potential of

confounding the effect of beach with season or year. Given these limitations and the observational nature of the data, we approached the analysis in an exploratory spirit, which is reflected in our presentation of the results. We used rank statistics (medians, 25th and 75th percentiles, maximums, often conditioned on non-zero values), and percent occurrence for most data description. To examine variation in the number of carcasses, we used carcass density, the total number of carcasses (of the species or group in question)/total kms walked.

Differences between regions and between beaches in carcass densities were examined using the entire data set. Comparisons between beaches in the Gulf of the Farallones and Monterey Bay were drawn by examining the proportion of surveys on which taxa were found and, conditional on their occurrence, the median monthly carcass density for each season (see Appendix A).

Seasonal trends, from June through May, in carcass rates were plotted for species that were sufficiently abundant for comparison. For seasonal trends, we compared the total carcasses found/total kms walked each month, using only beaches with complete years of data. Regional differences in seasonal trends were examined by combining the Santa Barbara Channel and Southern California regions (called southern coast on the histograms), combining Estero Bay and Monterey Bay (south-central coast), and presenting the Gulf of the Farallones (Gulf/Farallones) alone; data from the Northern California region were too sparse to plot.

We examined annual variation in carcass densities on beaches north of Point Conception, for those species sufficiently abundant for

comparison. Annual comparisons were made by season, using only beaches with complete coverage. For each beach, we calculated the total carcasses/total kms walked for each eligible season and year. The data were presented as box and whisker plots. These plots are designed to display the central 50% of the data within vertically oriented boxes. The remainder of the data appear as whiskers extending vertically from the boxes, with outlying values shown as isolated asterisks. The bottom of the box indicates the 25th percentile; the top, the 75th percentile; and the horizontal midline, the median of the data. The distance between the top and bottom of the box is the inter-quartile range, Q. A distance, $1.5 \times Q$, above the 75th percentile, the upper fence, is indicated by five dots above the boxes. The upper fence indicates the boundary between the main portion of the data and those values considered outliers. Vertical whiskers extend from the smallest value of the data to the 25th percentile and from the 75th percentile to the largest value of the data less than the upper fence. Data greater than the upper fence are plotted as isolated asterisks.

The location, spread, symmetry, and general shape of the data can be seen from these plots, as well as the approximate proportion of the data comprising zeroes. When a box rests on the horizontal axis, at least 25% of the data are zeroes. When such a box also lacks a median midline, at least 50% of the data are zeroes. When no box is shown, at least 75% of the data are zeroes.

Sample sizes for the box plots tended to be lower prior to 1975-76 than in later years. The number of beaches in fall samples were 3 in 1971, 8 in 1972, 11 in 1973, 7 in 1974, 17 in 1975, 18 in 1976, 21 in

1977, 27 in 1978, 20 in 1979, 29 in 1980, 22 in 1981, 29 in 1982, 30 in 1983, and 18 in 1984. The number of beaches in winter samples were 4 in 1971-72, 9 in 1972-73, 11 in 1973-74, 7 in 1974-75, 16 in 1975-76, 18 in 1976-77, 22 in 1977-78, 20 in 1978-79, 35 in 1979-80, 32 in 1980-81, 18 in 1981-82, 18 in 1982-83, 17 in 1983-84, and 18 in 1984-85. The number of beaches in spring samples were 5 in 1972, 9 in 1973, 12 in 1974, 13 in 1975, 19 in 1976, 17 in 1977, 25 in 1978, 19 in 1979, 30 in 1980, 24 in 1981, 24 in 1982, 23 in 1983, 16 in 1984 and 13 in 1985.

In three cases we altered the values of the maximum densities in order to maintain reasonable scale to the plots. For the plot of all birds in fall 1983 the density 118.0 is plotted as 30.0. For the Red Phalarope in winter 1976-77 the density 11.7 is plotted as 6.0. For the Common Murre in fall 1983 the density 114.8 is plotted as 30.0.

For each taxon or age class found on at least 25% of the beaches surveyed (non-zero 75th percentiles in box plots) in at least 8 of the 14 years (8 taxa in fall, 11 in winter, and 9 in spring) we ranked annual carcass densities by medians and 75th percentiles. Within each season, we then used the maximum, minimum, and median ranks of each year to identify years of higher or lower than usual carcass deposition.

We examined variation in oiling rates (the percent of carcasses oiled) in different regions and on different beaches. We compared beach oiling rates in the six outer coast regions. For each beach, the percent of carcasses that were oiled was calculated for each year in which at least 11 carcasses were found; the median percent for each beach was plotted. Comparisons between selected beaches in the Gulf of

the Farallones and Monterey Bay in the percent of carcasses oiled were made for beaches on which at least 11 carcasses were found during completely-covered falls or winters. Data for both comparisons were presented as boxplots.

Comparison of the PROS Results with the Survey Data

We used two estimates of the number of beached birds resulting from the PROS: 1) birds that were visibly oiled, and 2) visibly-oiled plus non-visibly oiled birds. The latter approach seemed justified because we suspected that at least some of the large number of seemingly non-oiled birds, beaching with the visibly oiled ones were disabled or killed after ingesting oil or were so thinly coated with lighter lube oil or dispersant that censusers could not detect it. The latter case is supported by the comments of censusers who reported difficulty in detecting a thin coating of light oil on some birds. We subtracted 7 Common Murres and 2 Western Grebes found on 8 November because either their state of decomposition was too great for them to have died recently or because they obviously had been killed by other causes. We included live oiled and non-oiled birds that were not removed from beaches in descriptions of daily beaching numbers but excluded them from the total number of birds beached between 7 and 11 November, unless they could not be accounted for in the numbers of birds found on the next day on the same or adjacent beaches.

We compared the magnitude of mortality from the PROS with previous, 1971 to 1983, levels for each species on each beach by dividing the mean daily carcass rate during the early phase of the PROS by daily

deposition rates for prior years. We compared PROS daily rates for each beach with usual levels (median ratios) using median daily deposition rates from the previous surveys, and with other high deposition periods (maximum ratios) using maximum daily deposition rates. Median and maximum rates of 0.00 were assigned rates of 0.05 in these ratios. To estimate the number of days of deposition that would have been required under "usual" conditions to account for the number of birds that beached in the initial five days of the PROS, we multiplied the median of the median ratios by five, for each species.

For the PROS, the daily rate was calculated as the total number of beached birds of each taxa divided by the number of days that censuses were conducted on a specific beach after birds started coming ashore (7 November for Common Murres and 8 November for loons and Western/Clark's Grebes). PROS rates were calculated only for Common Murre, loons, and Western/Clark's grebes, the most numerous bird taxa found on beaches during the PROS (PRBO 1985). The loons included Common, Arctic, Red-throated and unidentified loons.

To obtain daily deposition estimates from the monthly data collected between 1971 and 1983 we used a model of carcass deposition and disappearance. This model assumes that birds are deposited on beaches between surveys at a random but constant rate (a) and disappear from those beaches at a rate proportional to the number present (bN). If N is the number of carcasses present on a beach then $dN/dt = a - bN$. If carcasses are removed from beaches at the time of each survey and t is measured from the time of the previous survey, then, by solving the above differential equation for t and rearranging:

$$a = (bN) / (1 - \exp(-bt)),$$

where

a = the daily deposition rate since the previous survey,

b = the carcass disappearance rate,

N = the number of carcasses found on the current survey,

and

t = the number of days since the previous survey.

We used estimates of b from data collected on daily beached bird surveys on Seadrift and Limantour (Marin County) beaches 5 October-3 November 1979, on Seadrift Beach 24 October-23 November 1978 and 23 November-22 December 1977, and from RCA Beach (Marin County) 23 October-21 November 1978, and 31 October-5 December 1980 (Page et al. 1982, unpubl. data). Values for N and t were taken from the 1971-1983 October and November surveys.

RESULTS PART I: 14 YEAR SURVEY PROJECT**Beach Coverage**

Coverage varied considerably among the 6 regions and 14 years of study. North of Point Conception coverage was sparsest from 1971-72 to 1974-75, but each year afterwards there were at least 8 beaches with full-year coverage, 17 beaches with complete fall coverage, 16 beaches with complete winter coverage, and 13 beaches with complete spring coverage (Table 2). Overall, coverage peaked in 1979-80 and 1980-81, when there were up to 19 beaches with full-year, 29 with complete fall, 35 with complete winter, and 30 with complete spring coverage; most of those beaches were from the Gulf of the Farallones and Monterey Bay.

No beach in the Northern California region received more than 2 complete years or 12 complete seasons of coverage. The beaches with the greatest coverage were Manchester, Doran, and Salmon Creek (Table 2). There were more than two beaches with complete fall coverage only from 1976 to 1979 and in 1982 and 1983, with complete winter coverage only from 1976-77 to 1980-81, and with complete spring coverage only in 1977, 1978, 1981, and 1983.

In the Gulf of the Farallones, several beaches had at least 3 complete years of coverage: Cronkhite (9), Limantour (3), Muir (11), Ocean (6), RCA (5), and Seadrift (8). Six additional beaches received at least 12 complete seasons of data. The years of highest coverage varied between seasons, although in 1975-76, 1976-77, and 1980-81 at least eight beaches received complete coverage every season. At least eight beaches also received complete fall coverage in 1977,

Table 2. Survey coverage of beaches on the California coast, by year. P indicates complete fall coverage; W, complete winter coverage; S, complete spring coverage; three periods, surveys were conducted but no season completely covered; single period, no surveys conducted.

REGION-NORTHERN CALIFORNIA

BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
BIG LAGOON	.	.	.	.	.	.	.	..S	F..	F..	.	.	.	.
CENTERVILLE	.	.	.	.	.	..WS	.	FW.	FW.	FW.	.	.	.	.
CLAW	.	.	.	.	.	FWS	..S	FW.	FW.	..W.	..S	..S	F..S	.
DORAN	.	.	.	.	.	.	..WS	..W.	.	.	.	.	.	.
GOAT ROCK	.	.	.	.	.	.	.	.	.	.	.	.	.	.
GOLD BLUFF	.	.	.	.	.	.	.	.	.	.	.	.	.	.
JUCHAMOLE	.	..S	FWS	F..S	FWS	.	.	.	.	.	.	.	.	.
WACKERRICKER	.	.	.	..S	.	.	.	.	..W.	..WS	..W.	F..S	F..S	.
WAD RIVER, NORTH	.	.	.	.	.	.	.	.	..W.	..WS	..W.	F..S	F..S	.
WAD RIVER, SOUTH	.	.	.	.	.	..W.	..WS	.	FW.	F..	..S	FWS	F..S	.
WANCHESTER	.	.	.	.	.	.	..WS	.	FW.	F..	.	.	.	.
PELICAN	.	.	.	.	.	FWS	F..S	FW.	.	..WS	F..S	F..	.	.
SALMON CREEK	..S	F..	.	.	..S	F..S	FW.	F..S	.	.	.	.	.	.
SOMAHA COAST (DUALALA)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
TRINIDAD	.	.	.	.	.	.	..S	.	.	.	.	.	.	.
WRIGHTS	.	.	.	.	.	.	..WS	F..	.	.	.	.	.	.

REGION-GULF OF THE FARALLONES

BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
AMO NUEVO	F..	.	..W.	F..	..WS	..WS	..WS	F..	.	FWS	..S	FW.	.	F..
BOLINAS	..S	FWS	FWS	..WS	FWS	..WS	FWS	FWS	FW.	FWS	FWS	F..S	FW.	FWS
CROMKITC	.	.	..S	FWS	FW.	..W.	..WS	..W.	..WS	..WS	F..S	FW.	F..S	..S
DILLON	.	.	.	.	.	.	..WS	..S	..WS	..W.	.	.	.	.
DOUBLE POINT?	.	.	.	.	.	.	.	..S	..WS	..W.	.	.	.	.
DRAKES	.	.	.	.	.	.	.	.	.	..W.	.	.	.	.
EDGEHAR	.	F..	FWS	.	.	.	.	.	FW.	F..	..S	F..	FW.	FWS
FORT POINT	.	.	.	..WS	..S	FW.	F..	.	.	.	.	..WS	FW.	.
HALF MOON BAY, NORTH	.	.	.	.	.	.	.	.	..WS	..WS	..WS	..WS	.	.
HALF MOON BAY, SOUTH	.	.	.	F..S	FWS	F..S	..WS	F..S	..WS	FWS	..S	..W.	F..S	..WS
LIMANTONG	.	.	FWS	.	.	.	.	.	.	F..	.	.	.	.
LINDA MAR	.	.	.	.	.	.	.	.	.	F..	.	.	.	.
MONTARA	FW.	..WS	..WS	FWS	FWS	FWS	FW.	FWS	FW.	FWS	FWS	F..S	FW.	..S
MUTR	..S	..WS	FWS	..WS	..S	F..S	FW.	FWS	FW.	FWS	FWS	F..S	FW.	FWS
OCEAN	.	.	.	.	.	FWS	FWS	F..	..WS	..WS	..WS	.	.	.
PESCADERO	.	.	.	.	..WS	F..S	FW.	..W.	..WS	..WS	..WS	.	.	.
POINT REYES, A	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
POINT REYES, B	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
POINT REYES, C	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
POINT REYES, D	FW.	FWS	FWS	.	FWS	..W.	..WS	F..S	FW.	FW.	..WS	F..	FW.	FWS
NCA	..W.	FWS	FWS	.	FW.	F..	F..S	FW.	FW.	FWS	FWS	FW.	FW.	FWS
SEADRIFT	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
SHARP PARK	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
STINSON	.	.	.	.	.	.	.	.	..WS	..WS	..WS	.	.	.
THORNTON	.	.	..S	.	..W.	FWS	F..S	F..	..WS	..WS	..S	F..S	FW.	..W.

REGION-IONALES BAY

BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 2, continued (page 2 of 3).

REGION-MONTEREY BAY													
BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84 84-85
DAVENPORT, EAST							FWS	FWS	FWS	FWS	FWS	F.S	FWS
DAVENPORT, WEST							FWS	F.S	FWS	FWS	FWS	FWS	FWS
DEL MONTE							FWS	F.S	FWS	FWS	FWS	FWS	FWS
JETTY							FWS	FWS	FWS	FWS	FWS	FWS	FWS
LAGUNA CREEK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
MAJORS CREEK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
MARINA							FWS	FWS	FWS	FWS	FWS	FWS	FWS
PAJARO GUMES							FWS	FWS	FWS	FWS	FWS	FWS	FWS
RIO DEL MAR							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SALINAS RIVER							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SCOTT CREEK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SEASCAPE-APTOS							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SEASIDE							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SUNSET							FWS	FWS	FWS	FWS	FWS	FWS	FWS
WILDER							FWS	FWS	FWS	FWS	FWS	FWS	FWS
YELLOW DANCE CREEK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
HUDOVSKI							FWS	FWS	FWS	FWS	FWS	FWS	FWS
REGION-ESTERO BAY													
BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84 84-85
ATASCADERO							FWS	FWS	FWS	FWS	FWS	FWS	FWS
CANDRIA							FWS	FWS	FWS	FWS	FWS	FWS	FWS
HAIKRO CREEK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
MORRO BAY							FWS	FWS	FWS	FWS	FWS	FWS	FWS
PURISIMA POINT							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN SIMON							FWS	FWS	FWS	FWS	FWS	FWS	FWS
REGION-SANTA BARBARA CHANNEL													
BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84 84-85
ARROYO QUEBRO							FWS	FWS	FWS	FWS	FWS	FWS	FWS
BEVERAGE							FWS	FWS	FWS	FWS	FWS	FWS	FWS
LAS VARGAS CANYON							FWS	FWS	FWS	FWS	FWS	FWS	FWS
MCCRAITH							FWS	FWS	FWS	FWS	FWS	FWS	FWS
MUGU ROCK							FWS	FWS	FWS	FWS	FWS	FWS	FWS
PITAS POINT (FARIA)							FWS	FWS	FWS	FWS	FWS	FWS	FWS
POINT MUGU							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SM 1B							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SM 4B							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SM 6B							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SM 8B							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SM 12B							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SAN NICOLAS I. SC-NORTH							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SANIA CRUZ I. SC-SOUTH							FWS	FWS	FWS	FWS	FWS	FWS	FWS
SANIA CRUZ I. SC-WEST							FWS	FWS	FWS	FWS	FWS	FWS	FWS

Table 2, continued (page 3 of 3).

	REGION-SOUTHERN CALIFORNIA													
BEACH	71-72	72-73	73-74	74-75	75-76	76-77	77-78	78-79	79-80	80-81	81-82	82-83	83-84	84-85
BOLSA CHICA	.	.	..S	..S	.WS	FWS	FW.	.	.	.	.	.	.	.
BORDER FIELD	.	.	.	.	..S	FWS	FW.	.	.	.	.	.	.	.
CAMP PEMOLETON	.	.	.	.	..S	FWS	FW.	.	.	.	.	.	.	.
CRYSTAL COVE	.	.	.	.	.	F..	FWS	FW.	FW.	.	.	.	.	.
HERNOSA	.	.	.	.	.	FWS	FW.	.	.	.	.	.	.	.
HUNTINGTON BEACH	.	.	.	.	.	FWS	FW.	.	.	.	.	.	.	.
LEUCAUTA	.	.	.	.	.	...	...	.	.	.	.	.	.	.
REDONDO	.	.	.	.	.WS	FWS	FW.	.	.	.	.	.	.	.
SAN ONOFRE BLUFFS	.	.	.	.	.	FWS	FW.	.	.	.	.	.	.	.
SILVER STRAND	.	.	.	FWS	FWS	FWS	FW.	.WS	FWS	FWS	FWS	FWS	.	.
FORRANCE	.	.	.	.	.	.	.	.	.	.	.	.	.	.

1978, 1982, and 1983; complete winter coverage in 1973-74 and 1979-80; and complete spring coverage in 1974, 1978, 1980, and 1982 (Table 2).

In Monterey Bay, Pajaro Dunes received 11, Rio Del Mar 6, East Davenport, Laguna Creek, Wilder, and Yellow Bank Creek 5, Del Monte and Majors Creek 4, and Seascape-Aptos and Sunset 3 complete years of surveys. All other beaches were surveyed for 2 or fewer complete years (Table 2). Between 1977-78 and 1984-85 there were at least eight beaches with complete fall, six with complete winter, and five with complete spring coverage (Table 2).

In the Estero Bay region, Cambria received 10 and all other beaches 3 or fewer complete years of coverage. Years in which four or more beaches received complete fall coverage were 1980 and 1983; complete winter coverage, 1982-83; and complete spring coverage 1980, 1983, and 1984 (Table 2).

The only southern coast beaches with more than 1 complete year of coverage were Arroyo Burro (Santa Barbara Channel) with 4 and Torrance (Southern California) with 7 years. In 1976-77 there were 18 beaches with full-year coverage, 21 beaches with complete fall coverage, 22 beaches with complete winter coverage, and 24 beaches with complete spring coverage. Complete fall and winter coverage were similarly high in 1977-78 but in all other years was considerably lower (Table 2).

Total Numbers of Carcasses Found

There were 39444 carcasses found during the study, two thirds of which came from the Gulf of the Farallones and Monterey Bay. If we examine the entire data set without making any adjustments for

higher north of than south of Point Conception, and higher in Monterey Bay than in the other northern California regions. The total number of carcasses/km walked was 2.9 in each of Northern California, the Gulf of the Farallones, and Estero Bay, 4.5 in Monterey Bay, 1.8 in Santa Barbara Channel, and 1.5 in Southern California. Thus, total carcass density for Monterey Bay was about 1.5 times greater than that of any other region north of Point Conception and almost 3 times greater than regions to the south.

Within regions, total carcass densities for individual beaches in single months varied as shown on page 1 of Appendix A. Using beaches with sample sizes (N) of at least 10, conditional median densities (zero censuses not included) for the Gulf of the Farallones ranged from 0.6 (Fort Point) to 9.3 (Sharp Park) in fall, 0.8 (RCA) to 5.2 (Dillon) in winter, and 0.6 (Double Point) to 4.0 (Muir) in spring (Appendix A, page 1). Similarly, on Monterey Bay conditional median rates ranged from 1.2 (Wilder) to 10.6 (Seaside) in fall, 0.5 (Rio del Mar) to 13.4 (Del Monte) in winter, and 1.0 (Rio del Mar) to 18.8 (Del Monte) in spring. The medians of these medians were highest in both regions in fall (3.2 in the Gulf, 3.8 on Monterey Bay), and lower in winter (2.3 in the Gulf, 2.2 on Monterey Bay) and in spring (1.7 in the Gulf, 2.0 on Monterey Bay).

Regional densities of total birds varied seasonally. Highest total densities of birds occurred during fall in the Gulf of the Farallones, intermittently throughout the year in Monterey and Estero bays (south-central coast), and March through July in the regions south of Point Conception (Fig. 1). High fall densities in the Gulf of the Farallones were related to the timing of highest Common Murre carcass densities

central coast), and March through July in the regions south of Point Conception (Fig. 1). High fall densities in the Gulf of the Farallones were related to the timing of highest Common Murre carcass densities there. The intermittent timing of peaks on the south-central coast was related to the large number of species that appeared to prefer Monterey Bay, as discussed below. A possible explanation for the seasonal trend on the southern coast, which we propose below in the species accounts, is that birds in that area that remain behind after the spring exodus experience high mortality.

Carcass densities varied between years on beaches north of Point Conception. In fall, highest median densities occurred in pairs of years: 1972 and 1973; 1975 and 1976; 1980 and 1981; and 1982 and 1983 (Fig. 2). All but the third pair spanned ENSO episodes. High densities in the third pair of years may have been due, in part, to the first years of intense gill net fishing in the Monterey Bay area (Heneman in Appendix C). Years with the highest medians also appeared to be more variable than years with lower medians (except 1971). This indicated that in years of greater deposition, the upward shift of carcass density occurred on only some beaches (Fig. 2). Only in years of lowest density (1979, 1984) were there beaches with full fall coverage on which no birds were found in any month of the fall. Years of high or low winter carcass densities were more difficult to identify than those for fall. Median densities appeared higher in 1971-72, 1975-76, and 1982-83 but lower in 1974-75 than in some other years (Fig. 3). Of these, only the 1982-83 winter was part of an ENSO episode; the other two high density winters preceded ENSO episodes that

ALL SPECIES

27

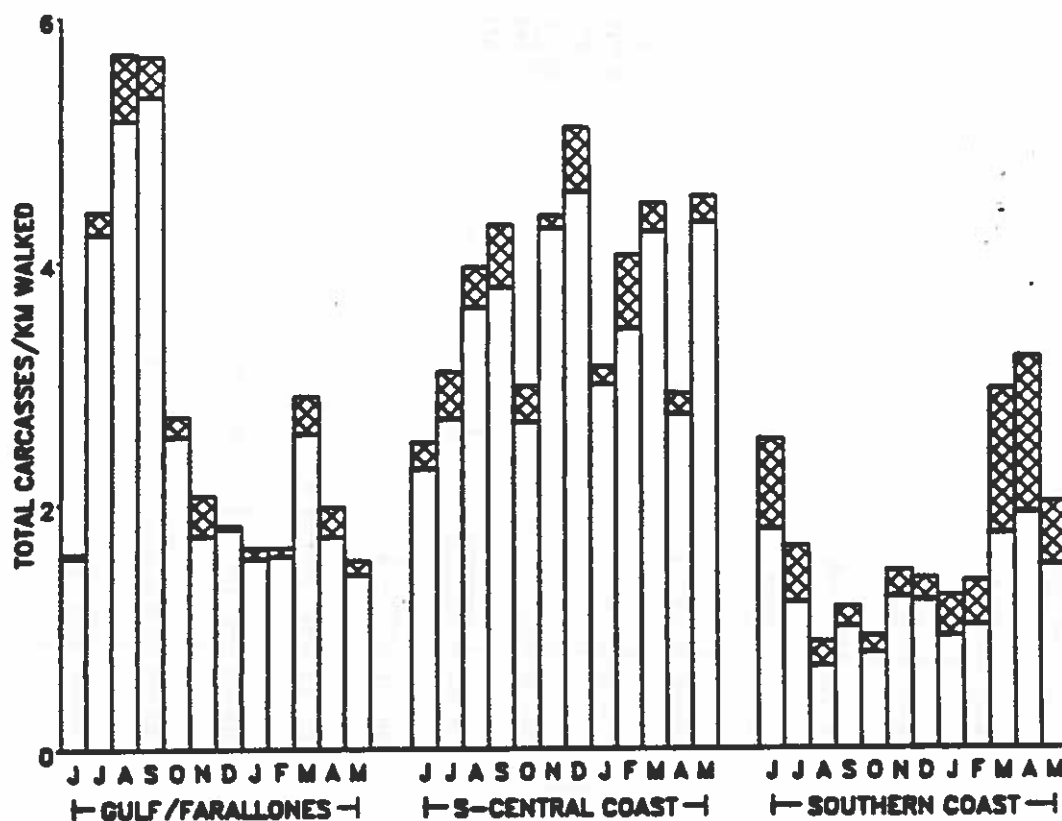


Fig. 1. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

ALL SPECIES FALL DATA ONLY

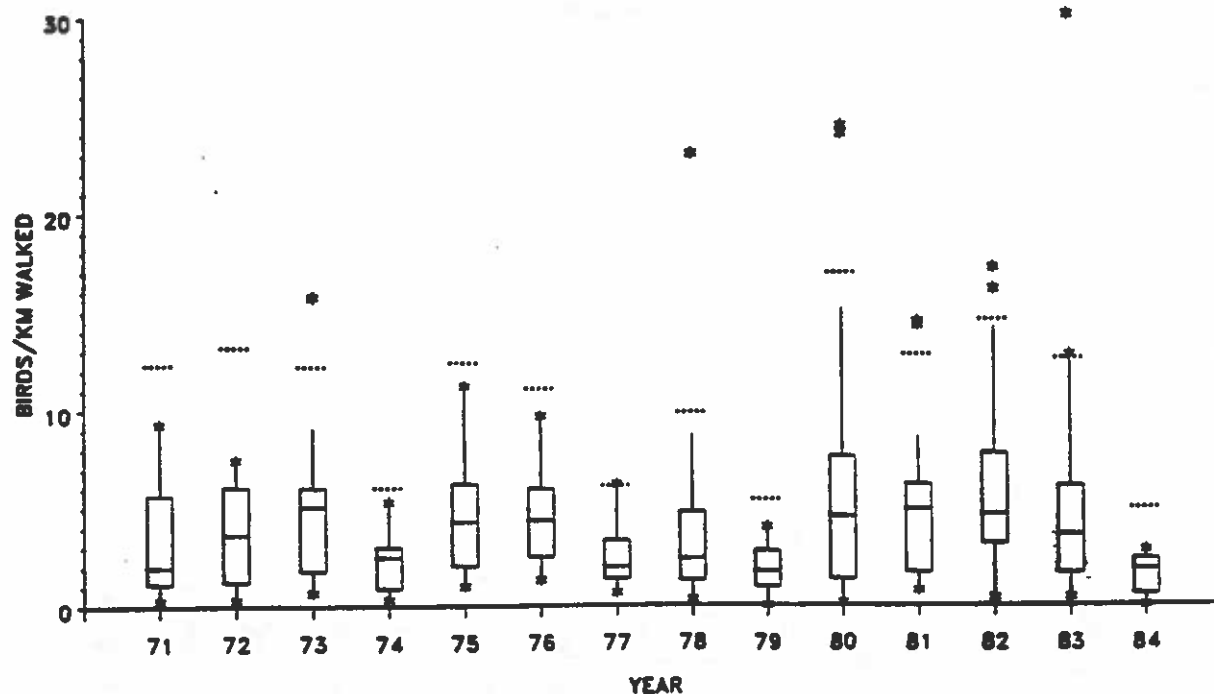


Fig. 2. Annual variation in carcass densities north of Point Conception. See methods for details.

ALL SPECIES

WINTER DATA ONLY

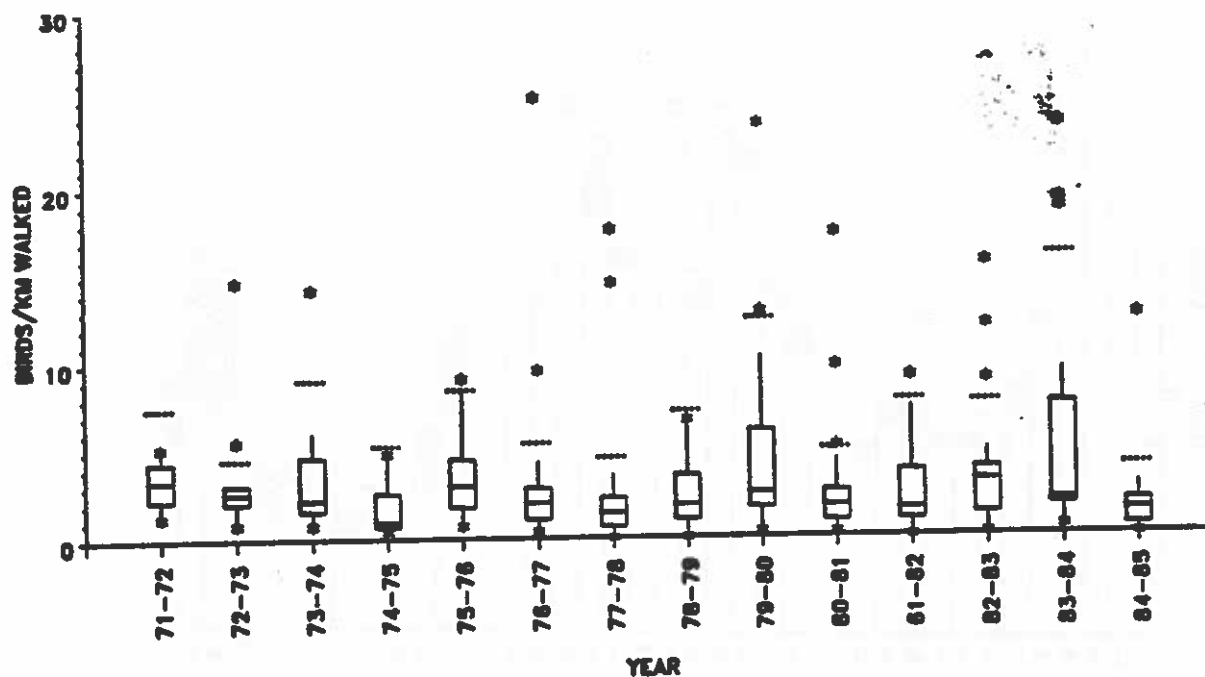


Fig. 3. Annual variation in carcass densities north of Point Conception. See methods for details.

ALL SPECIES

SPRING DATA ONLY

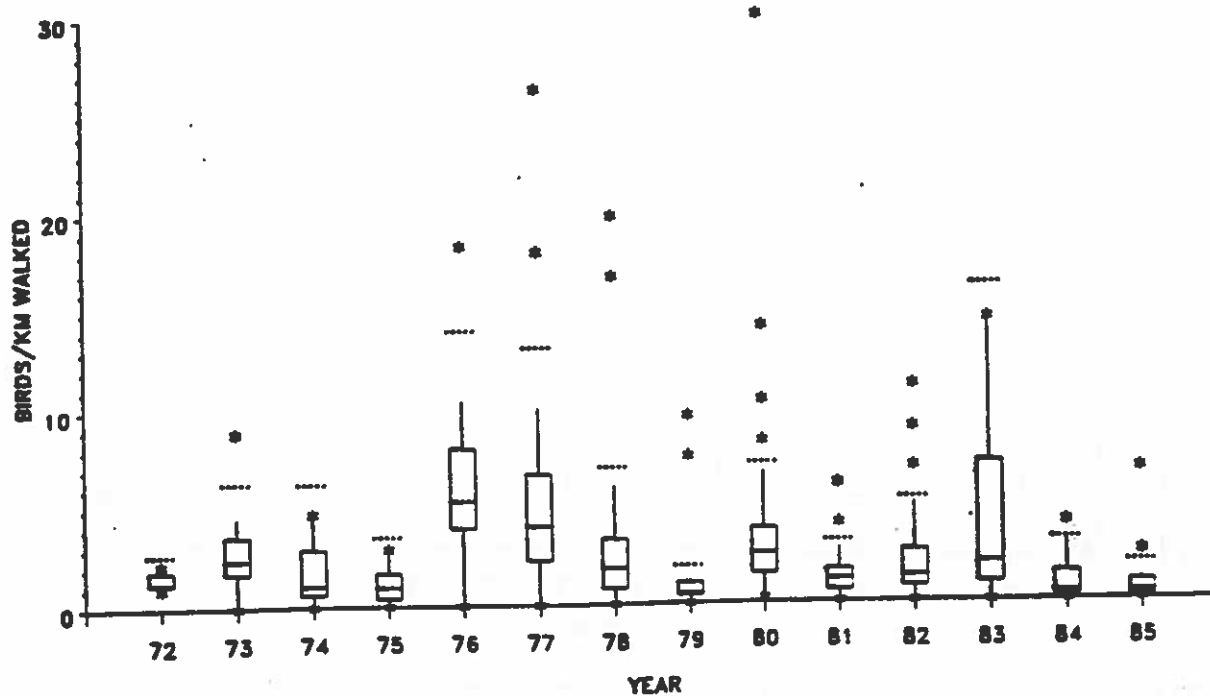


Fig. 4. Annual variation in carcass densities north of Point Conception. See methods for details.

began the following Junes. Carcass densities in spring were highly variable between years. In 1976 and 1977 median densities were noticeably higher than in other years; for these years, and 1983, the variability of densities was greater than in others (Fig. 4). Years of relatively low median density were 1979, 1984, and 1985 (Fig. 4).

Species Composition

Species composition varied among regions, shifting from large alcids and gulls in the north toward large tubenoses and gulls in the south. In Northern California and the Gulf of the Farallones at least half of the carcasses comprised large alcids and gulls (Table 3). In Tomales Bay, the only shoreline surveyed within an enclosed bay, over half of the carcasses were scoters (Table 3). In Monterey Bay at least half of the carcasses were large alcids, large tubenoses, and gulls; in Estero Bay at least half were large alcids, large grebes, cormorants, large tubenoses, and gulls (Table 3). At least half of the carcasses in the Santa Barbara Channel region comprised large tubenoses, gulls, and large alcids, and in the Southern California region large tubenoses and gulls (Table 3).

Of the 20 commonest species, the regions with the highest densities for each species included Northern California for 3, the Gulf of the Farallones for 4, Monterey Bay for 15, Estero Bay for 7, Santa Barbara Channel for 1, and Southern California for 3 species. Thus, high total carcass density in Monterey Bay is caused by higher densities for many rather than a few species. Highest overall densities of White-winged Scoter occurred in Northern California; Common Murre and Western Gull,

Table 3. Species group composition of the outer coast regions and Tomales Bay. See species account for species composition of the groups. Pct is percent.

	NORTHWEST CALIFORNIA			GULF OF THE FARALLONES			TOMALES BAY			MONTICUEY BAY			ESTEROO BAY			SANTA BARBARA CHANNEL			SOUTHERN CALIFORNIA		
	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL	REGIONAL PCT OF REGIONAL TOTAL
LOONS	171	4.2	453	2.0	10	7.1	403	4.7	273	9.3	194	8.7	200	6.2							
LARGE GRACIES	401	9.0	1271	7.7	22	0.7	661	8.4	510	17.2	274	12.3	234	7.3							
SMALL GRACIES	60	1.3	136	0.0	1	0.4	173	1.7	96	3.2	106	4.0	129	4.0							
LARGE TUBENOSES	329	7.9	1522	0.0			1516	14.0	302	10.2	491	22.1	1062	33.1							
STORM PETRELS	16	0.4	34	0.2			30	0.4	2	0.1	1	0.0	7	0.2							
CORMORANTS	259	6.3	1006	11.0	12	4.7	1079	10.5	317	10.7	249	11.2	133	4.2							
PELICANS	0	0.2	44	0.4	1	0.4	119	1.2	39	2.0	30	1.7	27	0.0							
HERONS & EGRETS	3	0.1	3	0.0	1	0.4	2	0.0	6	0.2	2	0.1	1	0.0							
SCOTERS	371	9.1	602	4.1	141	55.3	606	6.7	243	8.3	63	2.9	74	2.3							
OTHER WATERFOWL	21	0.5	163	1.0	12	4.7	33	0.3	13	0.3	30	2.3	17	0.5							
RAILS & COOTS	13	0.4	89	0.3	3	1.2	13	0.1	3	0.1	10	0.3	4	0.1							
PHALAROPES	124	3.0	254	1.3	2	0.8	433	4.4	62	2.1	24	1.1	69	2.2							
OTHER SHORCROBIDS	42	1.0	90	0.3	1	0.4	33	0.3	42	1.4	60	2.7	23	0.0							
JACOBES & SKUAS	1	0.0	0	0.0			3	0.0	2	0.1	1	0.0	0	0.2							
GULLS	597	14.6	2328	14.2	19	7.3	1410	13.0	301	10.2	346	13.6	893	27.0							
TERNS	4	0.1	7	0.0	1	0.4	11	0.1	2	0.1	3	0.1	3	0.2							
LARGE ALCIOS	1606	39.2	7272	44.2	20	7.9	3099	30.2	643	21.0	209	13.0	230	0.0							
SMALL ALCIOS	70	1.7	434	2.0			213	2.1	79	2.7	10	0.0	61	1.9							

from Northern California to Monterey Bay; Brandt's Cormorant, in the Gulf of the Farallones and Monterey Bay; Cassin's Auklet, from the Gulf of the Farallones to Estero Bay; Northern Fulmar, Pelagic Cormorant, Surf Scoter, Red Phalarope, California Gull, and Pigeon Guillemot, in Monterey Bay; Arctic Loon, Common Loon, and Brown Pelican, in Monterey and Estero bays; Sooty Shearwater, in Monterey Bay, Santa Barbara Channel, and Southern California; Red-throated Loon and Western/Clark's grebes, in Estero Bay; and Eared Grebe and Black-legged Kittiwake, in Southern California (Table 4).

Species Group Accounts

Below we briefly discuss patterns of carcass occurrence for different species. In Table 4 we present densities, totals, and months of occurrence for all carcasses by region, without adjusting for irregular coverage on some beaches. Regional comparisons are only made for the six outer coast regions, although we do include in some tables data from the one beach on Tomales Bay for completeness. Using only beaches with full years of coverage we present seasonal patterns for the most common species. These patterns are compared to the species' general occurrences in California as derived from Cogswell (1977), Roberson (1980), Garrett and Dunn (1981), Harrison (1983), and Shuford et al. (ms in prep.). We also examine annual densities for the most common species from the beaches with complete coverage in the seasons in which they were most abundant on beaches. Because carcass densities for some species on some beaches are consistently low, it is possible to underestimate carcass densities in years that the sample sizes of

[illegible]

Table 4, continued (page 9 of 11).

		Total Birds/km																		
	Region	Total	Walked	Max	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May				
Mourmann's Gull	N. California	30	0.02	5																
	Gulf/Peralones	131	0.02	5																
	Monterey Bay	97	0.04	11																
	Estero Bay	42	0.04	8																
	S.S. Channel	23	0.02	2																
	S. California	51	0.02	2																
New Gull	N. California	15	0.01	3																
	Gulf/Peralones	37	0.01	7																
	Monterey Bay	44	0.02	3																
	Estero Bay	3	*	1																
	S.S. Channel	2	*	1																
	S. California	2	*	1																
Ring-billed Gull	Tomas Bay	2	0.02	2																
	N. California	6	*	1																
	Gulf/Peralones	29	0.01	2																
	Monterey Bay	39	0.02	3																
	Estero Bay	11	0.01	1																
	S.S. Channel	7	0.01	2																
California Gull	S. California	40	0.02	3																
	N. California	42	0.03	4																
	Gulf/Peralones	140	0.02	4																
	Monterey Bay	242	0.11	8																
	Estero Bay	16	0.02	2																
	S.S. Channel	20	0.02	2																
Western Gull	S. California	112	0.03	5																
	Tomas Bay	1	0.01	1																
	N. California	262	0.19	14																
	Gulf/Peralones	1191	0.21	11																
	Monterey Bay	360	0.25	11																
	Estero Bay	143	0.14	8																
Glaucous-winged Gull	S.S. Channel	170	0.14	6																
	S. California	301	0.14	9																
	Tomas Bay	2	0.02	1																
	N. California	40	0.03	4																
	Gulf/Peralones	167	0.03	4																
	Monterey Bay	55	0.02	5																
Glaucous Gull	Estero Bay	12	0.01	3																
	S.S. Channel	4	*	1																
	S. California	2	*	1																
	Tomas Bay	3	0.03	1																
	Gulf/Peralones	1	*	1																
	Monterey Bay	1	*	1																

beaches are small. Such small sample sizes prevented us from identifying years of particularly low densities that might have occurred from 1971-72 to 1974-75.

Gaviiforms

Loons, found year round on the surveys, comprised four species, three of which were common. Of those identified, Arctic Loons were the most common in all regions, making up about one half of the total identified loons in each area (Table 4). Using only full years of data, Common and Arctic/Red-throated Loons occurred at greatest frequency on beaches of the south-central coast region, and at least frequency on beaches of the Gulf of the Farallones (Figs. 5, 6). The only two Yellow-billed Loons found on the surveys, from Centerville Beach in November 1979 and Clam Beach in January 1980, (Table 4) are consistent with the October to May occurrence of this species in California (Remsen and Binford 1975).

At least two strong seasonal peaks for the three common loon species were apparent in each region. North of Point Conception, the highest peak usually was in December and the next highest between April and June (Figs. 5, 6). Both of these peaks correspond with the known periods of maximum migratory movement and occurrence along the California coast. Loons are known to winter in California and Mexico waters from November through March, a residency reflected as well by the occurrence of beached carcasses. A third peak in July for Common Loons in the Gulf and possibly on the southern coast occurred when numbers of loons offshore are low. We hypothesize that it represented

COMMON LOON

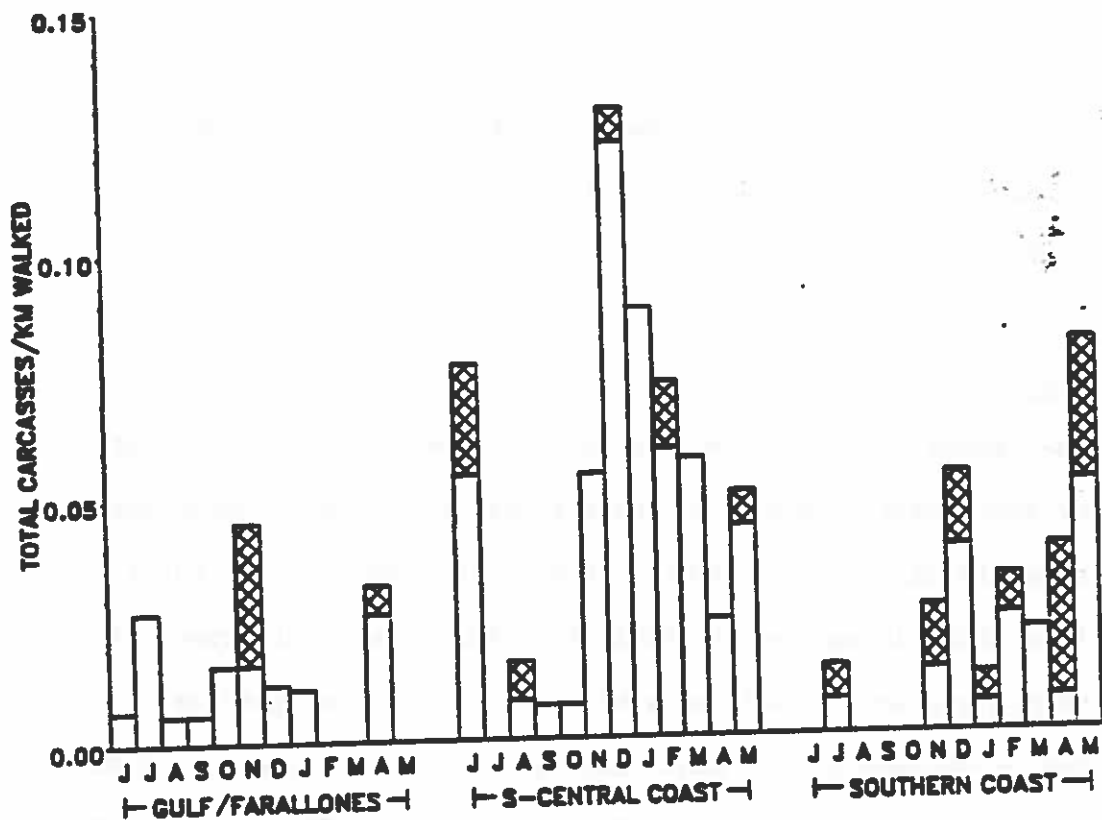


Fig. 5. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

ARCTIC AND RED-THROATED LOONS

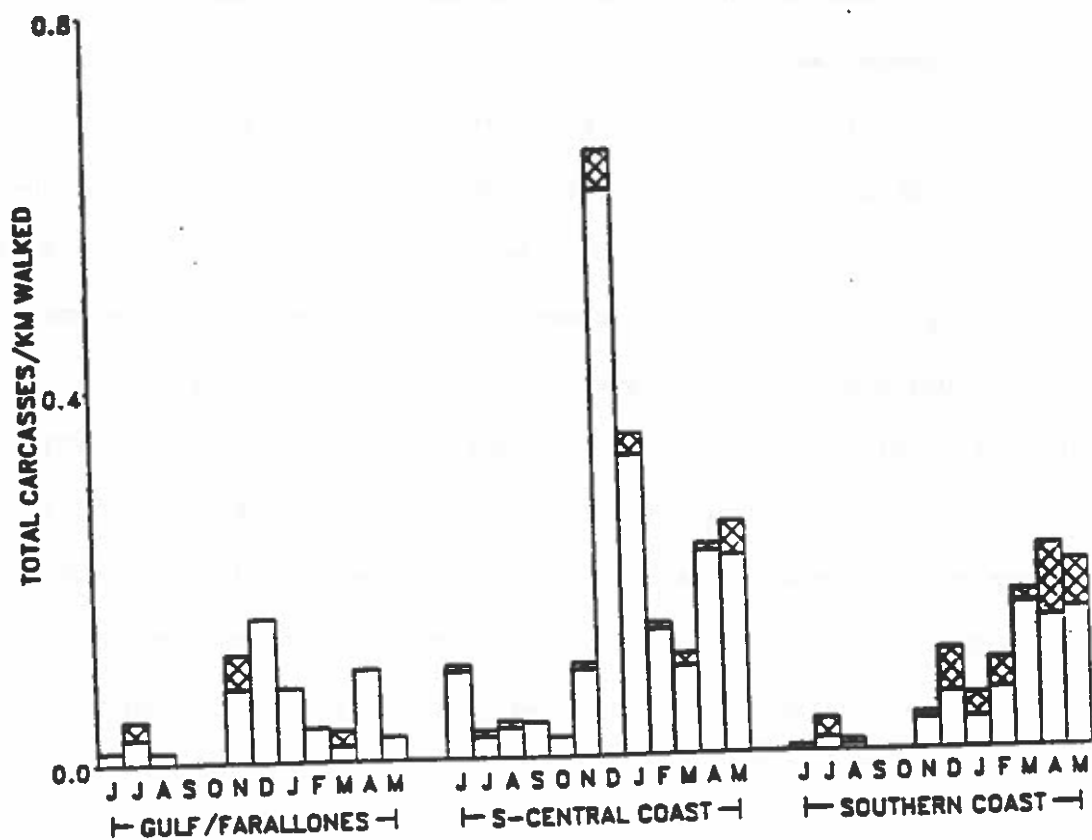


Fig. 6. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

COMMON LOON WINTER DATA ONLY

45

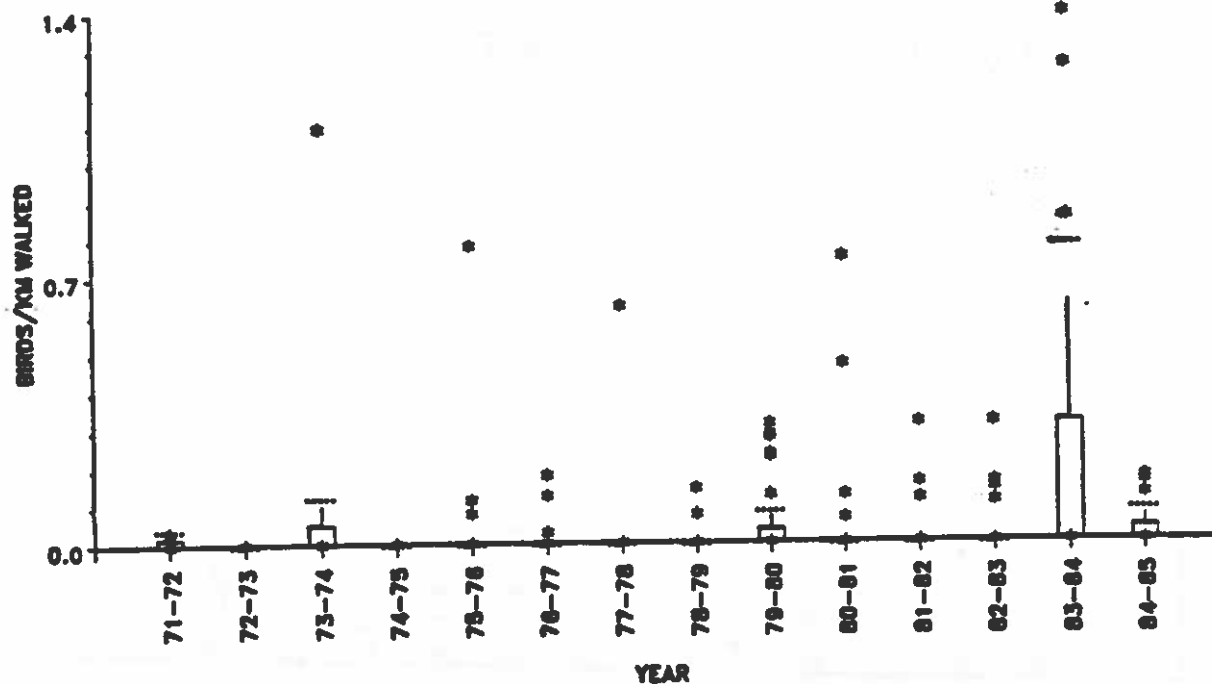


Fig. 7. Annual variation in carcass densities north of Point Conception. See methods for details.

COMMON LOON SPRING DATA ONLY

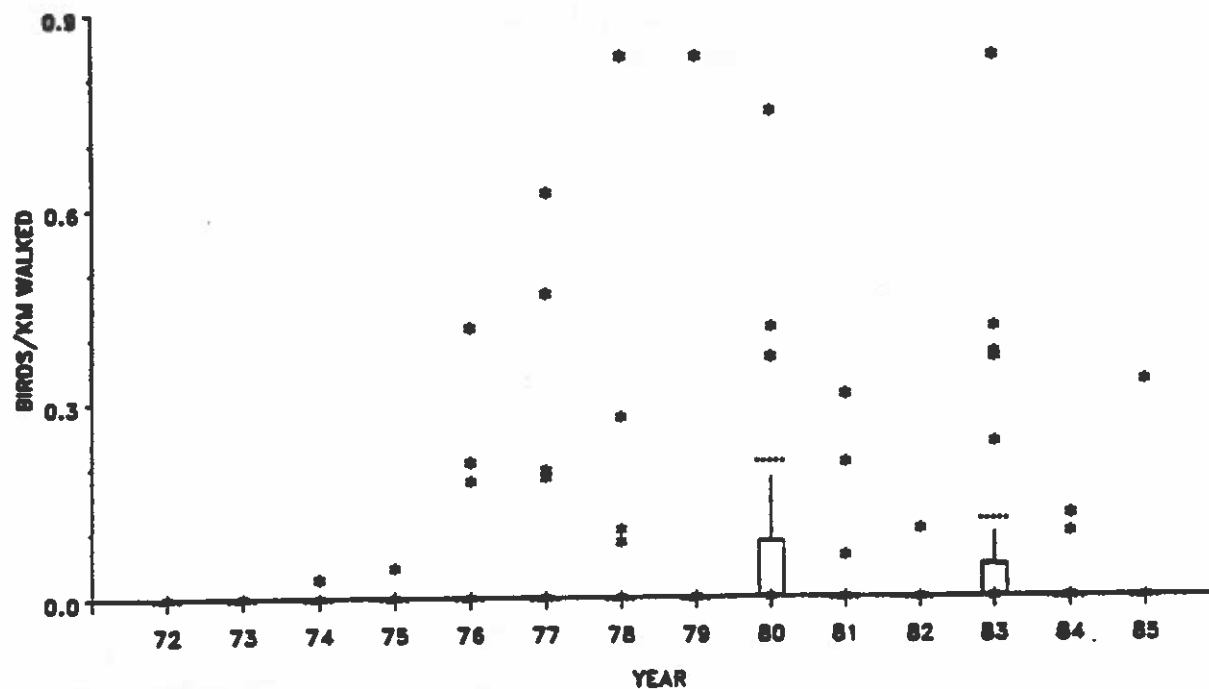


Fig. 8. Annual variation in carcass densities north of Point Conception. See methods for details.

ARCTIC AND RED-THROATED LOONS

WINTER DATA ONLY

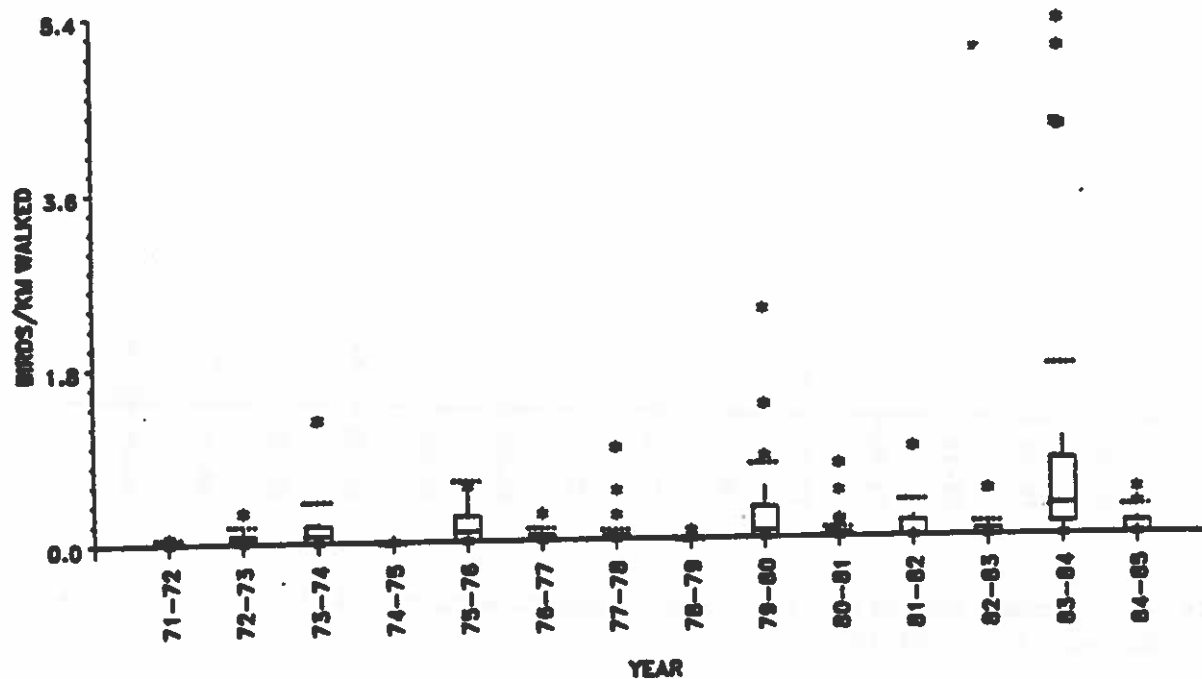
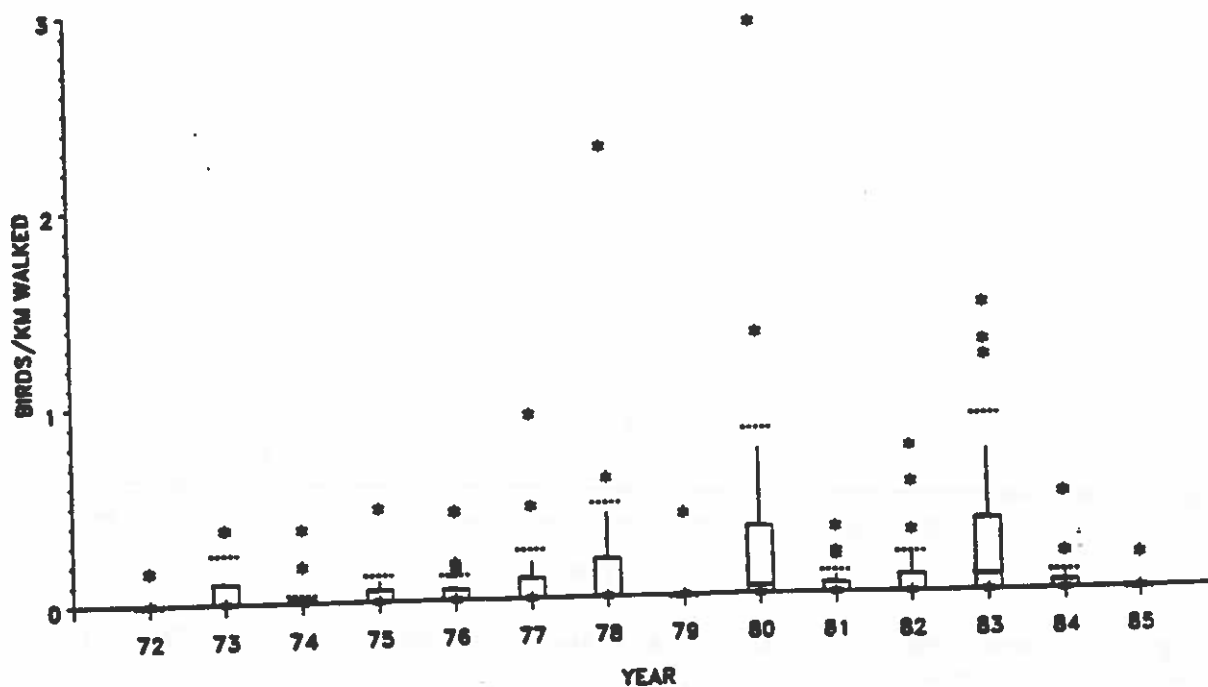


Fig. 9. Annual variation in carcass densities north of Point Conception. See methods for details.

ARCTIC AND RED-THROATED LOONS

SPRING DATA ONLY



weakened individuals which had remained behind after the spring exodus and subsequently died.

Even in the seasons of highest occurrence, winter and spring, Common Loons were frequently not found on beaches; in no winter or spring did they occur on even half of the beaches with complete coverage (note that median densities were zero in all years in Figs. 7, 8). However, carcasses were more common on beaches in some years than in others (see those years in Figs. 7 and 8 with boxes, indicating occurrence on at least 25% of the beaches). Higher densities in spring 1983 and winter 1983-84 corresponded to the end of the 1982-84 ENSO; higher densities in winter 1973-74 occurred just after the 1972-73 ENSO. It is possible that the prolonged ENSO episodes may claim a higher mortality in the Common Loon. Higher densities in winter 1979-80 and spring 1980 were inexplicable, even though intensive gill netting in Monterey Bay began in that spring. Were gill netting the cause, one would expect most of the non-zero densities to be from Monterey Bay beaches. However, three of the nine beaches with non-zero densities were in Estero Bay and four were from the Gulf of the Farallones, where gill netting was not a problem in spring 1980. The five non-zero densities in winter 1984-85 were from beaches affected by the T/V Puerto Rican oil spill. Years of low apparent mortality could also be identified in winter 1977-78 and spring 1979, 1982, and 1985.

Arctic and Red-throated loon densities were high in the same years that Common Loon densities were highest, but since the former species were more common, it was also possible to identify other years of high density (Figs. 9, 10). In winter, median Arctic and Red-throated loon

WESTERN/CLARK'S GREBES

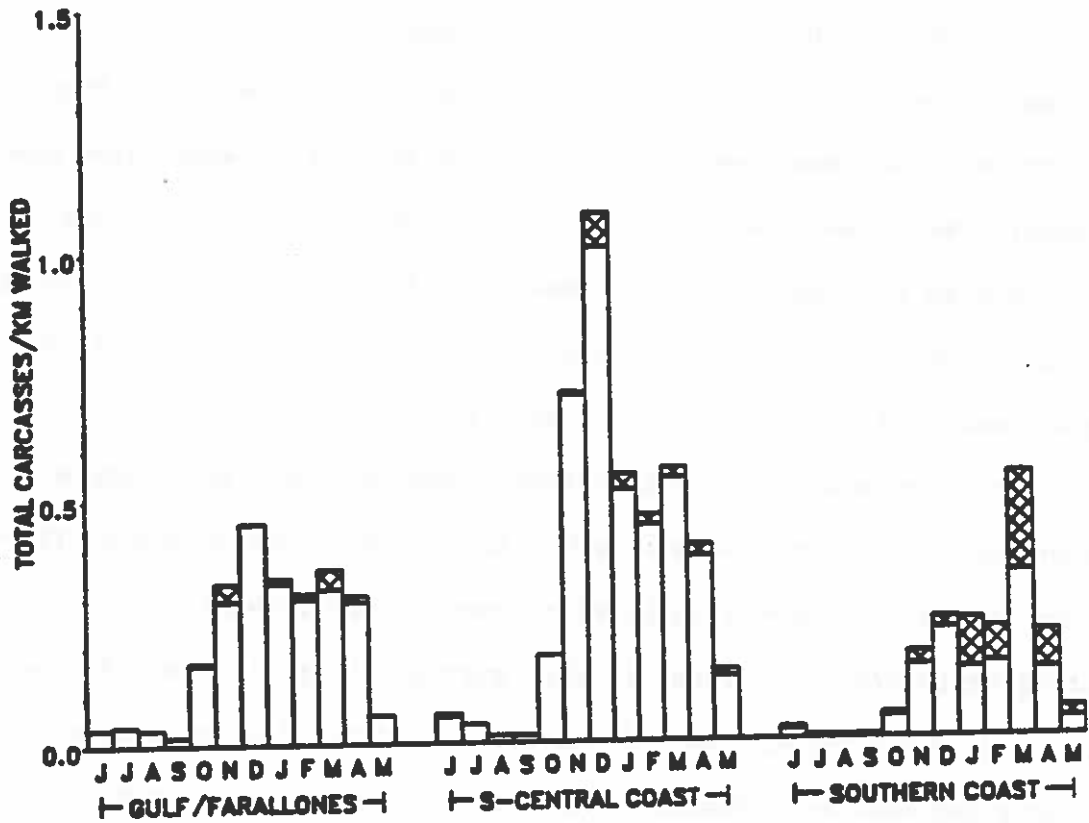


Fig. 11. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

densities were greater than zero in five years (Fig. 9). Densities were highest in 1983-84, as for Common Loons, but as high in 1975-76 as in 1979-80. Densities in 1973-74 and 1972-73 were lower than in the other three high years. Low winter densities occurred in 1978-79. In spring, 1983 and 1980 were the only years in which medians were greater than zero; densities in 1978, during the Aleutian warm-water period, may have been somewhat greater than in other years. Low spring densities occurred in 1979 and 1985.

Podicipediforms

Large grebes, comprising Red-necked Grebes, Western Grebes, and Clark's Grebes, occurred throughout the year in most regions. Only 11 Red-necked Grebes were found on the surveys, all north of Point Conception (Table 4); this is consistent with their known distribution and abundance. Although some observers separated Western and Clark's Grebe (as light and dark phase Western Grebes) before they were distinguished as separate species in 1985 (A.O.U. 1985), the identified proportion is too small to allow us to separate these two species in analyses. From the relative abundance of the live birds and from the identifications of those observers that separated these species on surveys, we know that Western Grebes were much more common than Clark's Grebes on the surveys. Together, the two species made up over 99% of the large grebes found.

Seasonal patterns of occurrence for the Western/Clark's grebes were clear and consistent with their live occurrence. Using only full years of data, Western/Clark's grebes occurred primarily from November

through April in all regions; they were encountered with greatest frequency in the south-central region (Fig. 11). Peaks in carcass density occurred on the south-central coast in November and December and on the southern coast in March, but not in the Gulf of the Farallones (Fig. 11). Shuford et al. (ms in prep.) found live Western and Clark's grebes exhibiting migratory peaks at one location but not at another nearby site.

Annual variation in densities during the Western/Clark's grebes' two seasons of greatest abundance was relatively high (Figs. 12, 13). Densities in several winters appeared higher than in others. In the winters of 1971-72, 1972-73, and 1975-76 Western/Clark's grebes were found on every beach with complete coverage and median densities were among those of the highest four years (Fig. 12). In 1983-84 the densities were highly skewed, as indicated by the spread above the median which was much greater than in any other year. Although the median density in 1982-83 was among those of the highest four years, Western/Clark's grebes were absent from at least 25% of the beaches with complete coverage that winter. Densities in 1977-78, 1978-79, and 1984-85 were the lowest of the 14 years. In spring, the location, spread, and symmetry of the densities were quite variable (Fig. 13). In 1973 and 1980, these grebes were found on at least 75% of the beaches and median densities were among those of the highest five years. Median densities were also among those of the highest five years in 1977 and 1983 when these grebes were found on at least 50% of the beaches with complete coverage. Particularly low occurrence was indicated in spring 1979 when they were absent from at least 75% of the

WESTERN AND CLARK'S GREBES

WINTER DATA ONLY

51

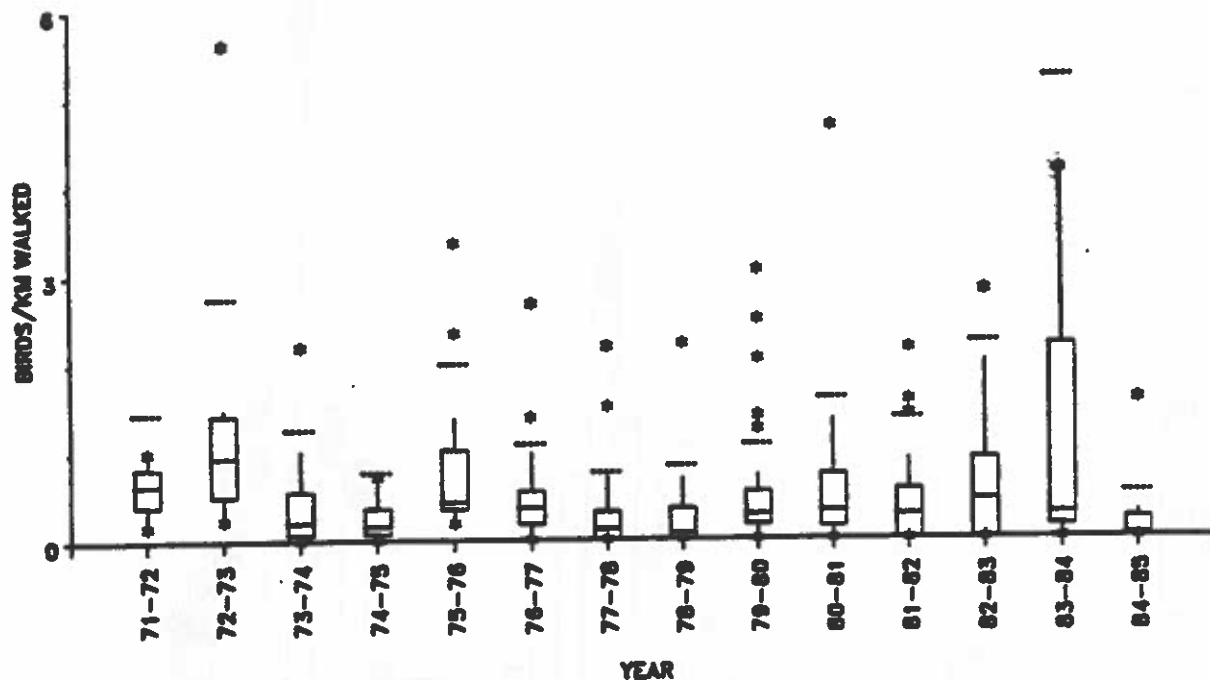


Fig. 12. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN AND CLARK'S GREBES

SPRING DATA ONLY

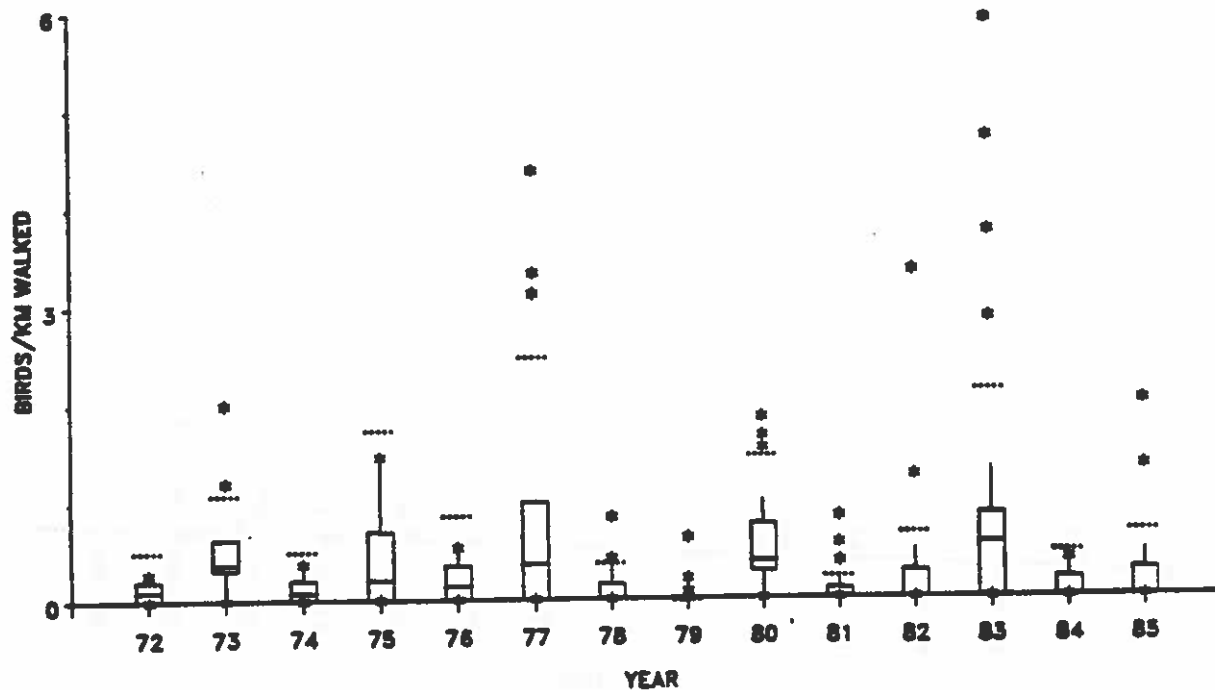


Fig. 13. Annual variation in carcass densities north of Point Conception. See methods for details.

EARED AND HORNED GREBES

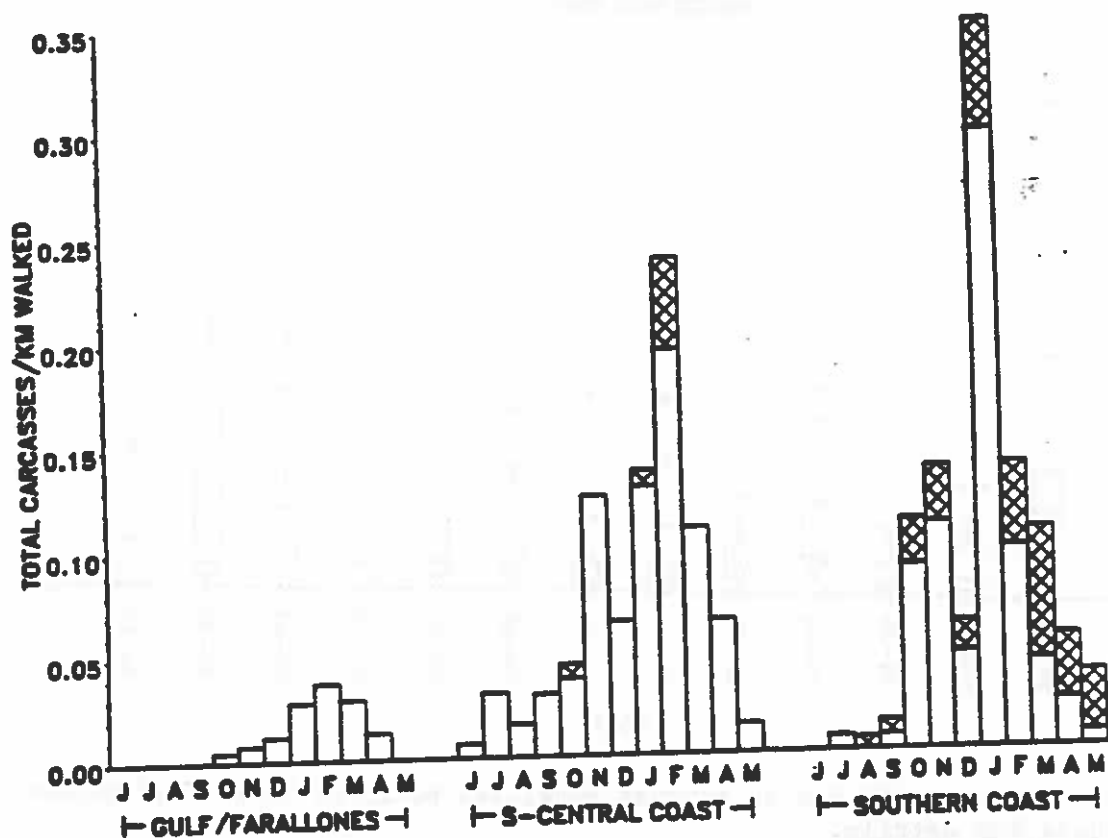


Fig. 14. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

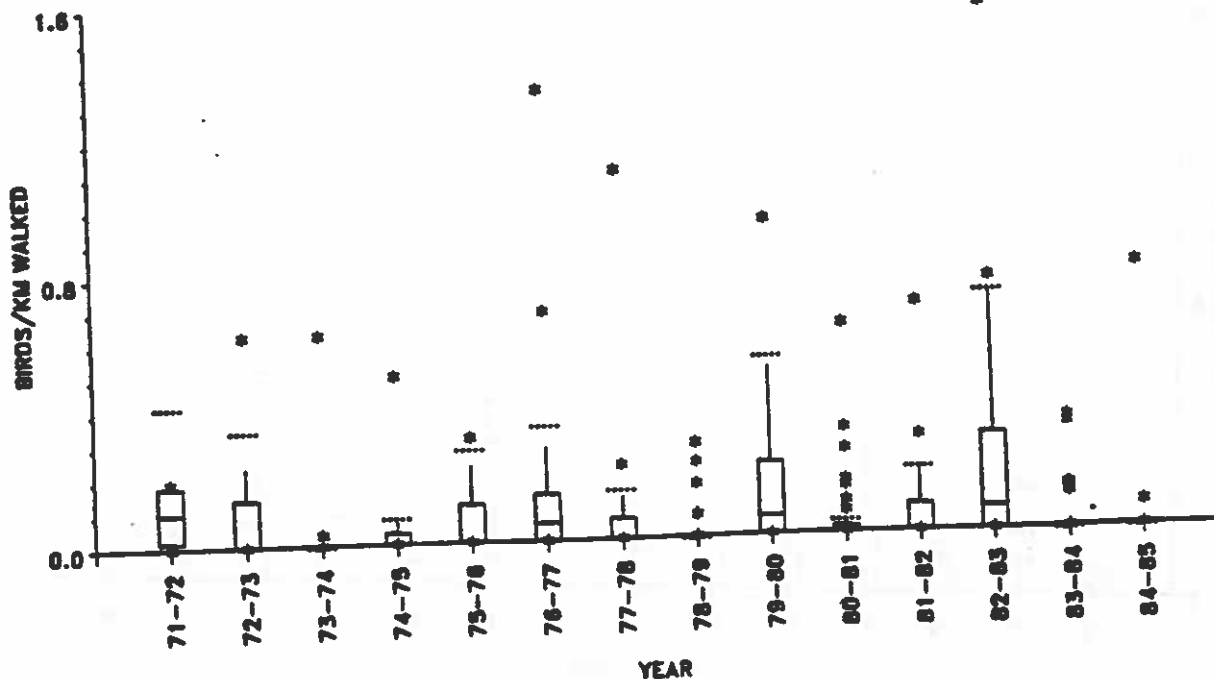
EARED AND HORNED GREBES
WINTER DATA ONLY

Fig. 15. Annual variation in carcass densities north of Point Conception. See methods for details.

beaches with complete coverage.

Small grebes comprised Pied-billed, Horned, and Eared grebes. Only nine Pied-billed Grebes were found, all between the Gulf of the Farallones and Santa Barbara Channel (Table 4). Almost three quarters of the identified small grebes were Eareds; they were the most common small grebe from Monterey Bay south (Table 4). About one quarter of the identified small grebes were Horneds; they were the most common small grebe in Northern California but were only slightly more common in the Gulf of the Farallones than the Eared Grebe (Table 4). Only Eared and Horned grebes are included in the small grebe graphs.

Since Horned and Eared grebes can be difficult to distinguish, particularly if the head is missing or damaged, we combined these species for seasonal and annual analyses. Using only full years of data, Eared and Horned grebes occurred from October through April in the Gulf of the Farallones, primarily from November through April on the south-central coast, and primarily from October through March on the southern coast (Fig. 14). A depression in density in December, apparent both on the south-central coast and on the southern coast, is suggestive of the passage of two groups of birds (possibly the two species) through those regions.

Annual variability in small grebe densities on beaches with complete coverage was apparent in winter and spring. Densities in the winters of 1971-72, 1976-77, 1979-80, and 1982-83 appeared higher and in 1978-79, 1983-84, 1984-85 lower than other years (Fig. 15). In spring, only 1977 densities were notably high; in all other years except 1980 these grebes were absent from at least 75% of the beaches

with complete coverage (Fig. 16).

Procellariiforms

Large tubenoses comprised albatrosses, Northern Fulmar, Mottled Petrel, and shearwaters. Fulmars and Sooty Shearwater made up 98% of the identified large tubenoses. Fulmars were more common than Sooty Shearwaters in Northern California, Gulf of the Farallones, and Estero Bay; Sooty Shearwaters more common than fulmars south of Point Conception; and the two species were about equally common in Monterey Bay (Table 4).

Northern Fulmars occurred on beaches primarily from November to March in the Gulf and on the south-central coast, and in November, December, and from February to July on the southern coast (Fig. 17). The occurrence period on southern coast beaches likely reflect a lesser degree of residence of this species in that region than in the others. As with the loon pattern, we believe the summer peak in June and July on the southern coast is a consequence of higher mortality rates among weak individuals, which remained behind after the exodus north. The large majority of these summer-occurring fulmars had exceedingly abraded and faded plumage, giving the impression to the uneducated eye that they were light color morphs. Densities in the winters of 1971-72, 1975-76, 1976-77, and 1983-84 appeared notably higher and in 1978-79 and 1982-83 lower than in other years (Fig. 18). The extreme March peak in the Gulf and south-central coast regions (Fig. 17) was an artifact of a spectacular die-off of this species during 1976 (Fig. 19, Harrington-Tweit 1979). Other years in which spring densities were

EARED AND HORNED GREBES SPRING DATA ONLY

55

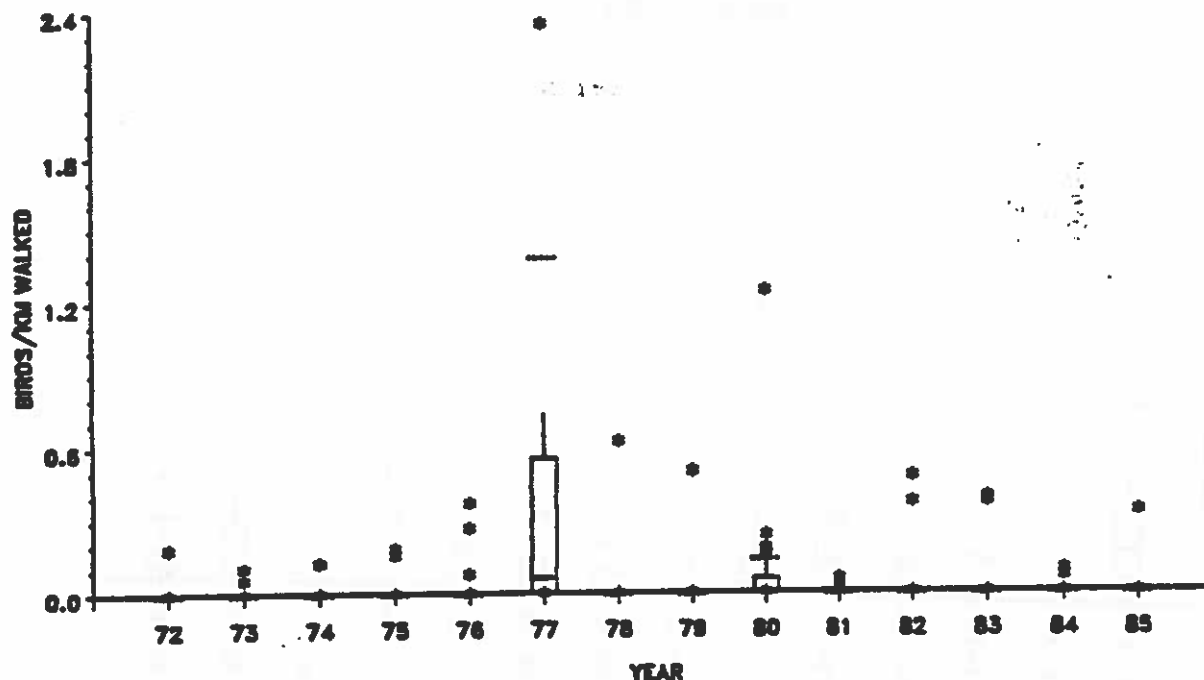


Fig. 16. Annual variation in carcass densities north of Point Conception. See methods for details.

NORTHERN FULMAR

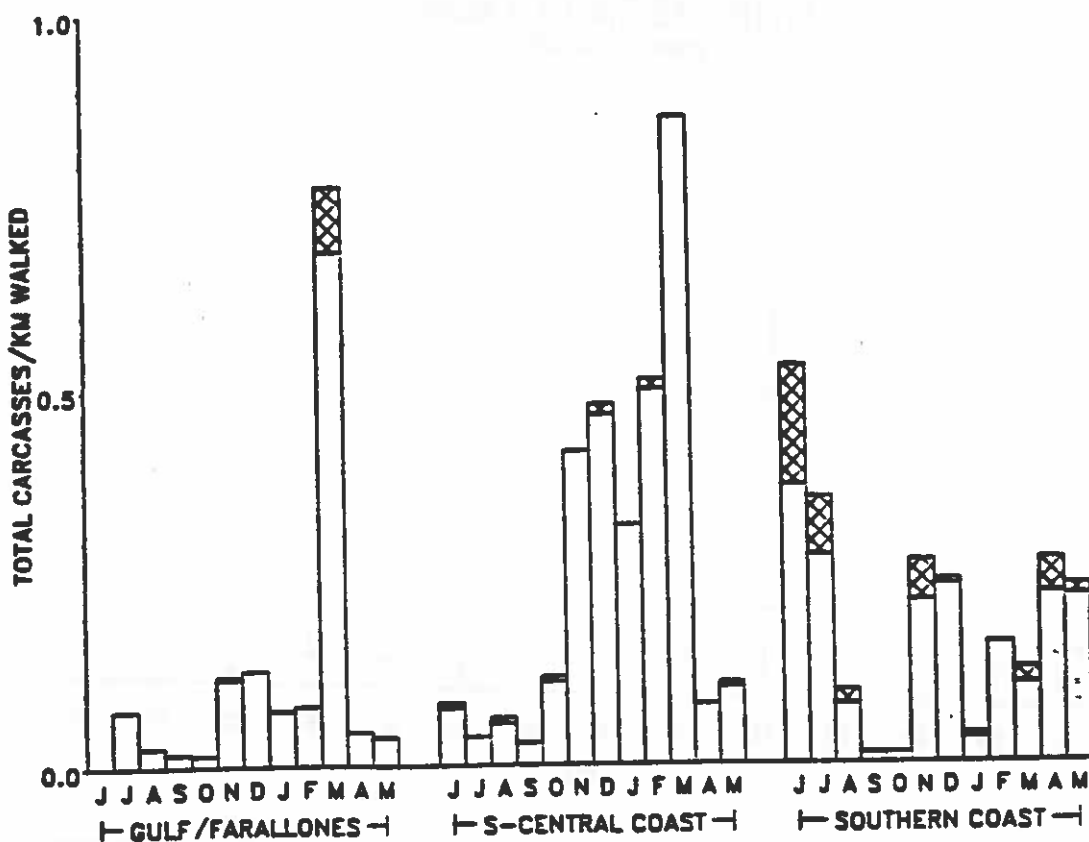


Fig. 17. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

NORTHERN FULMAR

WINTER DATA ONLY

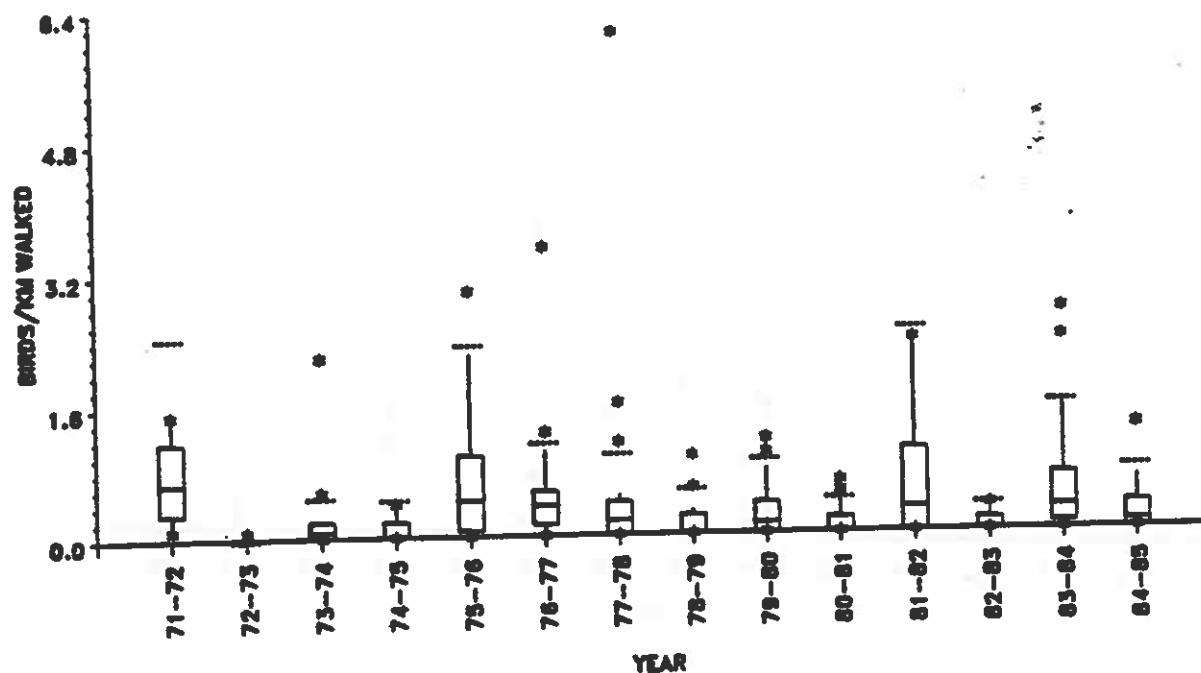


Fig. 18. Annual variation in carcass densities north of Point Conception. See methods for details.

NORTHERN FULMAR

SPRING DATA ONLY

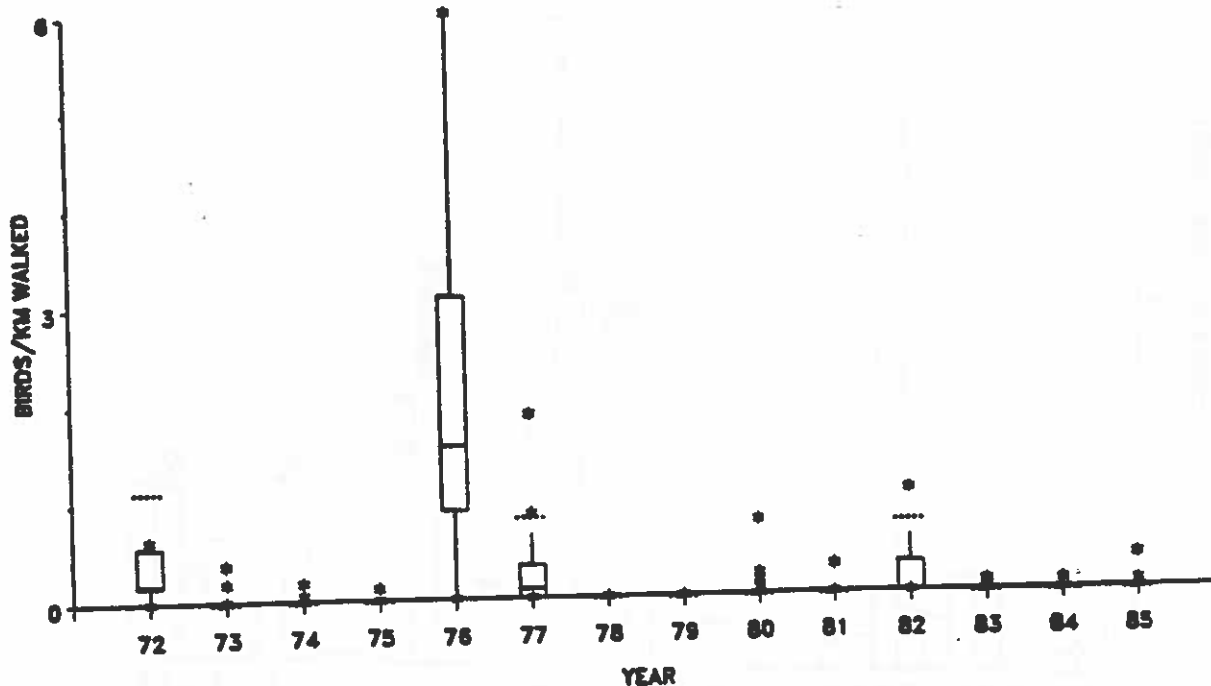


Fig. 19. Annual variation in carcass densities north of Point Conception. See methods for details.

particularly high were 1972, 1977, and 1982 (Fig. 19).

Sooty Shearwaters are most common on California beaches from May through September (Fig. 20). It was surprising that Sooty Shearwater densities on the southern coast were about as high as those on the south-central coast (Fig. 20) since Briggs et al. (1983a) note that the species is especially attracted to waters of the latter areas. The seemingly large peak on the southern coast, when gauged against what is known of this species occurrence, suggests either greater mortality or an at-sea distribution that is closer to shore in the south. The later spring arrival of this species in the Gulf compared to the other two areas (Fig. 20) is consistent with known occurrence patterns of live individuals. During fall, densities were higher in 1972, 1973, 1975 and, to a lesser degree, in 1981, 1982, and 1984 than in other years (Fig. 21).

Other shearwaters, albatross, and large petrels breed primarily in the south, central and west Pacific. Their sporadic occurrences on beaches during this study are consistent with their low frequency of occurrence off the California coast. Between April and September, 28 Black-footed Albatross were found from Northern California to Monterey Bay (Table 4). Two Laysan Albatross were found on Centerville Beach in September 1979 and on South Mad River Beach in May 1983 (Table 4). A Mottled Petrel was found on Cambria Beach in March 1976 (Table 4); this species occurs in California offshore waters during March and April on its migration northward (Ainley and Manolis 1979). Pink-footed Shearwaters were found from the Gulf of the Farallones south between March and November (Table 4) consistent with known occurrence (Ainley

SOOTY SHEARWATER

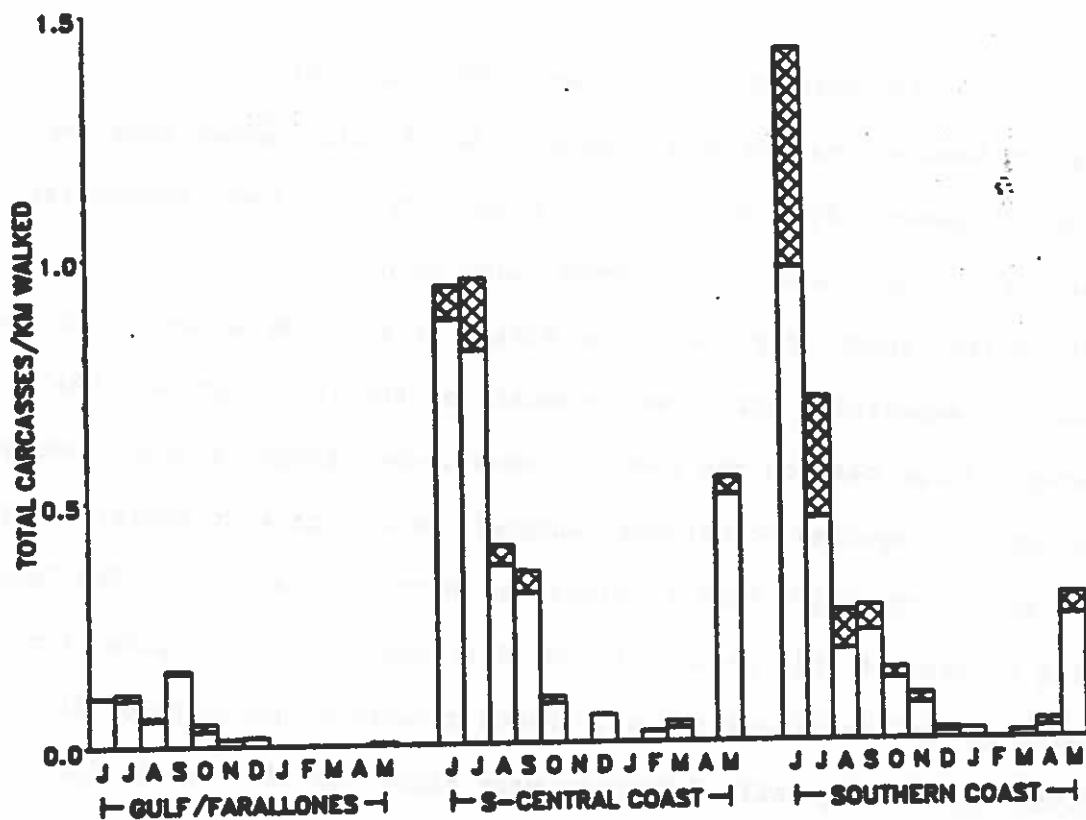


Fig. 20. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

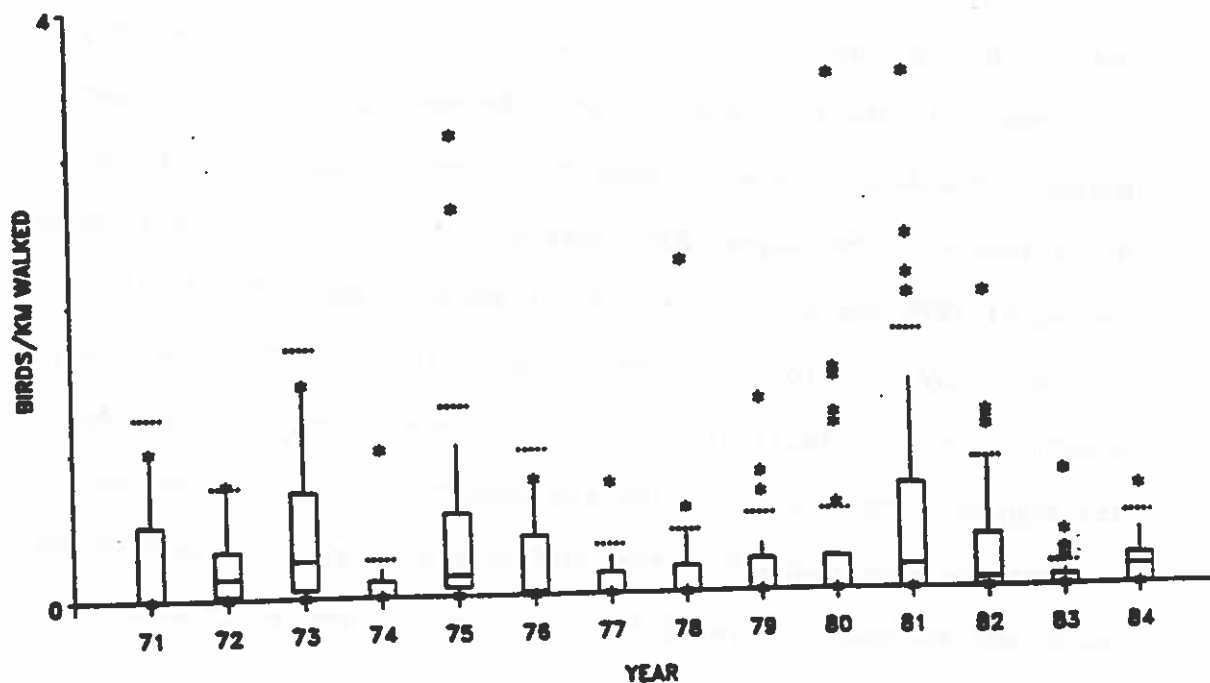
SOOTY SHEARWATER
FALL DATA ONLY

Fig. 21. Annual variation in carcass densities north of Point Conception. See methods for details.

1976, Briggs et al. 1983a). Buller's Shearwaters were found on Marina and Del Monte beaches in February, September, and October 1976, on Thornton Beach in August 1976, and on Clam Beach in October 1977 (Table 4); only the February record is outside of the fall period when the species usually occurs. Twenty-three Short-tailed Shearwaters were found in May, July, and September and between November and February north of Point Conception; the May to September records fall outside of the usual winter occurrence periods. Black-vented (Manx) Shearwaters were found in June, July, September, October, and December from the Gulf of the Farallones south.

Four species of storm-petrel were found on the surveys. Although none were very common, on several instances from two to six individuals were found on single surveys (Table 4). Fork-tailed Storm-Petrels were found from Monterey Bay north throughout the year (Table 4). Leach's Storm-Petrels were found in all regions except Santa Barbara Channel, between June and August and between November and February (Table 4). Ashy Storm-Petrels were found from Monterey Bay north from June through October and from February through April and on the southern coast in May and in July (Table 4). Black Storm-Petrels were found at Muir Beach in September 1983, Pajaro Dunes in August, Zmudowski Beach in October 1974, Torrance Beach in September 1975 and 1979 and October 1974, and Border Field Beach in June 1977 (Table 4).

All four storm-petrels breed in California. Their rare occurrence on beach surveys may be explained by their pelagic feeding habits, their small body size (making them more susceptible to scavenging and disintegration), and small population sizes in areas where most surveys

were conducted.

Pelecaniforms

Brown Pelicans occurred in all regions from August to October (Table 4), a period that corresponds to their movement out of Mexico, where they breed during late winter and spring, and to their peak of abundance on beaches in the Gulf of the Parallones (Fig. 22). Data from regions south of Point Conception have been reported previously in Briggs et al. (1981). North of Point Conception, carcasses were most common on the south-central coast (Table 4, Fig. 22), a pattern similar to that reported for live Brown Pelicans at roosts (Briggs et al. 1983b). With decreasing latitude toward breeding regions, the seasonal spread of carcass occurrence became broader as would be expected. Only in 1981 did the fall median density exceed zero, although in 1971, 1972, 1976, 1982, and 1983 Brown Pelicans were found on at least 25% of the beaches with complete coverage (Fig. 23). In winter, only in 1982-83 and 1983-84 were carcasses found on at least 25% of the beaches fully covered (Fig. 24). The 1976 and 1982-1984 ENSO episodes may help to explain the elevated densities that occurred in those periods but not the highest densities in fall 1981.

Cormorants comprised three species; over half of those identified were Brandt's Cormorants. We suspected that some Double-crested Cormorants were misidentified Brandt's Cormorants because the most experienced observers in all regions rarely found Double-cresteds and the breasts of cormorant carcasses remaining on beaches for a long time often faded to the color of immature Double-cresteds. We included

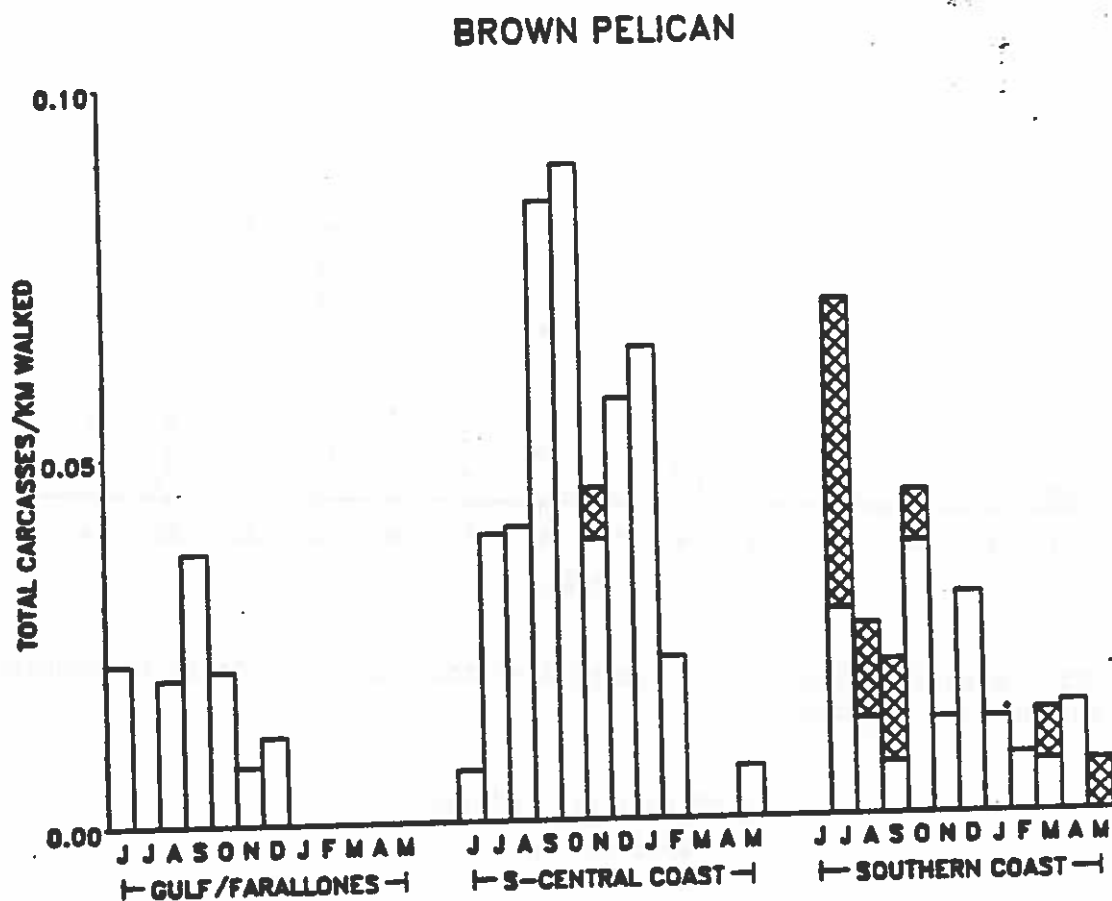


Fig. 22. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

BROWN PELICAN

FALL DATA ONLY

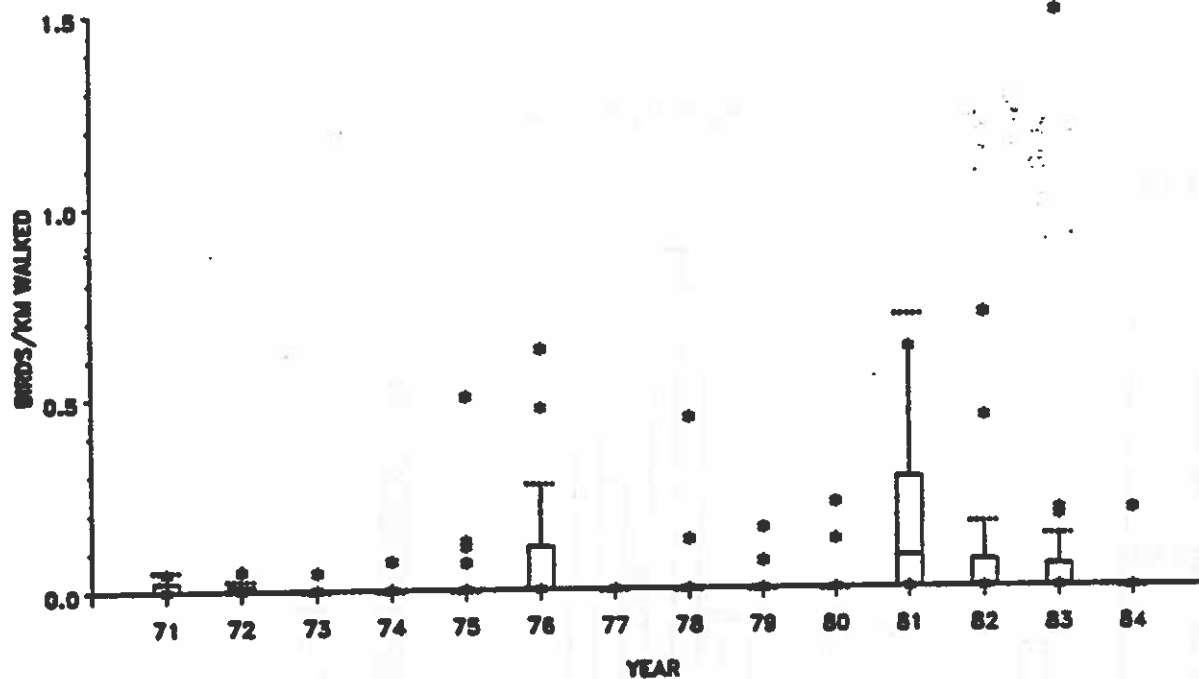


Fig. 23. Annual variation in carcass densities north of Point Conception. See methods for details.

BROWN PELICAN

WINTER DATA ONLY

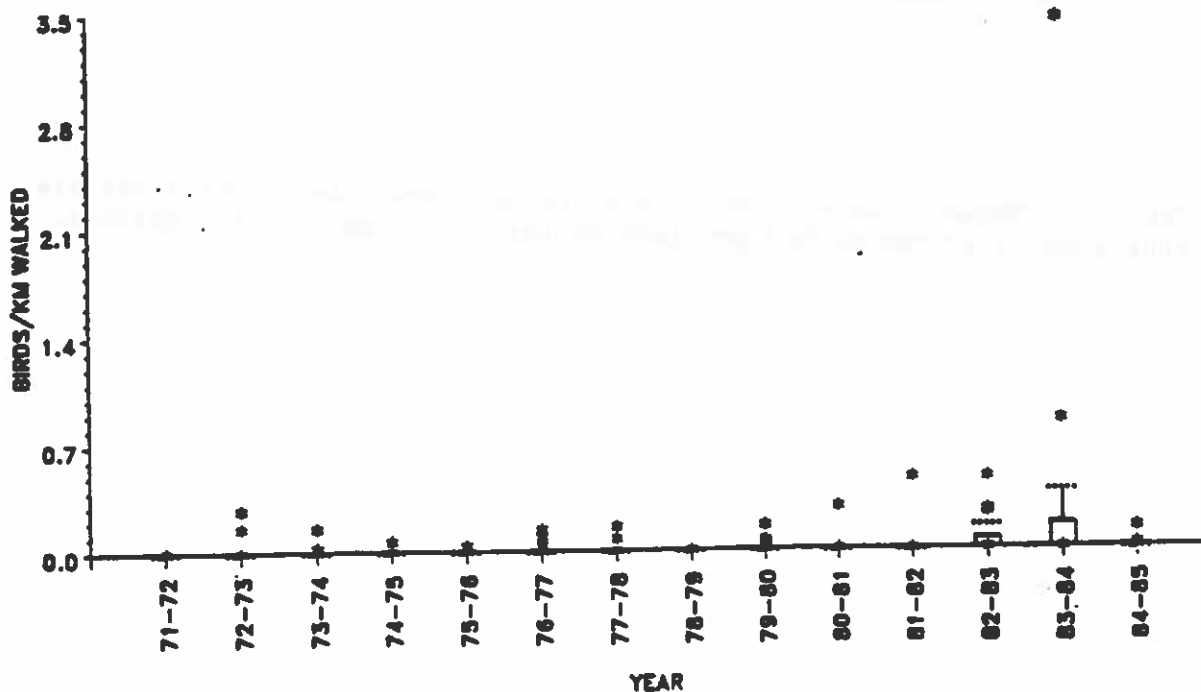


Fig. 24. Annual variation in carcass densities north of Point Conception. See methods for details.

included unidentified cormorants with the Brandt's in analyses. Brandt's Cormorants occurred year round in all regions and Pelagic Cormorants occurred year round north of Point Conception. Both species are common breeders north of Point Conception and on the Santa Barbara Channel Islands (Sowls, et al. 1980).

The Brandt's and Pelagic cormorants both exhibited fall and spring peaks of occurrence in most regions in which they occurred (Figs. 25, 26). The fall peak for both species in the Gulf and for the Brandt's on the south-central coast occurred in September and October. The fall peak on the south-central coast for the Pelagic was less well defined but appeared to occur from September through November. On the southern coast, where both species were less common than in the other regions, the fall peaks were in September for the Brandt's and in October for the Pelagics; for both species minor peaks occurred in December. The striking fall peak, especially in the Gulf of the Farallones where very large breeding populations occur, was composed mainly of young birds, which fledge from breeding localities in July and August. These individuals apparently failed to reach true independence. Spring peaks for both species occurred in March and April in the Gulf and from March through May on the south-central coast; on the southern coast the spring peak was from February through April for the Brandt's and in February for the Pelagic (Figs. 25, 26). The spring peak may reflect pre-breeding mortality that seemed to occur in some years.

Years of particularly high mortality were reasonably similar for the two species in fall, spring, and, to a lesser degree, in winter. In fall, relatively high densities occurred from 1976 to 1978 and from

BRANDT'S CORMORANT

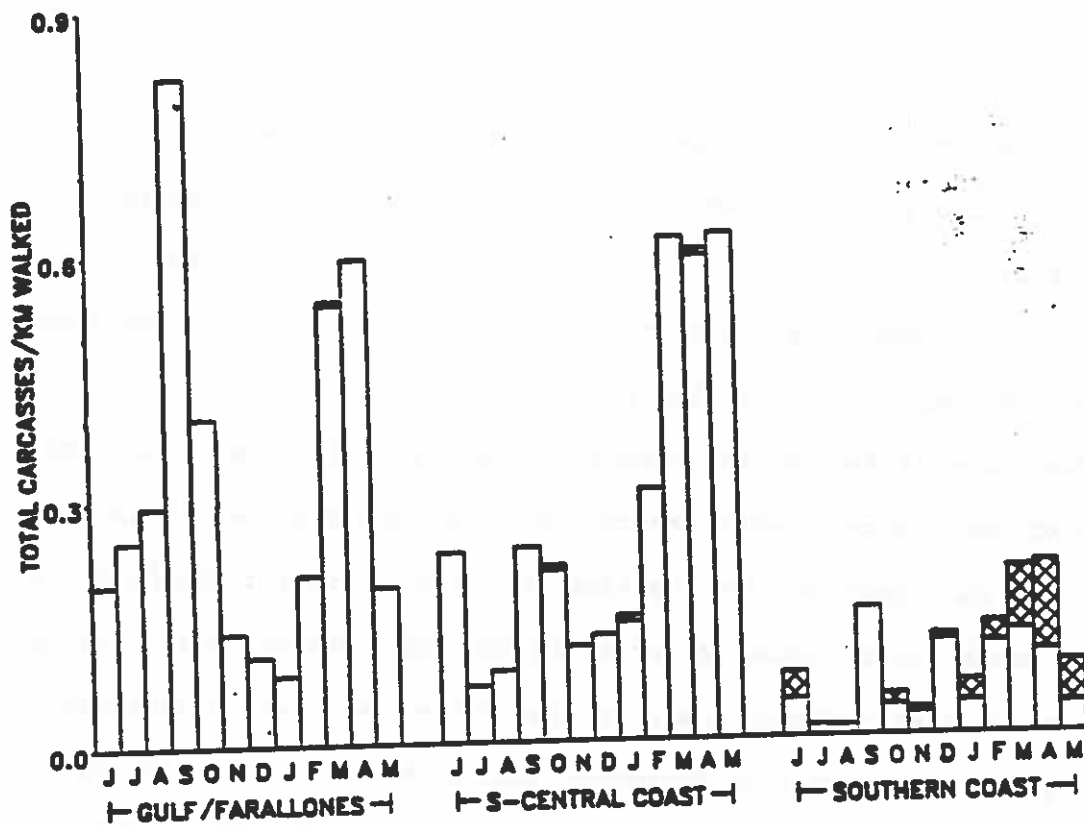


Fig. 25. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

PELAGIC CORMORANT

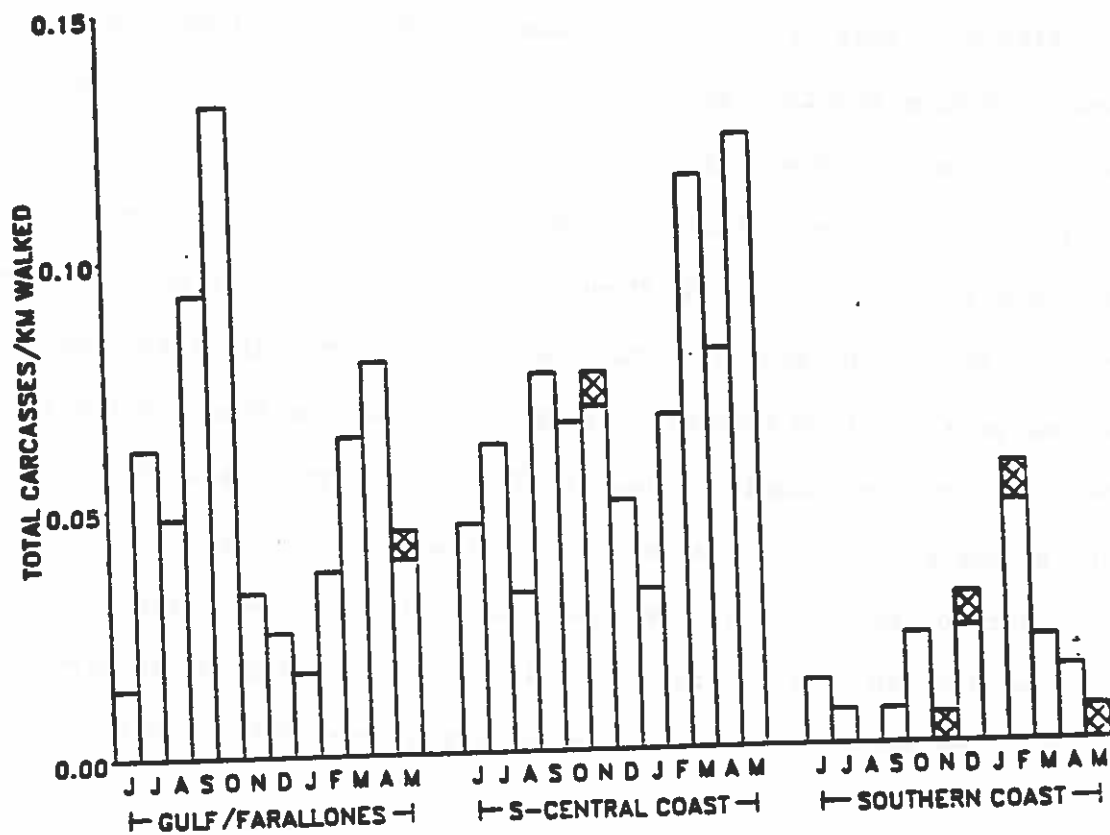


Fig. 26. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

BRANDT'S CORMORANT

FALL DATA ONLY

65

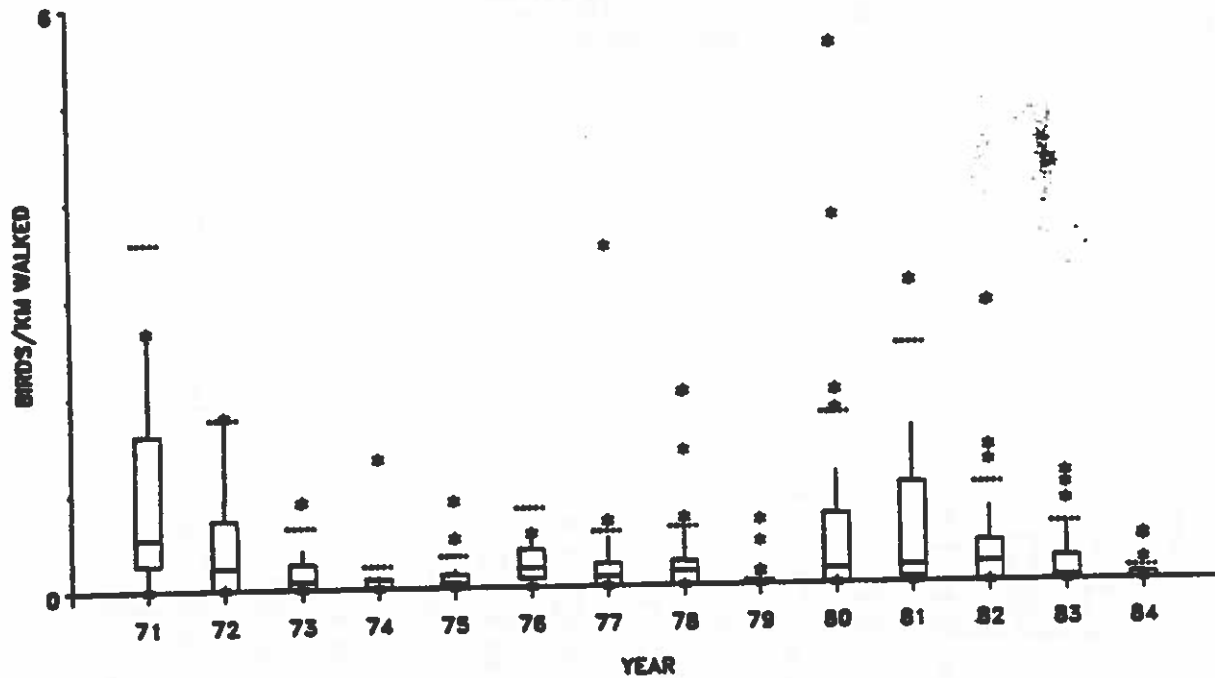


Fig. 27. Annual variation in carcass densities north of Point Conception. See methods for details.

PELAGIC CORMORANT

FALL DATA ONLY

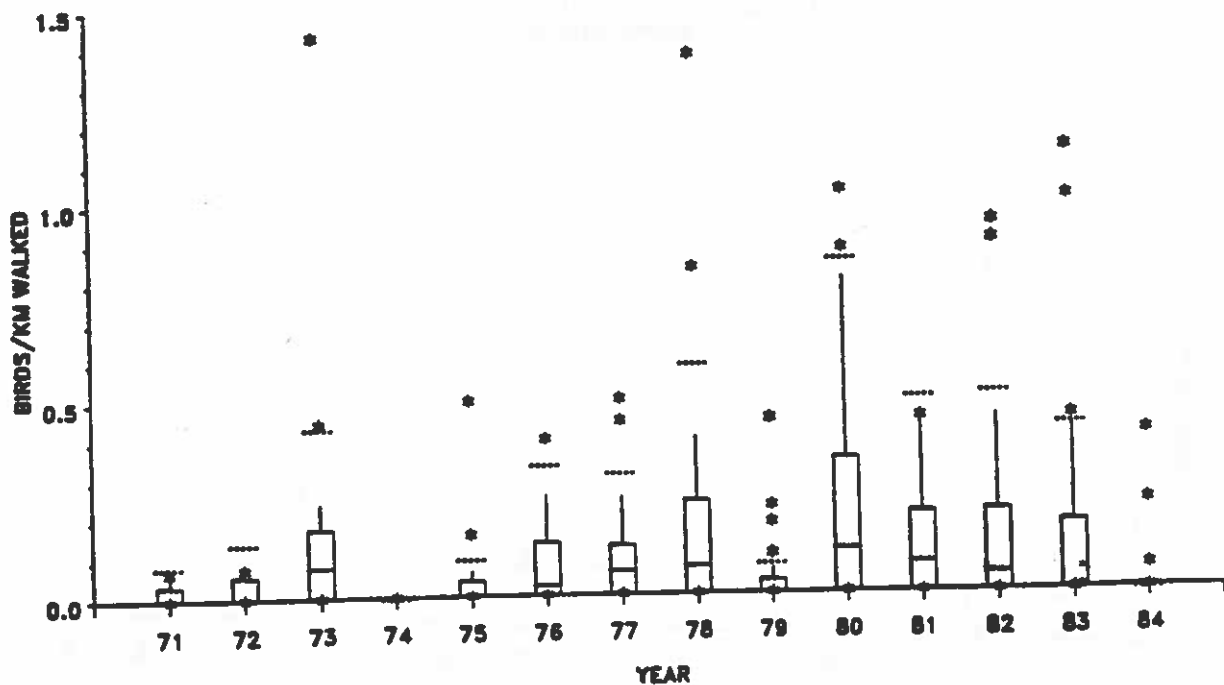


Fig. 28. Annual variation in carcass densities north of Point Conception. See methods for details.

BRANDT'S CORMORANT

WINTER DATA ONLY

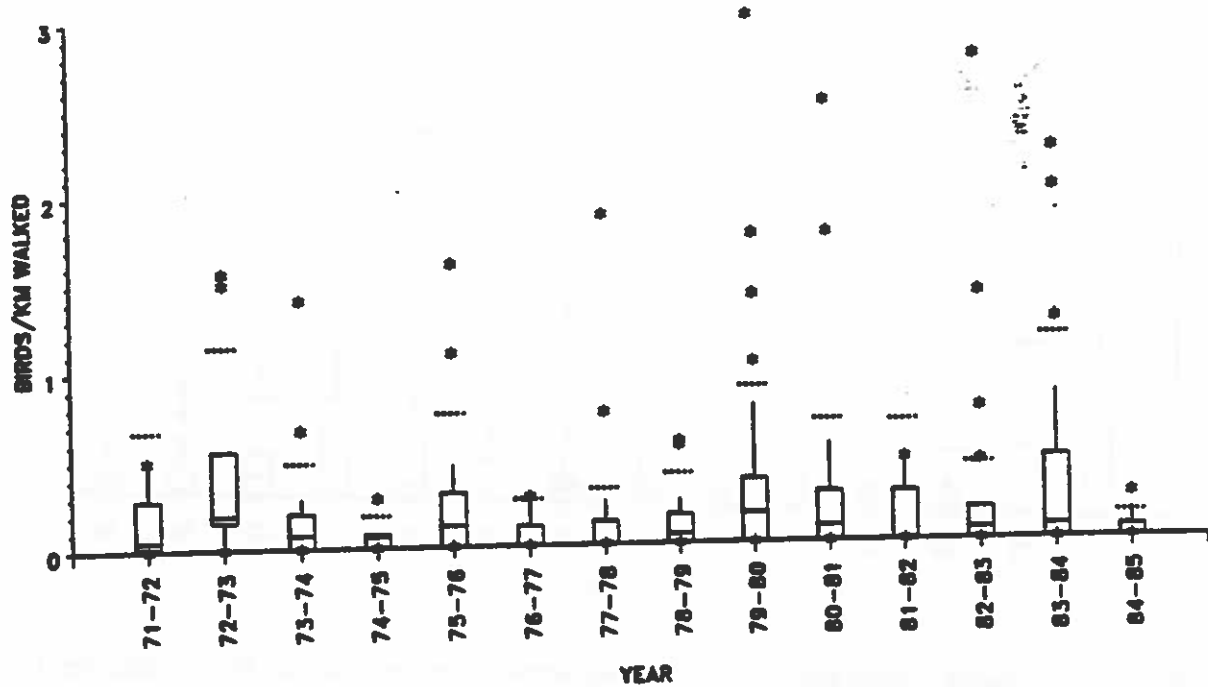


Fig. 29. Annual variation in carcass densities north of Point Conception. See methods for details.

PELAGIC CORMORANT

WINTER DATA ONLY

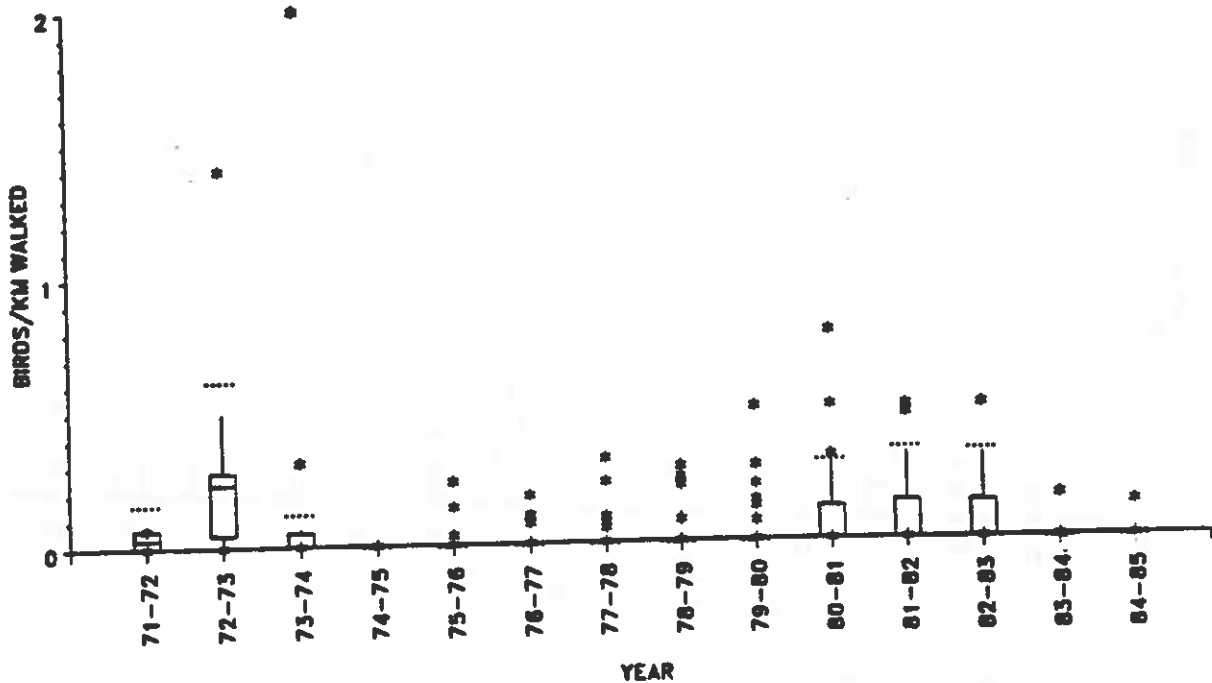


Fig. 30. Annual variation in carcass densities north of Point Conception. See methods for details.

BRANDT'S CORMORANT

SPRING DATA ONLY

67

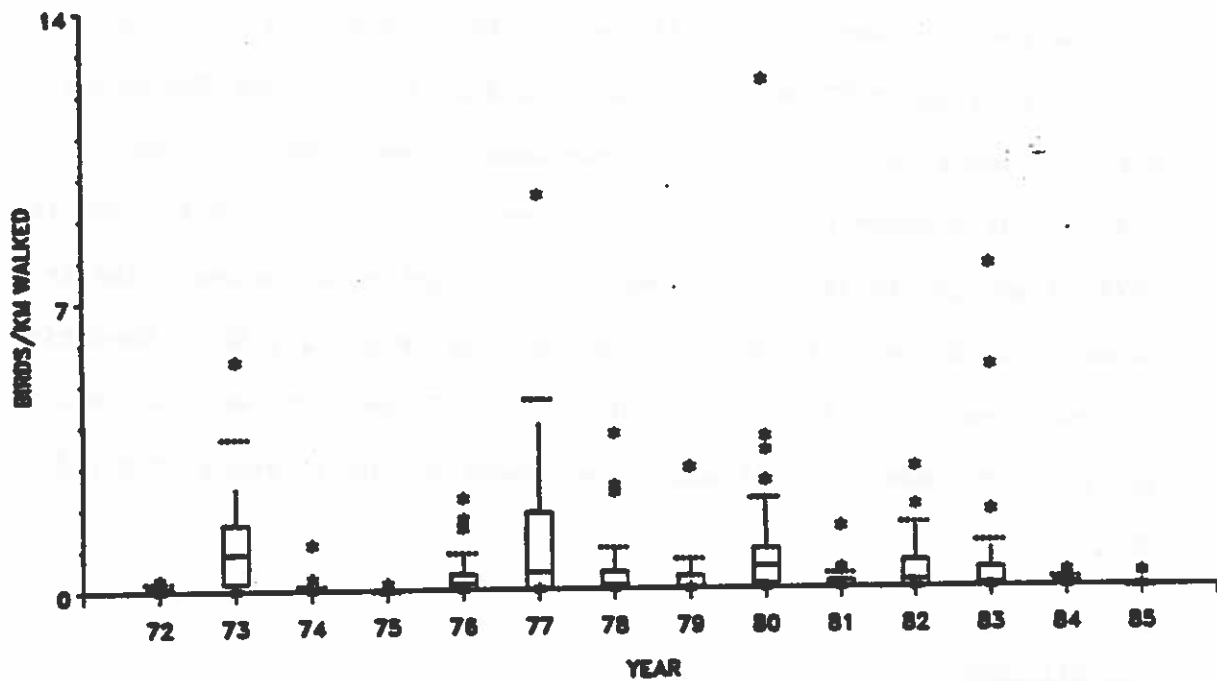


Fig. 31. Annual variation in carcass densities north of Point Conception. See methods for details.

PELAGIC CORMORANT

SPRING DATA ONLY

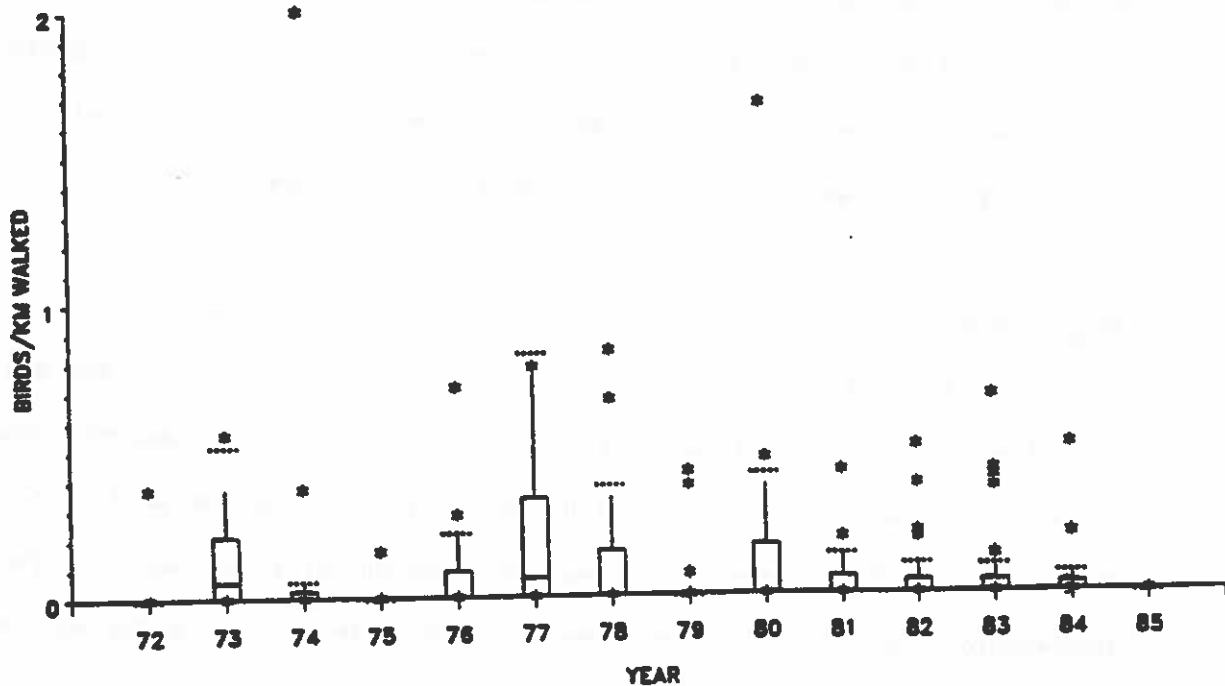


Fig. 32. Annual variation in carcass densities north of Point Conception. See methods for details.

1980 to 1983 for both species (Figs. 27, 28). Densities were high in fall of 1971 and 1972 for the Brandt's and in 1973 for the Pelagics, but low sample sizes before 1975 may have played a role in these differences between the species. In winter, densities were highest in 1972-73 and low in 1984-85 for both species but relative densities in other years differed between the two species (Figs. 29, 30). Densities for both species in the springs of 1973, 1977, and 1980 were highest and of 1979, 1984 and 1985 among the lowest of the 14 years (Figs. 31, 32).

Ciconiiforms

Four species of herons and egrets occurred uncommonly on surveys (Table 4). Their rarity on surveys is due to their preference for estuarine habitat over outer coast beaches. Eleven Great Blue Herons were found throughout the year between Northern California and Santa Barbara Channel and nine Black-crowned Night Herons were found in January, February, May, August, and December north of Point Conception (Table 4). Only a single Snowy Egret in Monterey Bay and a single Cattle Egret in Southern California were found (Table 4).

Anseriforms

Three species of scoters occurred on the surveys but only two were relatively common. Surf Scoters made up over half of the scoters found in Northern California, over two-thirds of those from the Gulf of the Farallones to Estero Bay, and about nine-tenths of those south of Point Conception (Table 4). White-winged Scoters made up just under half of

the scoters found in Northern California, about 30% of those found from the Gulf of the Farallones to Estero Bay, and less than 10% of those found south of Point Conception (Table 4). This is consistent with the trend for live White-winged Scoters, whose numbers decrease from north to south along the coast. Black Scoters were much less common than the other two species, occurring from October through May, mostly north of Point Conception (Table 4).

Seasonal patterns of occurrence for the scoters from full years of data generally reflected the occurrence periods of live birds. In all regions that either species was relatively abundant, carcasses were found primarily from November through May (Figs. 33, 34). Pulses in Surf Scoter carcass density occurred in November, January, and April in the Gulf of the Farallones. Surf Scoter carcass density built gradually from November to April, with a possible drop in February, on the south-central coast. On the southern coast, where Surf Scoter densities were lowest, densities built up gradually between November and March and pulsed in May (Fig. 33). White-winged Scoter densities pulsed in December in both the Gulf of the Farallones and on the south-central coast; densities peaked in March in the Gulf but declined slowly from February through May on the south-central coast (Fig. 34). On the southern coast, where White-winged Scoters numbers are low, they only occurred at low densities on beaches with complete coverage from January to March (Fig. 34).

Judging from seasonal patterns of carcass occurrence, relatively few Surf or White-winged scoters winter south of the south-central coast (Figs. 33, 34). Bimodal peaks for Surf Scoters in the two

SURF SCOTER

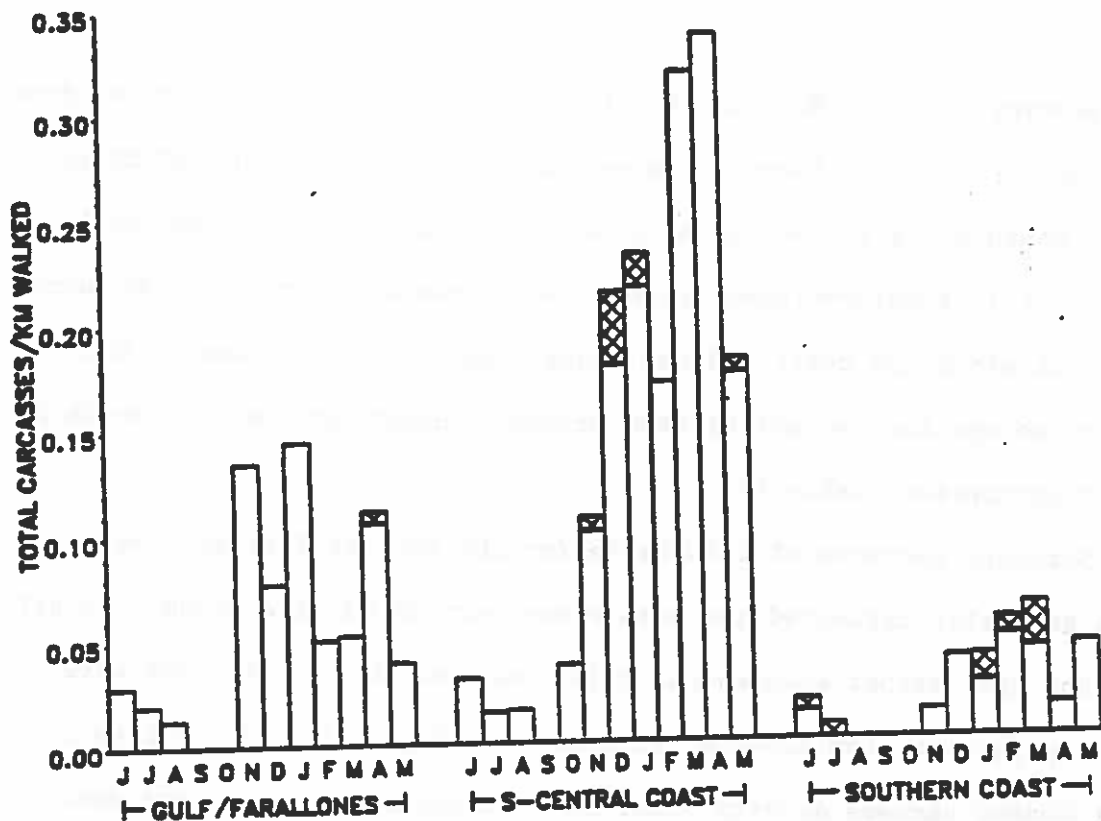


Fig. 33. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

WHITE-WINGED SCOTER

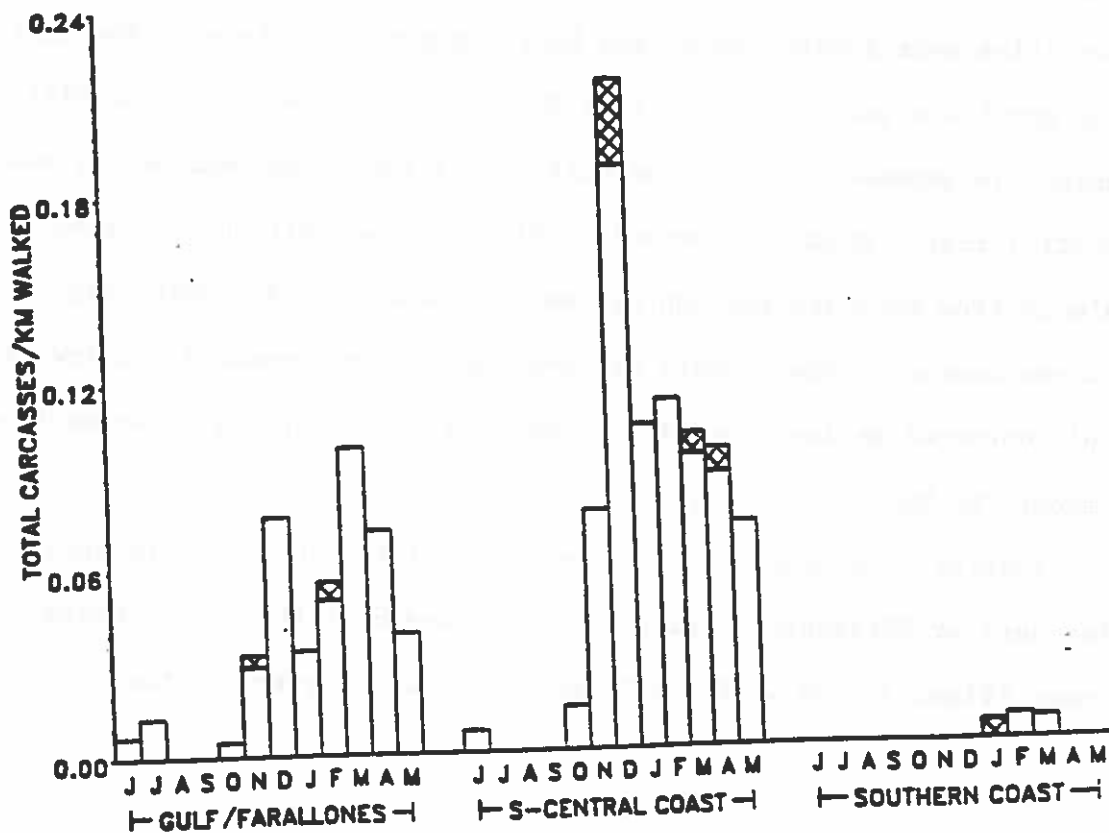


Fig. 34. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

northern regions correspond with known periods of migration; those of the southern region appear to be delayed. The lack of a bimodal peak for White-winged Scoter in the south-central region is not readily explainable.

Annual variation in scoter densities in winter and spring differed somewhat for the two species. Surf Scoter winter densities were highest in 1973-74, 1971-72, and 1977-78 (Fig. 35). White-winged Scoter winter densities were highest in 1978-79, 1980-81, and 1971-72 (Fig. 36). Lowest winter densities after 1974-75 occurred in 1975-76 and 1976-77 for both species and in 1977-78 for the White-winged Scoter (Figs. 35, 36). Surf Scoter spring densities were highest in 1978, 1977, and 1982 and lowest in 1976, 1981, and 1985 (Fig. 37). White-winged Scoter spring densities were highest in 1980, 1981, and 1978 and lowest in 1976, 1977, 1979, and 1985 (Fig. 38).

Other waterfowl comprised a Tundra Swan, two species of geese, and 16 species of duck (Table 4). Of these, only Northern Pintail, Northern Shoveler, and Ruddy Duck attained densities as high as 0.01 birds/km walked on outer coast beaches (Table 4). The seasonal occurrence of these species on the surveys roughly corresponded to the known period of their use of the California coast as a wintering area. The Tundra Swan and White-fronted Goose were both found in January, the Brant from November through April (Table 4). Mallards are the commonest coastal breeding duck, and they occurred from August through May on the surveys (Table 4). Other dabbling ducks, with the exception of a pintail in May and a Gadwall in June, occurred from August through March (Table 4). Diving ducks, with the exception of a Greater Scaup

SURF SCOTER WINTER DATA ONLY

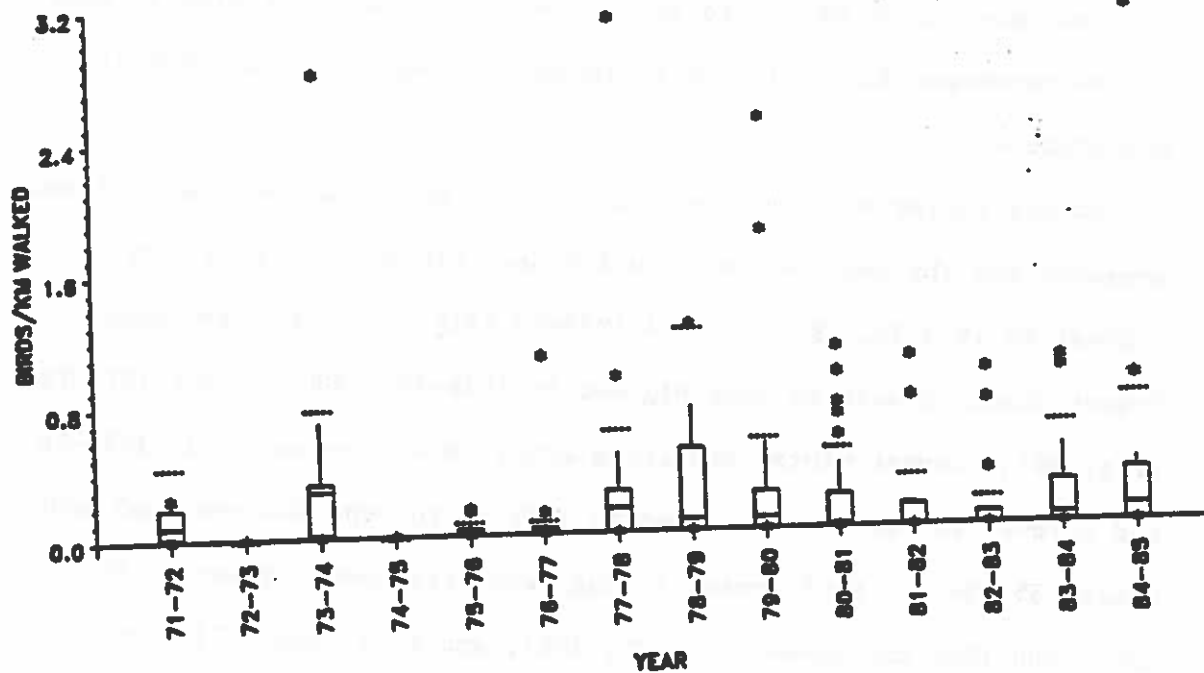


Fig. 35. Annual variation in carcass densities north of Point Conception. See methods for details.

WHITE-WINGED SCOTER WINTER DATA ONLY

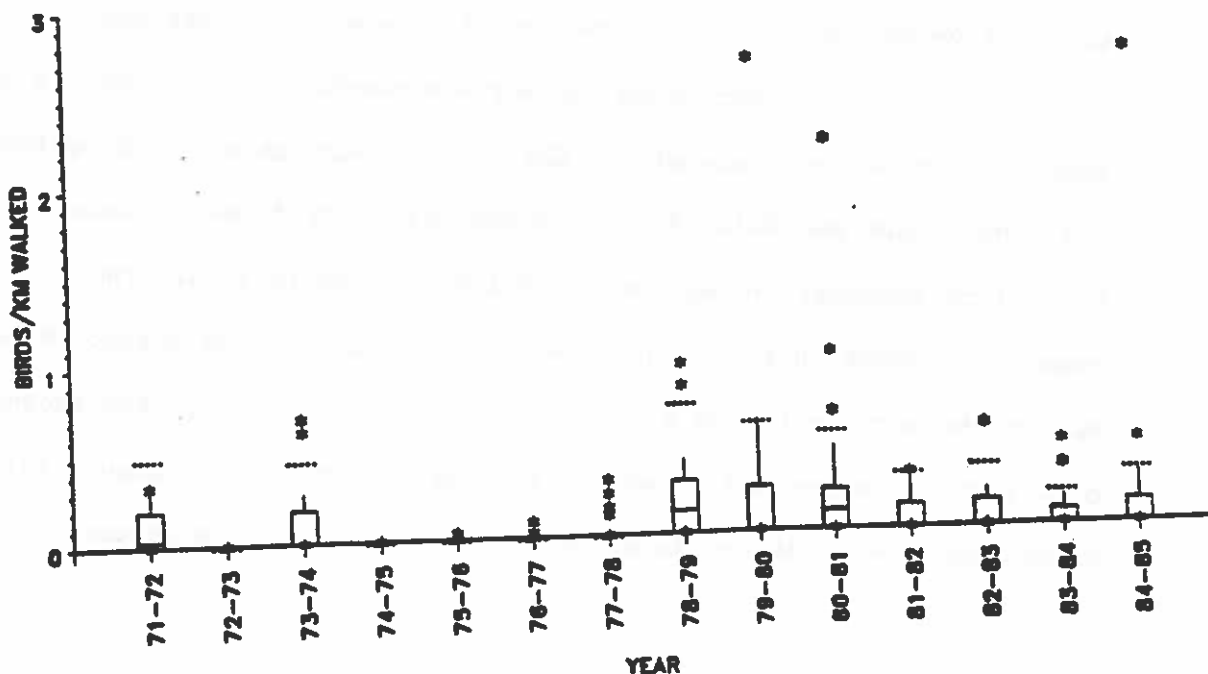


Fig. 36. Annual variation in carcass densities north of Point Conception. See methods for details.

SURF SCOTER SPRING DATA ONLY

73

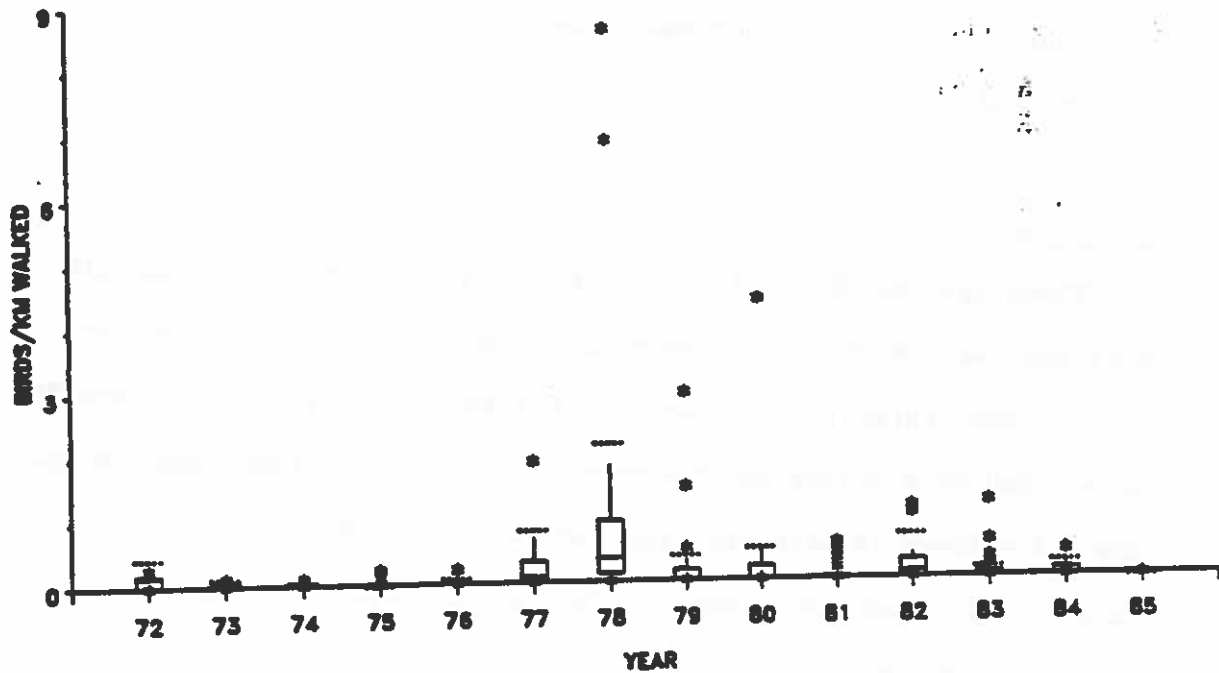


Fig. 37. Annual variation in carcass densities north of Point Conception. See methods for details.

WHITE-WINGED SCOTER SPRING DATA ONLY

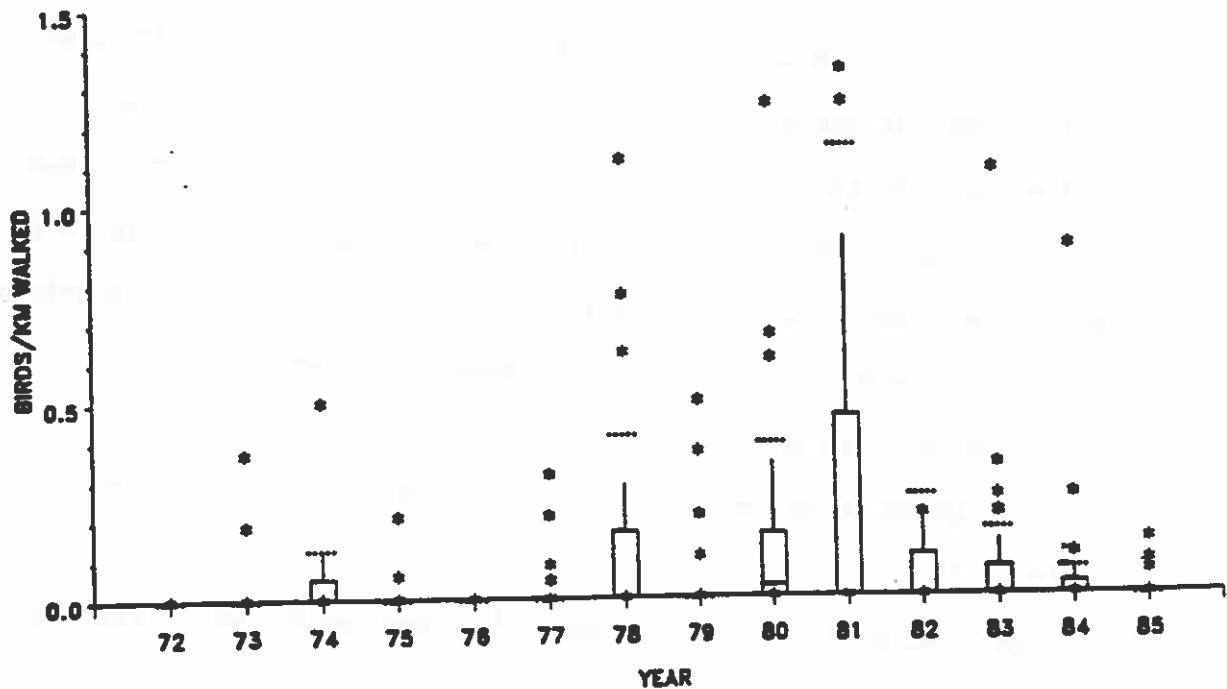


Fig. 38. Annual variation in carcass densities north of Point Conception. See methods for details.

in August and a Red-breasted Merganser in July, occurred between October and May (Table 4).

Gruiforms

Three species of rails and coots were found. Only one Virginia Rail and two Common Moorhen were found, but American Coot were more common, particularly in the Gulf of the Farallones (Table 4) where 36 were found on a Dillon Beach survey. On the coast, these species are typically found in estuaries and marshes, although coots are occasionally found near shore on the ocean; consequently they occurred rarely on beached bird censuses.

Charadriiforms (Charadriidae, Haematopodidae, Scolopacidae)

The two pelagic species of phalaropes were the commonest shorebirds found on the surveys although neither species was encountered very often.

Overall, Red-necked Phalaropes were more or less equally common in all regions of the coast and were less common than Reds (Table 4). Using only the full years of data, Red-necked Phalaropes were found over a period primarily from July to December and in May (Fig. 39). Red-necked Phalaropes occurred infrequently on surveys and in only 9 of the 14 fall seasons on beaches with complete coverage (Fig. 40). Spring occurrence was even sparser than in winter; however, in 1976 they occurred on at least 25% of the beaches with complete coverage (Fig. 41).

Red Phalaropes were most common in Monterey Bay where they were

RED-NECKED PHALAROPE

75

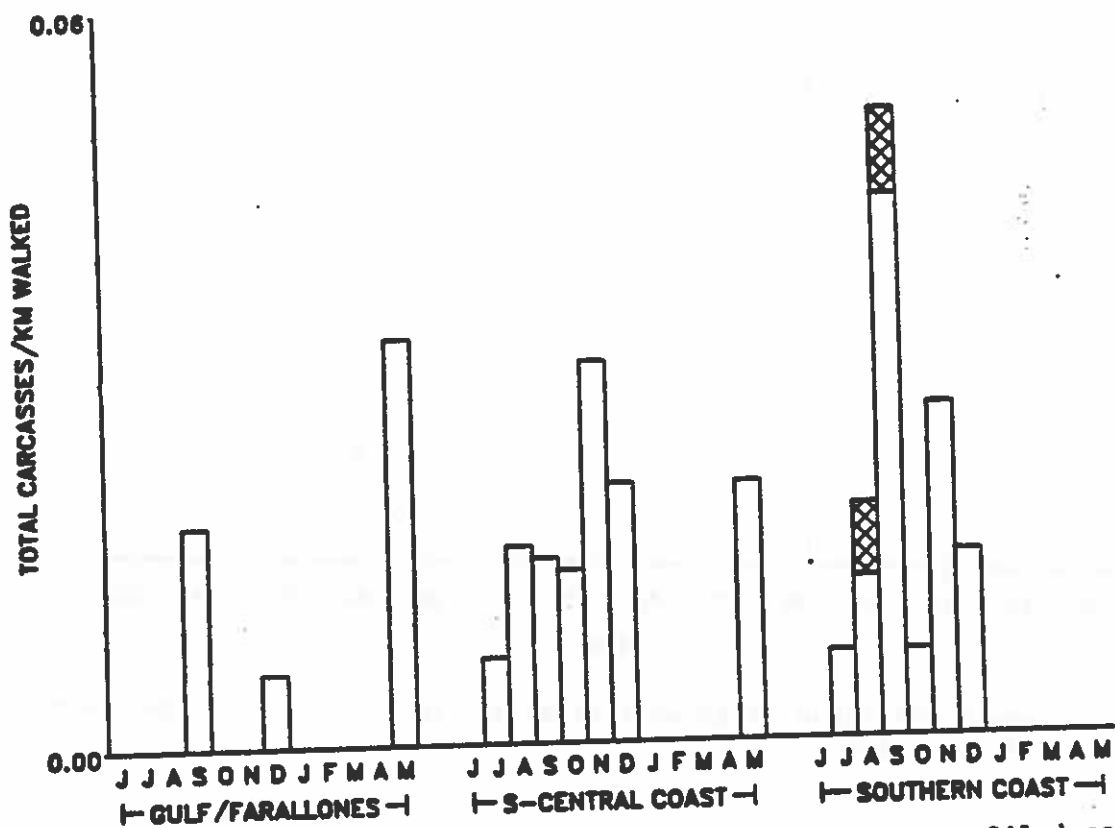


Fig. 39. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

RED-NECKED PHALAROPE FALL DATA ONLY

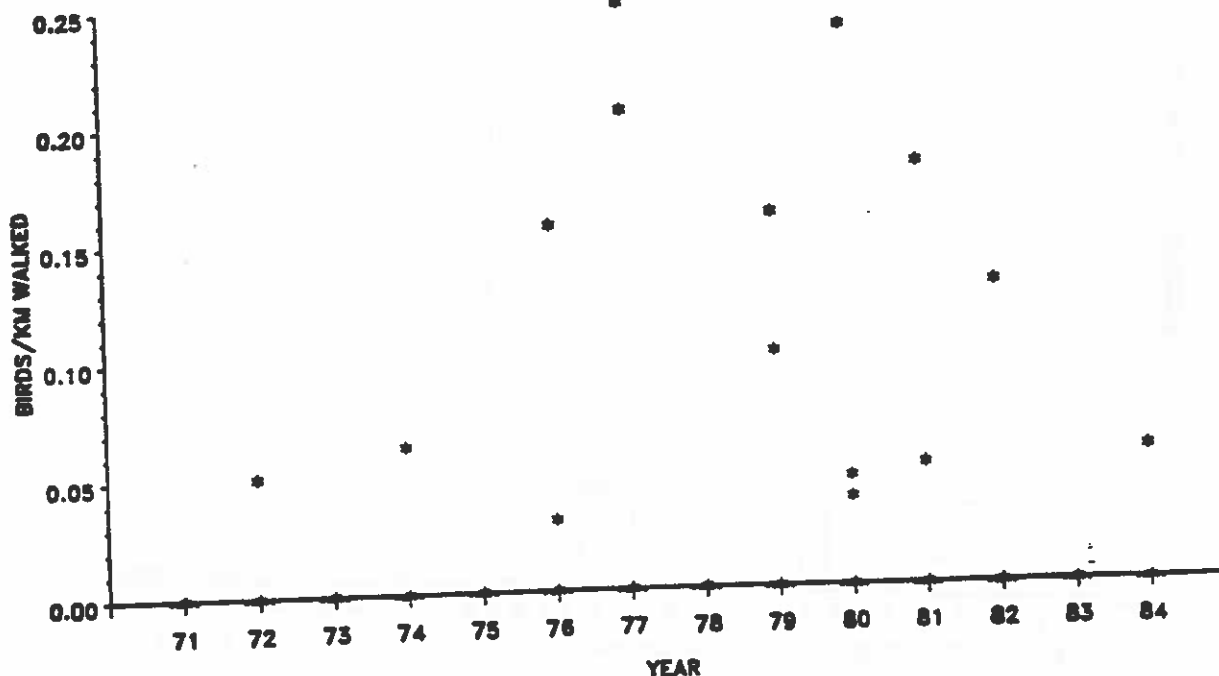


Fig. 40. Annual variation in carcass densities north of Point Conception. See methods for details.

RED-NECKED PHALAROPE

SPRING DATA ONLY

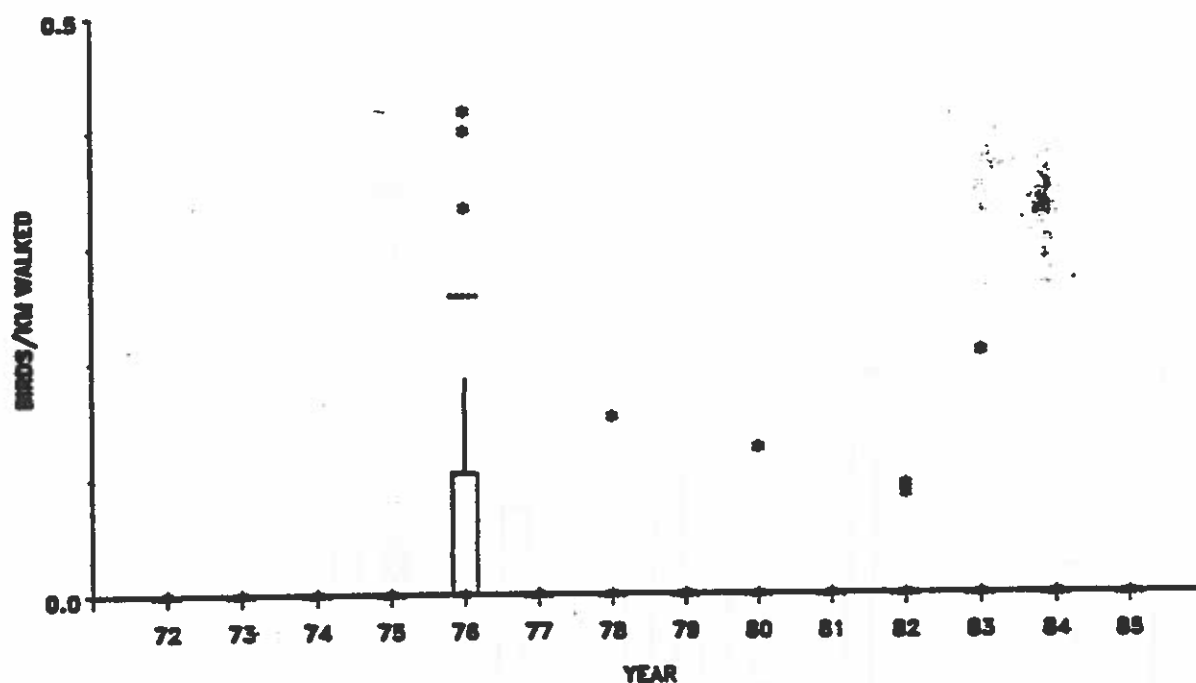


Fig. 41. Annual variation in carcass densities north of Point Conception. See methods for details.

RED PHALAROPE

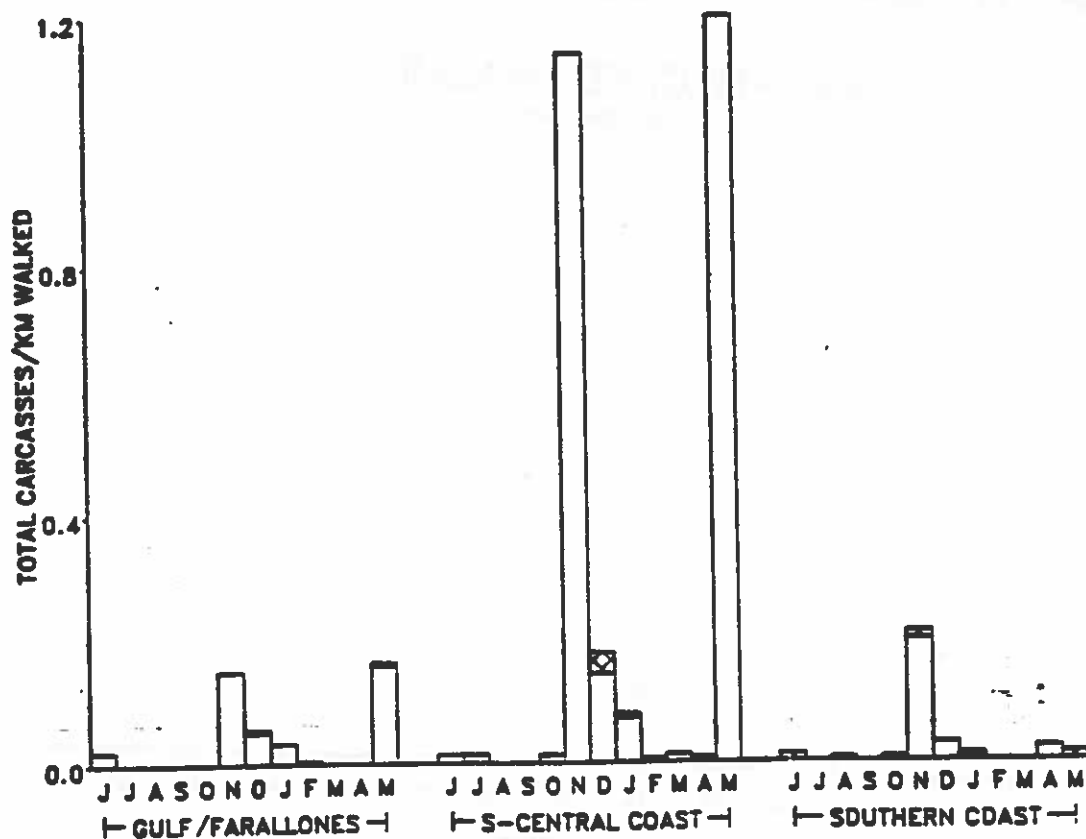


Fig. 42. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

RED PHALAROPE

WINTER DATA ONLY

77

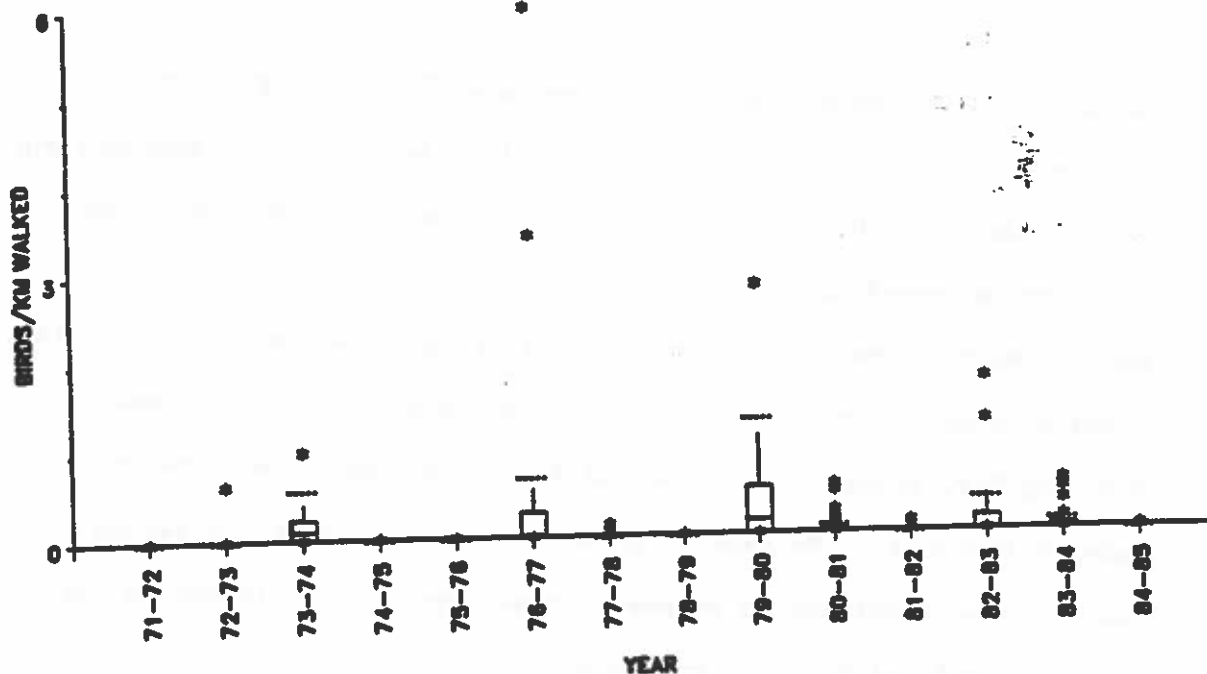


Fig. 43. Annual variation in carcass densities north of Point Conception. See methods for details.

RED PHALAROPE

SPRING DATA ONLY

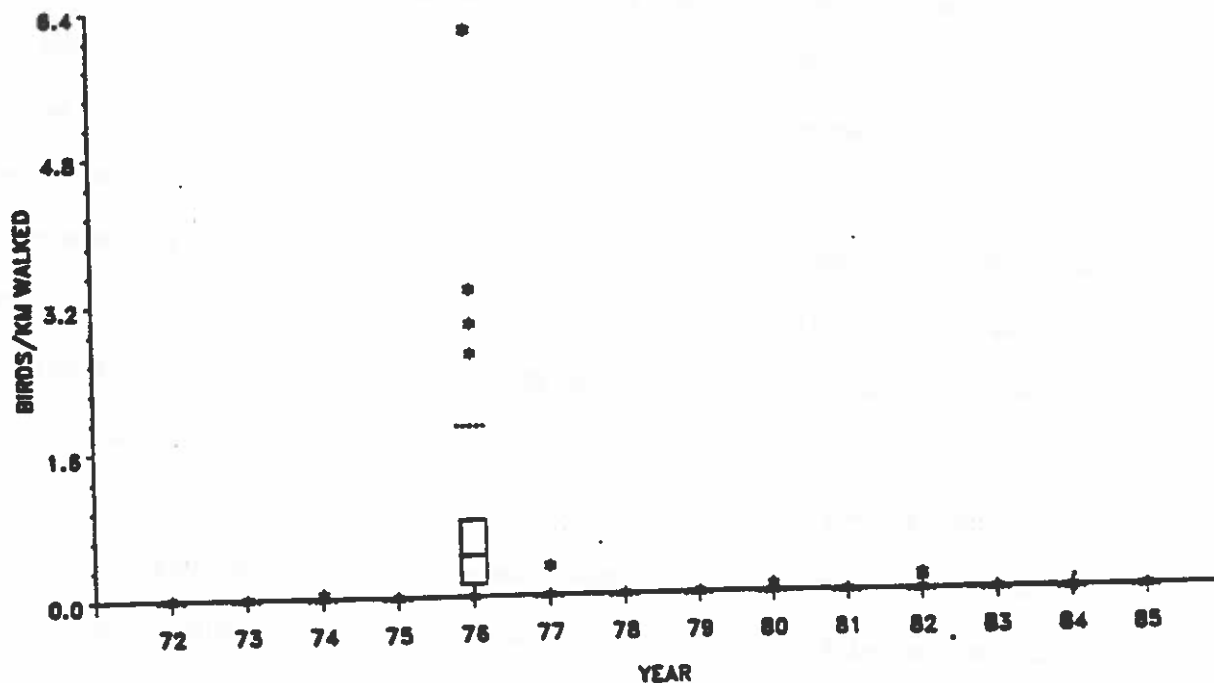


Fig. 44. Annual variation in carcass densities north of Point Conception. See methods for details.

found in all months but August and September (Table 4, Fig. 42). In most other regions they were absent in those months and in February and March (Table 4). Occasional episodes of catastrophic Red Phalarope mortality occurred along the California coast, particularly during early winter storms, when large numbers of carcasses were occasionally found on single surveys. In Northern California, over half, and in Monterey Bay, almost a third of all Red Phalaropes found were on single surveys (Table 4). On beaches with full year coverage, pulses in densities were evident in November in all regions and in May in the Gulf of the Farallones and on the south-central coast (Fig. 42). Highest winter densities occurred in 1979-80 and 1973-74 (Fig. 43). Almost all spring carcasses occurred in 1976 when Red Phalaropes were found on at least 75% of the beaches with complete coverage (Fig. 44).

The Red-necked Phalarope is known to move through California more rapidly than the Red, in contrast to the patterns shown in the carcass data. Red-necked Phalarope carcasses were found over a protracted early fall to early winter period while Red Phalarope carcasses were found during brief periods with high spikes in density in November and May. This contradiction can be explained by differences between the species in their distance from shore during migration. Red Phalaropes may normally migrate too far from shore for mortality to be detected. This could account for their adventitious occurrence on beaches in years when strong onshore winds are associated with early winter storms. Elevated phalarope densities associated with these storms could be caused by winds driving the birds closer to shore (and therefore a higher proportion of casualties depositing), higher than

usual mortality, or a combination of these factors. Although migration should be largely over for the Red-necked Phalarope by mid October, a secondary peak in carcass density in November and December is evident in all regions (Fig. 39). This peak may be due to the effects of early winter storms on the last Red-necked Phalarope migrants or may consist primarily of misidentified Red Phalaropes.

In addition to phalaropes, 23 species of shorebirds occurred on surveys, but only the Black-bellied Plover, Willet, and Sanderling ever attained densities as high as 0.01 carcasses/km walked. These and the Marbled Godwit are the shorebird species most commonly found using outer coast sand beaches away from estuaries in California. These outer coast species, the phalaropes, and the Dunlin were the only other shorebird species for which more than one carcass was found on a single survey. Willet, the commonest species, occurred year round, whereas Sanderling were found in all months except June and Black-bellied Plovers in all months except June and July (Table 4). The other, less commonly encountered species were found primarily between July and October and between January and May (Table 4).

Charadriiforms (Laridae)

Three species of jaeger and the South Polar Skua were found uncommonly. They were found in all regions of the coast except the Santa Barbara Channel. Pomarine and Parasitic jaegers breed in the Arctic and occur regularly along the coast in fall and uncommonly at other times of year. Pomarine Jaeger carcasses were found almost year round; Parasitic Jaegers were found from September through November, in

February, April, and May (Table 4). The Long-tailed Jaegers were found on Point Reyes A and Zmudowski beaches in September 1975 and on RCA Beach in September 1980; they occur off the California coast regularly between August and October. The South Polar Skua was found on Muir Beach in September 1977 (Table 4), consistent with this southern hemisphere species' unusual fall occurrence along the coast.

Eleven identified species of gull occurred on beached bird surveys. All except Glaucous Gull and Sabine's Gull attained densities of 0.01 birds/km walked in three or more regions. The Glaucous Gulls were found on Muir Beach in April 1977 and on Wilder Beach in August 1984. The Sabine's Gull was found on Jetty Beach in September 1978 (Table 4). The densities of some of the larger species are undoubtedly depressed due to unidentified and partial gull carcasses, which we believe were mostly California Gulls, Western Gulls, Herring Gulls, Thayer's Gulls, and various hybrids (particularly Western x Glaucous-winged).

Bonaparte's Gulls were found in all months except August (Table 4). In Monterey Bay, where they reached their highest density, they occurred from October through January and from March through June, which corresponds to their fall and spring migrations (Shuford et al. ms in prep.). South of Point Conception they occurred from October through June (Table 4).

The Heermann's Gull, which migrates north into California from its Mexican breeding grounds, peaked in carcass density in September or October; with decreasing latitude its period of occurrence lengthened (Fig. 45). These patterns correspond fairly well to those of live Heermann's Gulls, except that dead birds occurred later into winter

HEERMANN'S GULL

81

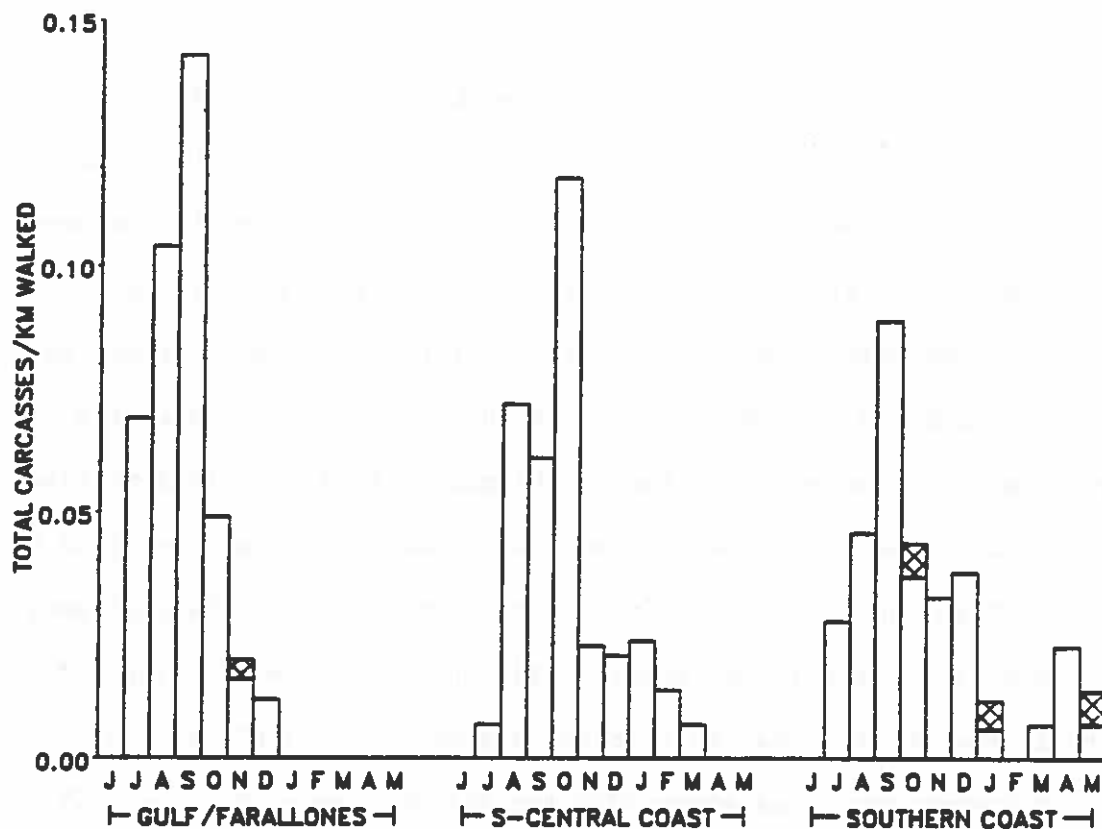


Fig. 45. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

HEERMANN'S GULL FALL DATA ONLY

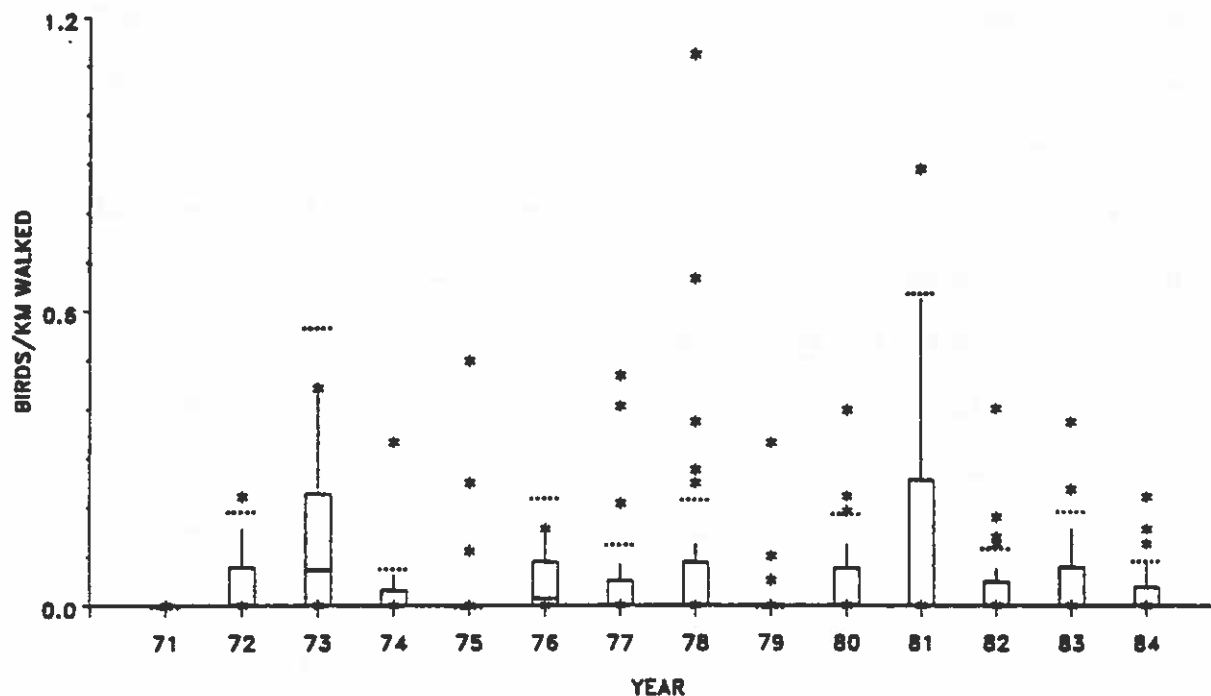


Fig. 46. Annual variation in carcass densities north of Point Conception. See methods for details.

than would be expected by the dwindling numbers of live birds present after October north of Point Conception (Shuford et al. ms in prep.). This suggests that mortality rates for the birds remaining into winter may be higher than those in fall. Carcass occurrence patterns also were consistent with those of the Brown Pelican, which also breeds in Mexico and migrates northward and of which the Heermann's Gull is a kleptoparasite. Annual variation in the gull's fall carcass densities did not reflect Brown Pelican carcass densities as strongly as might be expected (Figs. 46, 23). Years of highest densities for the gull were 1973, 1976, and, to a lesser degree, 1981 while high density years for the pelican were 1981 and, to a lesser degree, 1976, 1982, and 1983. Years of lowest densities after 1974 for the gull were 1975 and 1979 but for the pelican were 1977 and 1984.

Mew Gulls were more common to the north than to the south of Monterey Bay (Table 4). They occurred on surveys from November through May, corresponding to their period of winter residency on the coast but also in July, when the species is very rare along the coast (Table 4, Shuford et al. ms in prep.).

Ring-billed Gulls occurred in low densities in all regions (Table D). They occurred year round, corresponding to the occurrence of live birds (Shuford et al. ms in prep.).

California Gulls attained highest densities in Monterey Bay, but occurred commonly in all regions (Table 4). They were found year round from Monterey Bay north but were missed in one or more months in all regions to the south (Table 4).

Western Gull occurred year round in all regions (Figs. 47-49).

This is not surprising because the Western Gull nests at many localities along the California coast, especially in the Gulf of the Farallones where carcass densities were highest for both first year birds and adults compared to the other two regions. In contrast, carcass densities were higher on the south-central and southern coasts than in the Gulf for second and third year birds (Fig. 48), suggesting that non-breeding subadults either move south or experience relatively higher mortality in the four southernmost regions than the other age groups. Among first year birds, densities peaked after the July to August fledging period, except on the south-central coast where densities were high through December (Fig. 47). The slight, but more obvious elevation in carcass occurrence during spring with decreasing latitude is even more clearly exhibited by two and three year old Western Gulls (Fig. 48). For the latter, the September and May centered peaks in carcass densities are approximately equal. Among the after third year birds, most of which are adults (Fig. 49), densities are highest from June through September in the Gulf of the Farallones and from July through December on the south-central coast (Fig. 49). Again, however, a bimodal pattern is evident along the southern coast.

The bimodal pattern to carcass deposition is likely a reflection of the fact that during the winter, Western Gulls move from coastal and marine habitats to dumps (Spear et al. 1987). Thus, if they die, they do so away from the coastal areas which the beach surveys sampled. The increase in bimodality with decreasing latitude indicates that dumps may be relatively more important to gulls as feeding sites in the southern region than they are toward the north where the marine system

WESTERN GULL FIRST YEAR

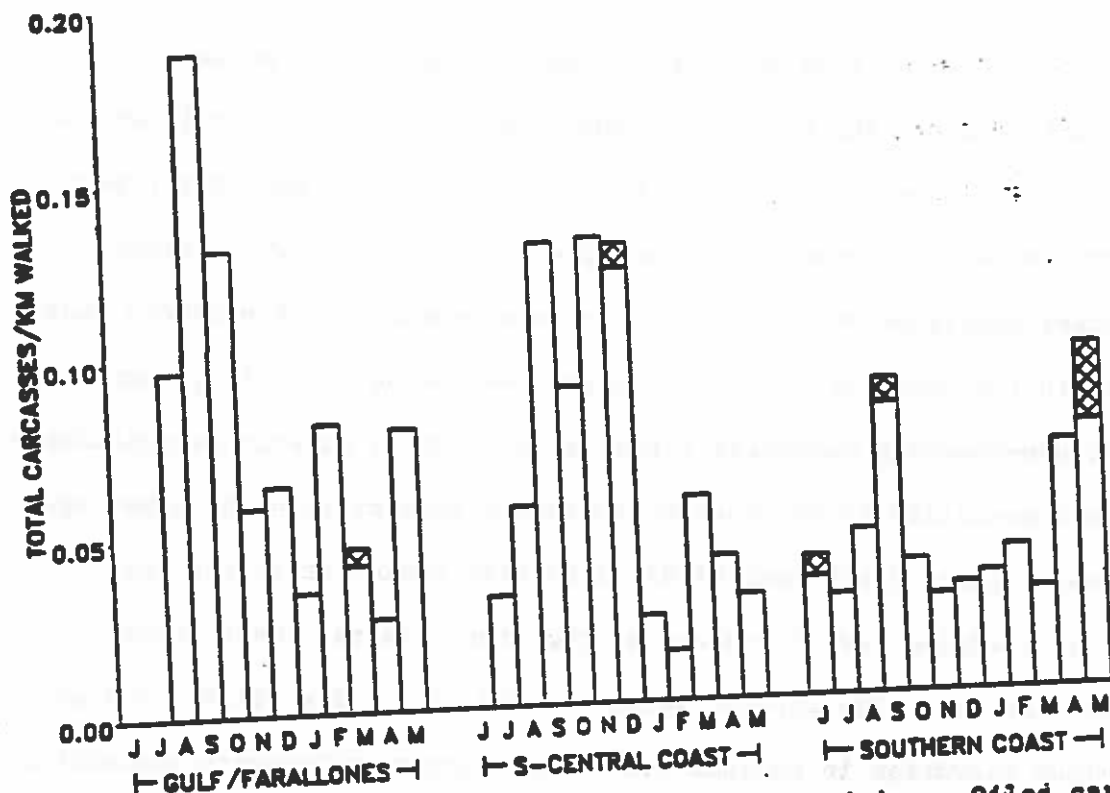


Fig. 47. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

WESTERN GULL SECOND AND THIRD YEAR

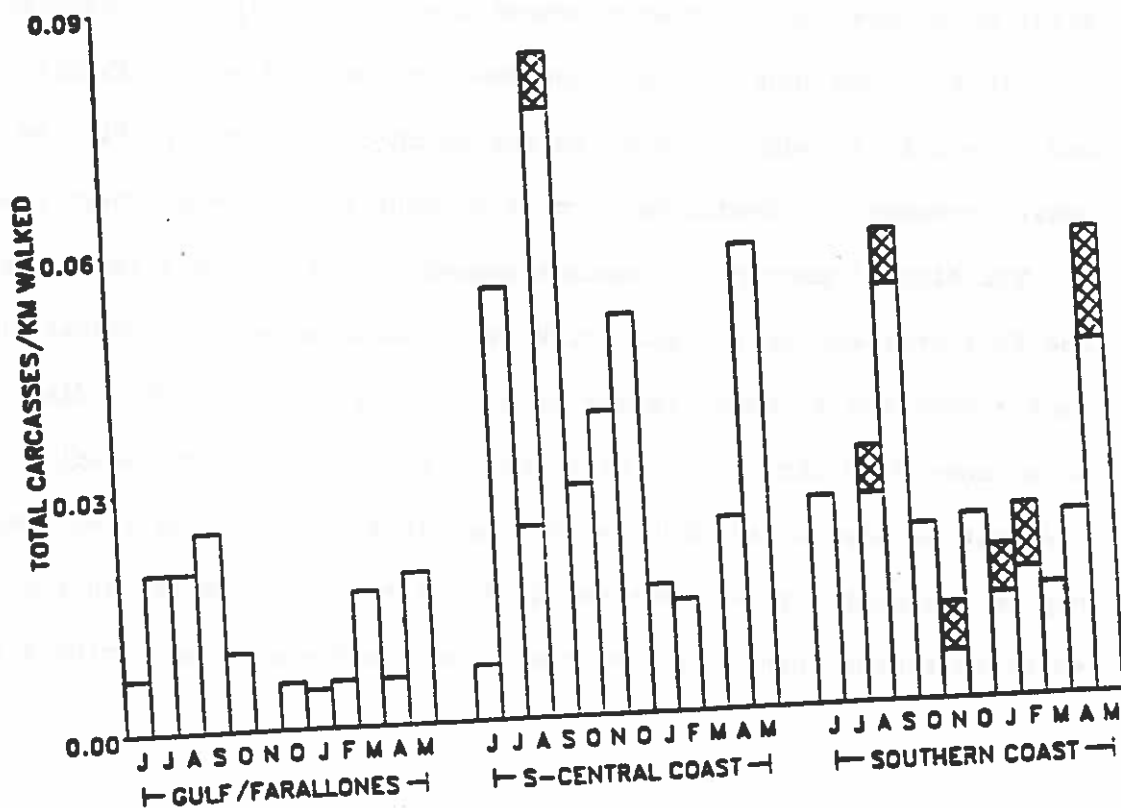


Fig. 48. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

WESTERN GULL AFTER THIRO YEAR

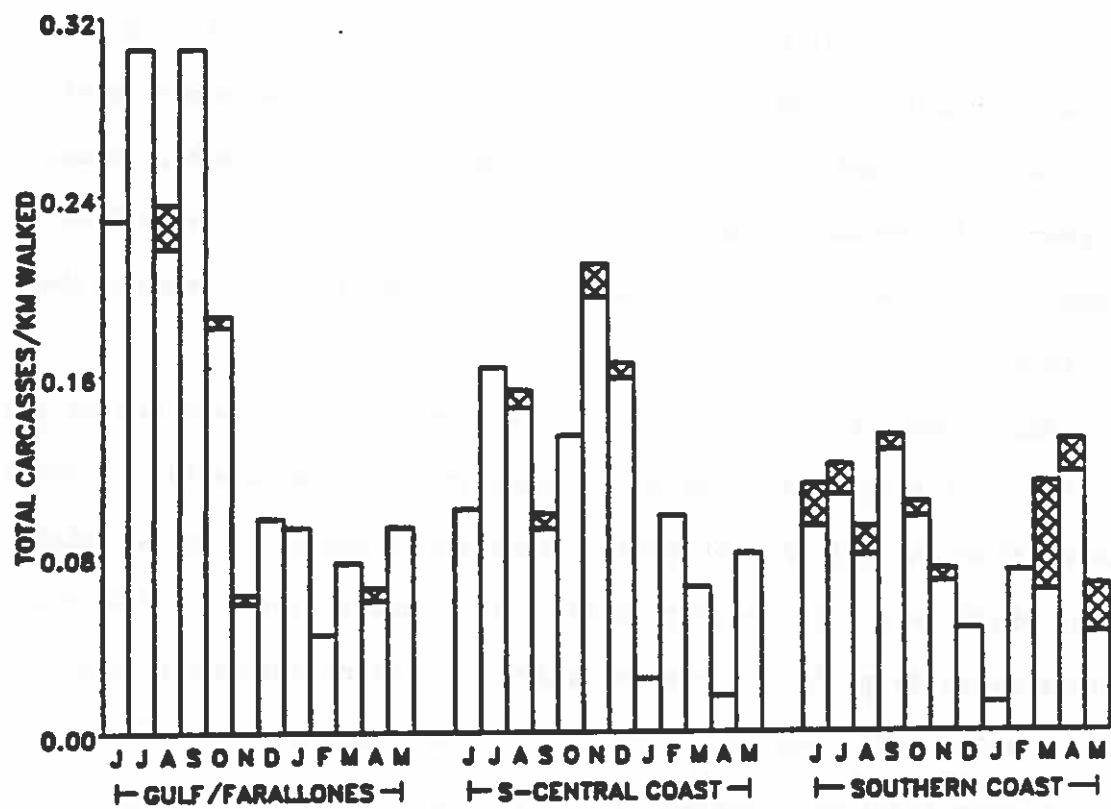


Fig. 49. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

is more productive. As for the high summer-time mortality of older gulls, it is likely that this is a function of a high incidence of shootings in the salmon troll-fishery. As pointed out elsewhere in this report, as well as in Spear et al. (1987), about 50% of the after third year gulls found on beaches have been shot. The summer peak in carcass occurrence corresponds closely to the June-September salmon fishery. Fishermen may shoot gulls attempting to steal baits from hooks before the baited hooks have had a chance to sink beneath the sea surface.

Annual variation in Western Gull carcass densities was not as great as for some seabird species but in some years appeared a bit higher or lower than the majority of years. Fall densities of first to third year birds were a bit higher in 1971 and somewhat lower in 1983 than in other years (Fig. 50); for after third year birds they were higher in 1975, 1976, 1973, and 1971 (Fig. 51). Winter densities of first to third year birds were highest in 1971-72 and 1975-76 and lowest in 1984-85 (Fig. 52) and of after third year birds highest in 1971-72, 1972-73, 1975-76, 1976-77, and 1982-83 and lowest in 1981-82 and 1984-85 (Fig. 53). Three of the five high winters for the after third year birds corresponded to ENSO years. Spring densities of first to third year birds were generally low but perhaps a bit higher in 1980 and 1981 (Fig. 54). Spring densities of after third year birds were highest in 1976 and lowest in 1978, 1979, 1983, and 1985 (Fig. 55).

Glaucous-winged Gull densities decreased slightly from north to south (Table 4). They could be found year round from Monterey Bay north and in winter and spring to the south (Table 4).

WESTERN GULL – FIRST TO THIRD YEARS

FALL DATA ONLY

87

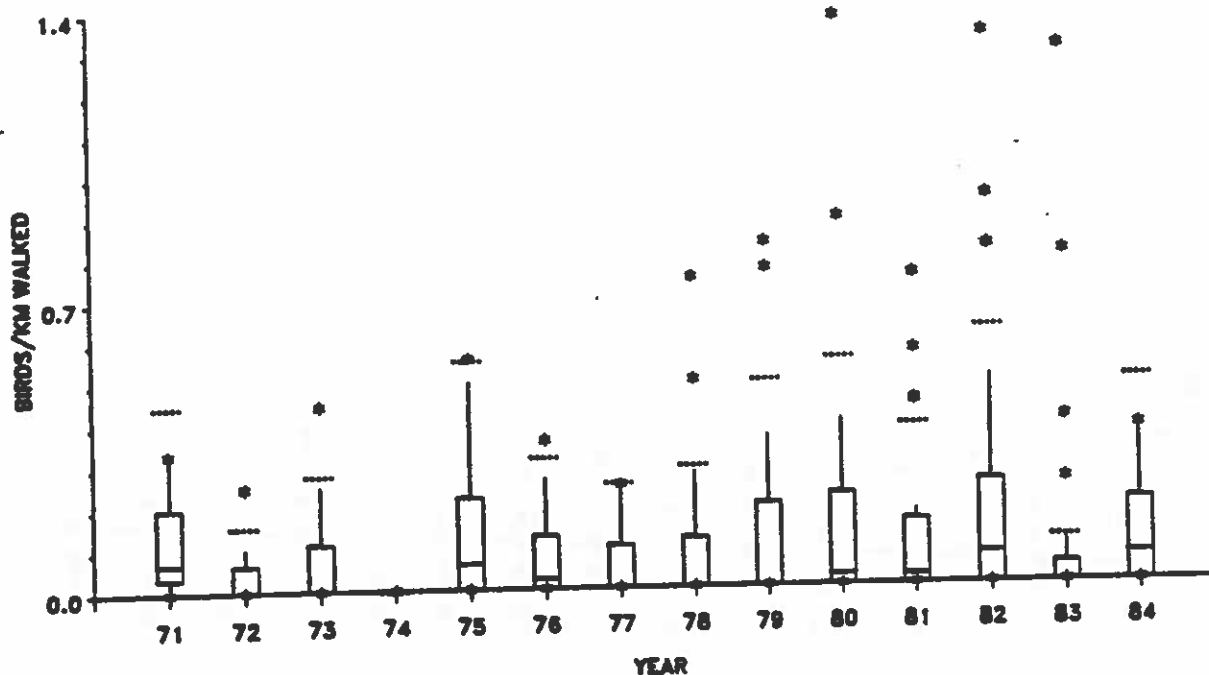


Fig. 50. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN GULL – AFTER THIRD YEAR

FALL DATA ONLY

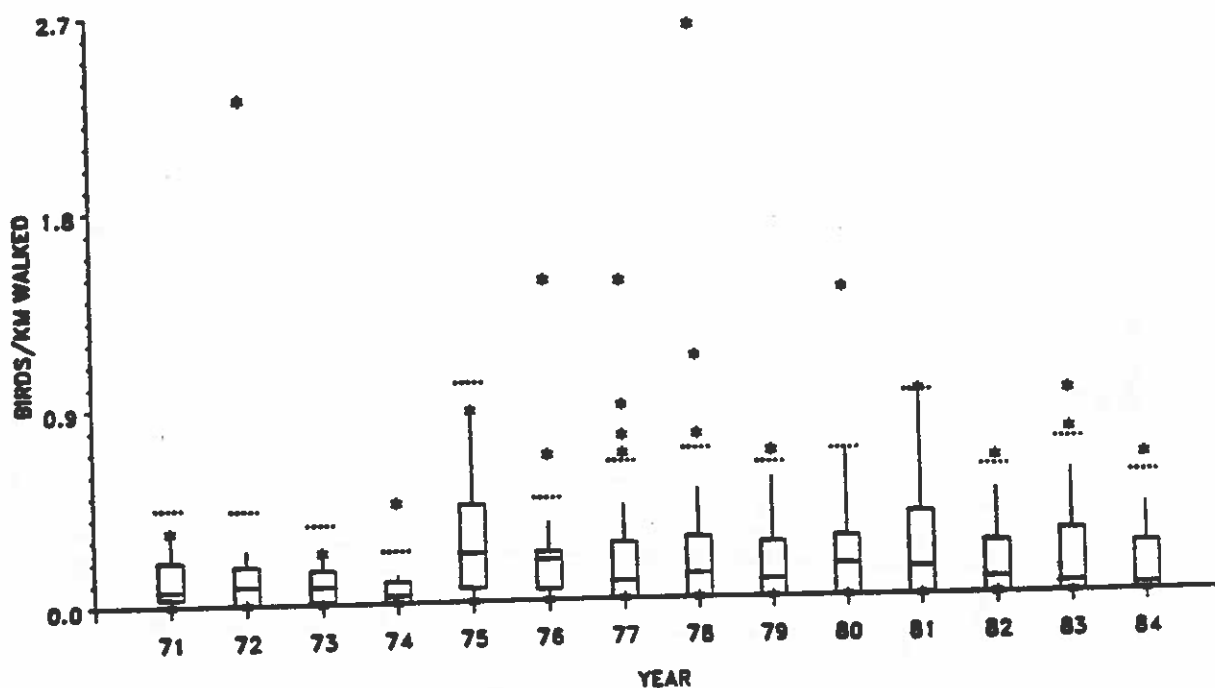


Fig. 51. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN GULL - FIRST TO THIRD YEARS

WINTER DATA ONLY

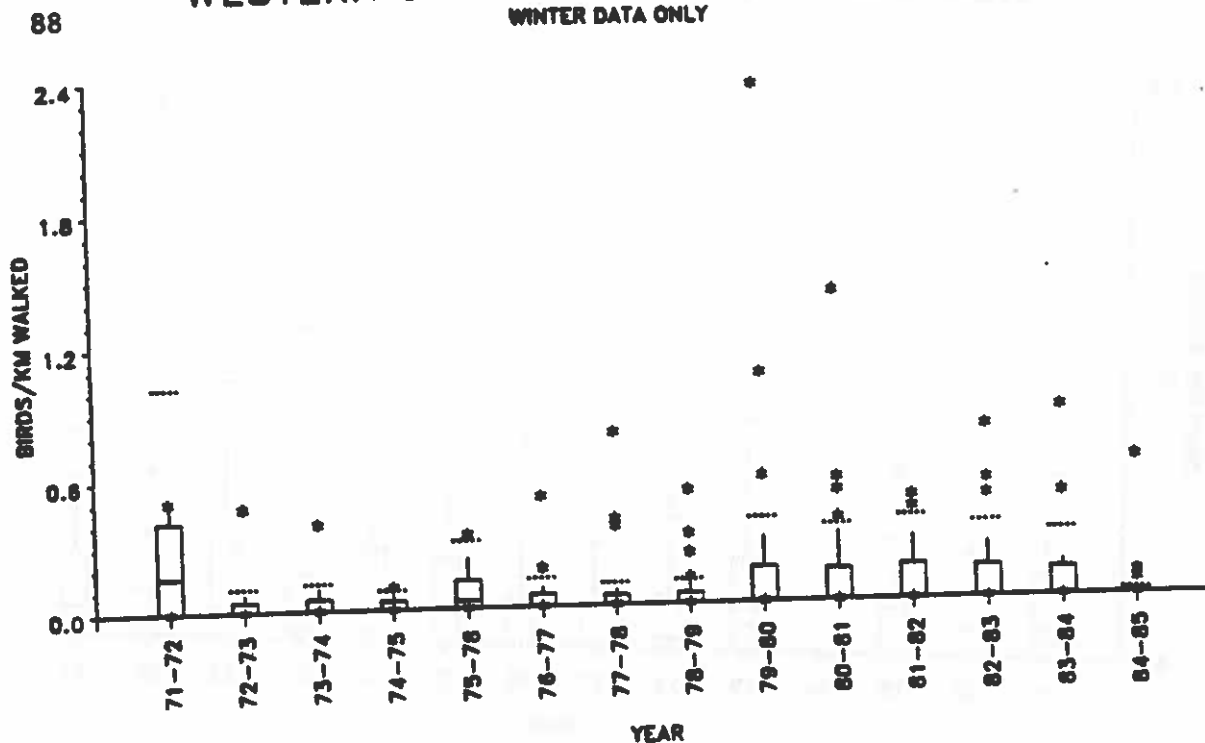


Fig. 52. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN GULL - AFTER THIRD YEAR

WINTER DATA ONLY

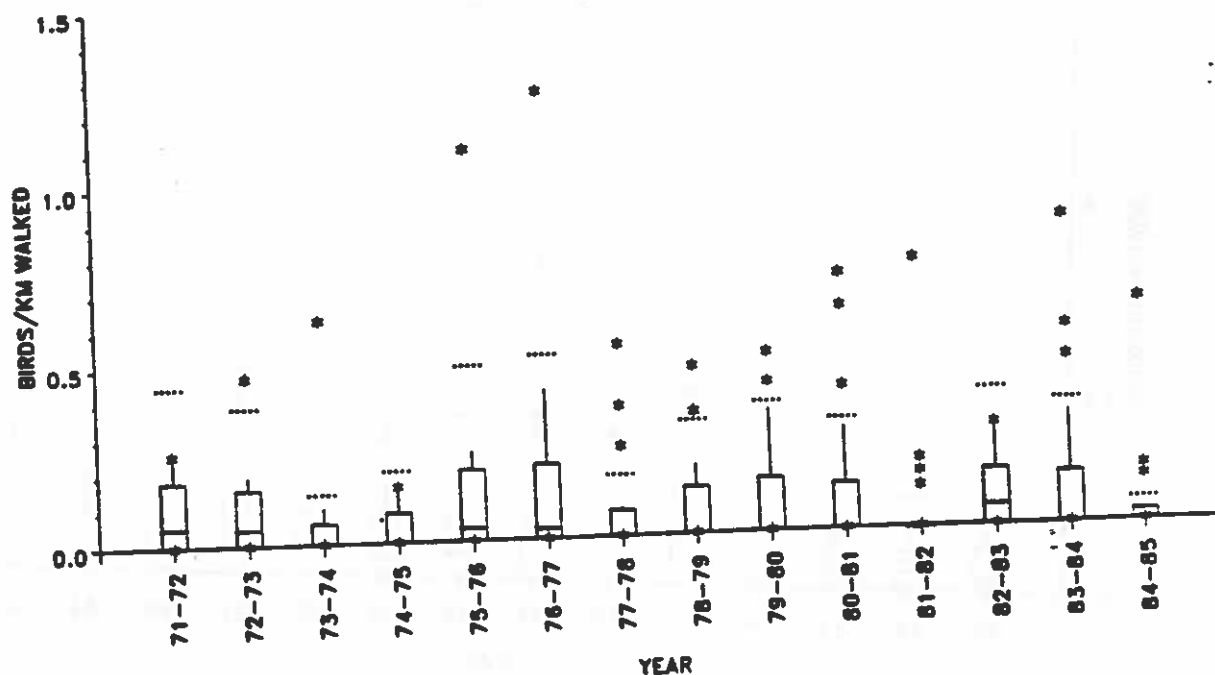


Fig. 53. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN GULL – FIRST TO THIRD YEARS

SPRING DATA ONLY

89

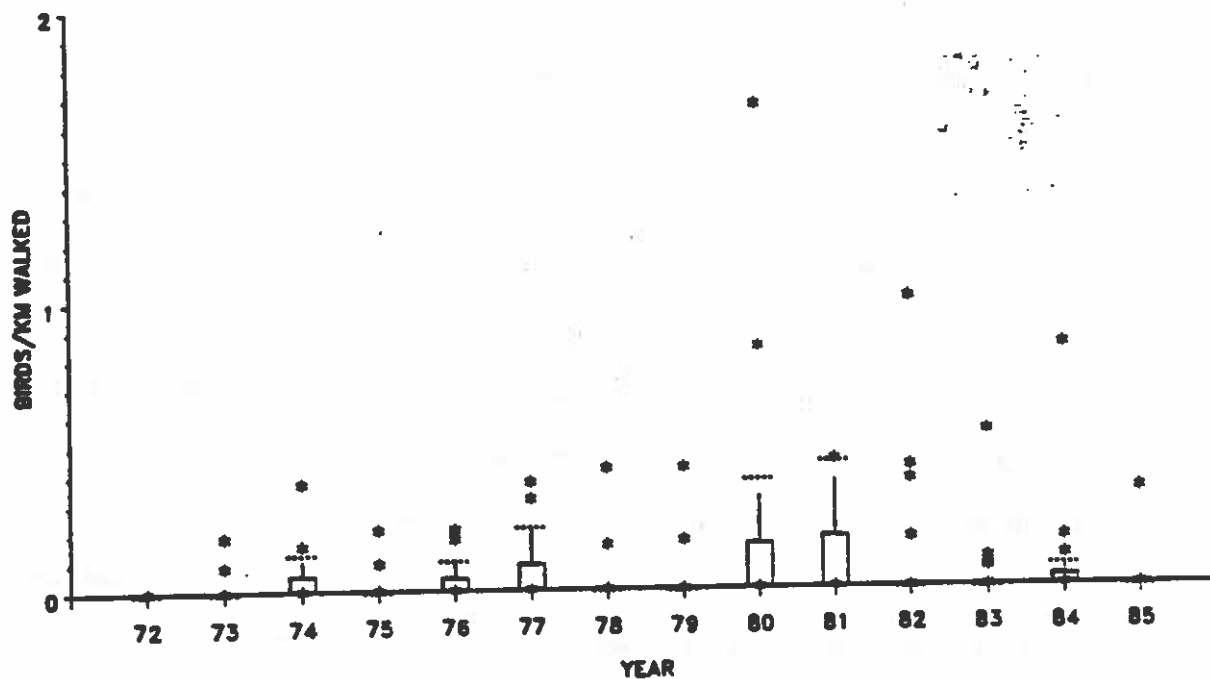


Fig. 54. Annual variation in carcass densities north of Point Conception. See methods for details.

WESTERN GULL – AFTER THIRD YEAR

SPRING DATA ONLY

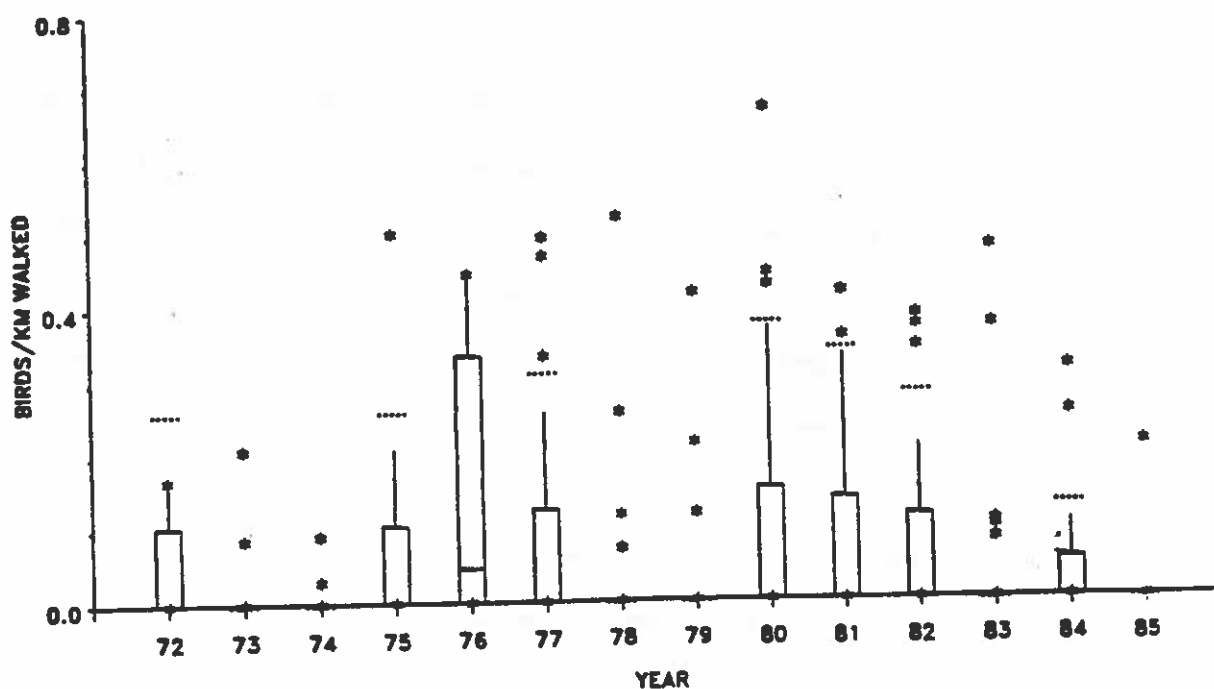


Fig. 55. Annual variation in carcass densities north of Point Conception. See methods for details.

Black-legged Kittiwake densities were higher south than north of Point Conception (Table 4). They were found in all regions from December through May and in August, in four or five regions in June and July, but not in more than two regions from September through November (Table 4). A late winter through spring occurrence is apparent in the full years of data (Fig. 56). Live birds have been reported off the coast primarily from September through May (refs. cited in Shuford et al. ms in prep.). Annual variation in winter and spring densities is quite high. Only in the 1975-76, 1971-72, and 1976-77 winters and the 1976 and 1977 springs were kittiwakes found in any numbers (Figs. 57, 58). The extreme March peak, particularly in the four northern regions, occurred almost entirely during a large die-off in March 1976 (Fig. 58, Harrington-Tweit 1979). The broader seasonal pattern in the southern region may have resulted from a higher mortality rate for birds failing to migrate northward to breeding grounds; most carcasses encountered during the summer were in faded, worn plumage.

Six species of terns were found on surveys, with none occurring at densities as high as 0.01 carcasses/km walked in any region (Table 4). Forster's Tern was the most common, found on various dates from March through November in the four regions with the greatest coverage (Table 4). Caspian Tern occurred on surveys from April through September north of Point Conception and in February in Santa Barbara Channel (Table 4). Elegant, Common, and Arctic terns were recorded August through November in Monterey Bay and Southern California (Table 4). The Common Terns were from Seaside Beach in November 1982, and from Torrance Beach in October 1982 (Table 4). The Arctic Tern was found on

BLACK-LEGGED KITTIWAKE

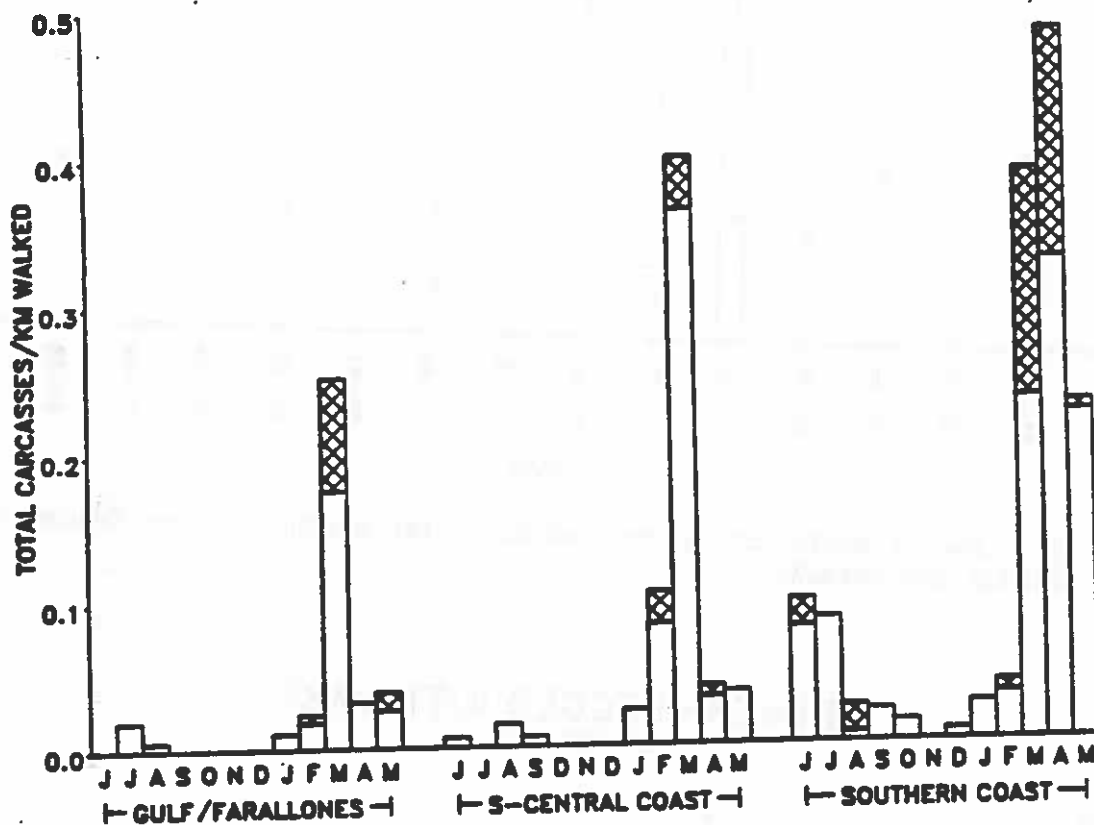


Fig. 56. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

BLACK-LEGGED KITTIWAKE

WINTER DATA ONLY

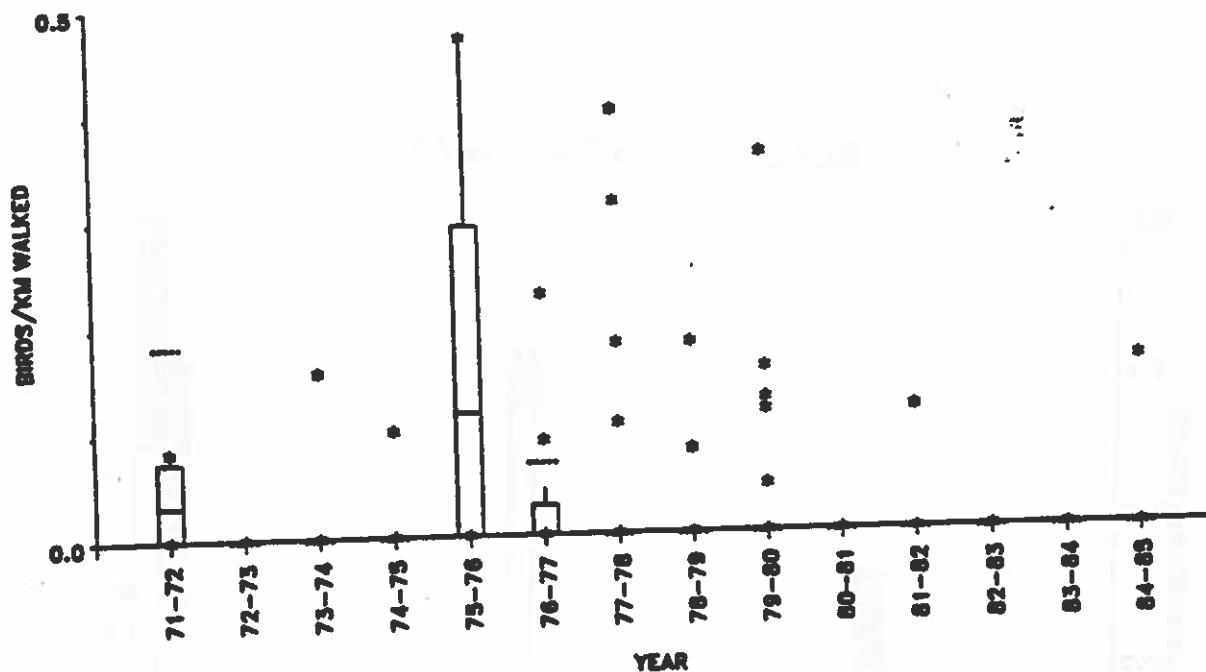


Fig. 57. Annual variation in carcass densities north of Point Conception. See methods for details.

BLACK-LEGGED KITTIWAKE

SPRING DATA ONLY

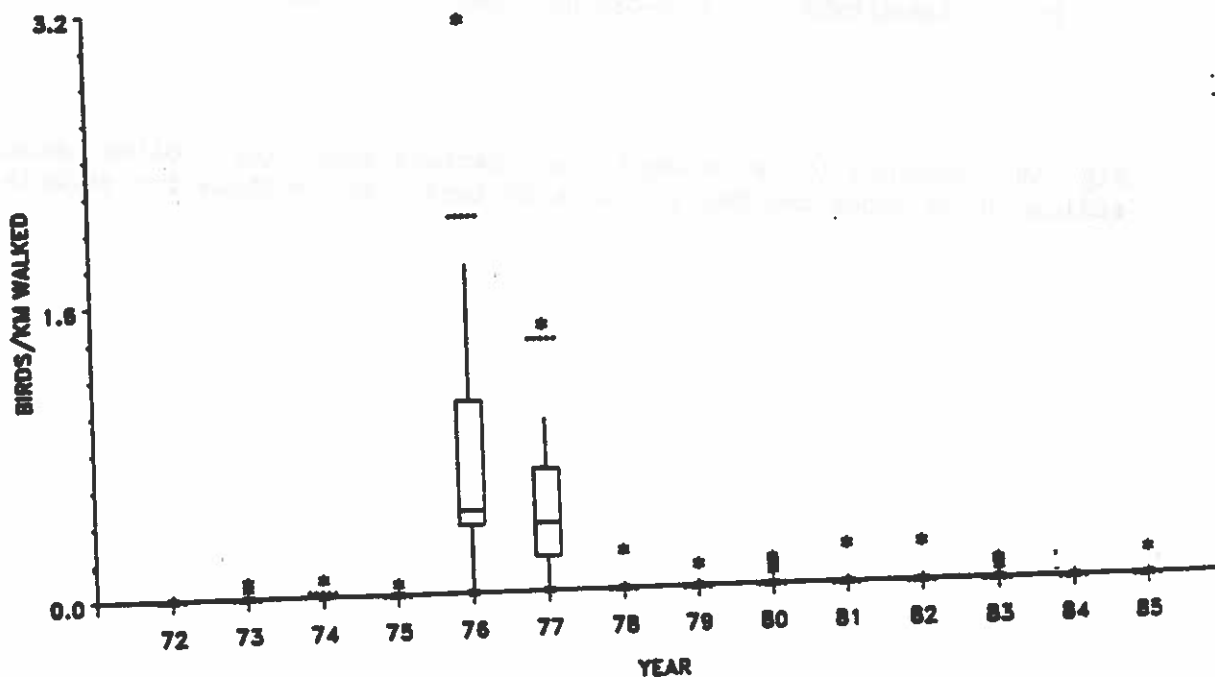


Fig. 58. Annual variation in carcass densities north of Point Conception. See methods for details.

Marina Beach in September 1976 (Table 4). One Black Tern was reported on Salmon Creek Beach in December 1981.

Charadriiforms (Alcidae)

Large alcids comprised Common and Thick-billed murres, Pigeon Guillemot, Tufted and Horned puffins, and Rhinoceros Auklet. The Thick-billed Murre and puffins never attained densities as high as 0.01 birds/km walked (Table 4). The Thick-billed Murres were found on Jetty Beach in March of 1979 and 1980 (Table 4).

Recently fledged Common Murres exhibited a high mortality in the months immediately after fledging in July (Fig. 59). No juveniles were found on southern beaches; the species does not breed south of the south-central coast and only in very small numbers in the latter area. Among older murres, a large post-breeding mortality was apparent, especially during August and September in the northern regions (Fig. 60). These fall occurrence rates could be unnaturally elevated to a significant degree, however, by mortality due to gill nets. Murres often move into nearshore waters during the fall, and it is in those waters that they have been most susceptible to the nets (Ainley and Boekelheide ms in prep.). In the southern region, the spring-only occurrence of carcasses could reflect a pattern we hypothesized for fulmars and kittiwakes: birds at the extreme southern edge of their geographic range fail to migrate north due to disease or injury, and subsequently die. If the murres found on southern beaches during spring were going to breed, they should have migrated north several months earlier. However, well over half of the murres that were found

COMMON MURRE FIRST YEAR

94

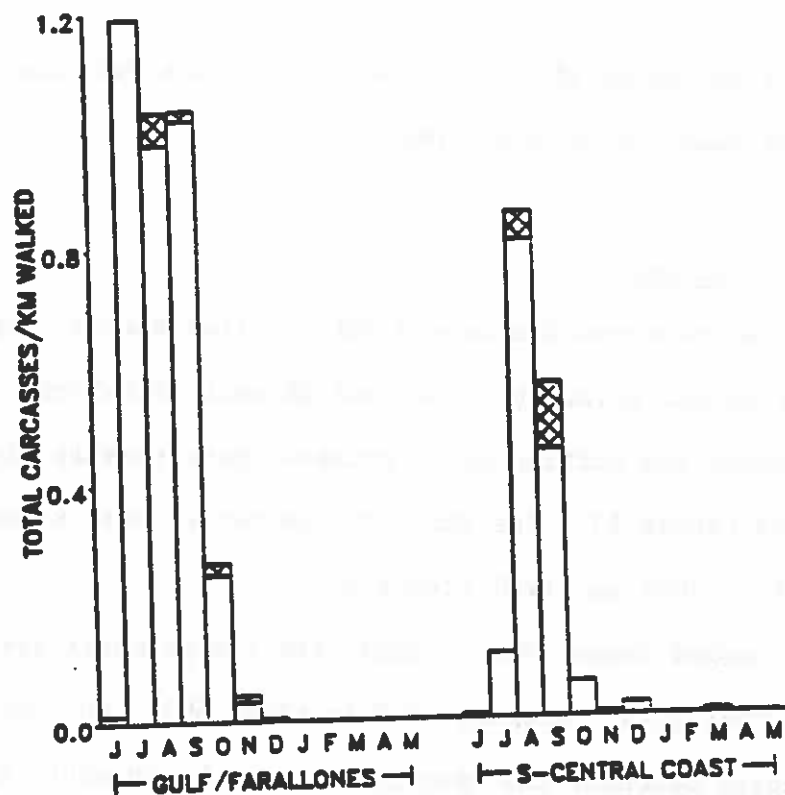


Fig. 59. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

COMMON MURRE AFTER FIRST YEAR

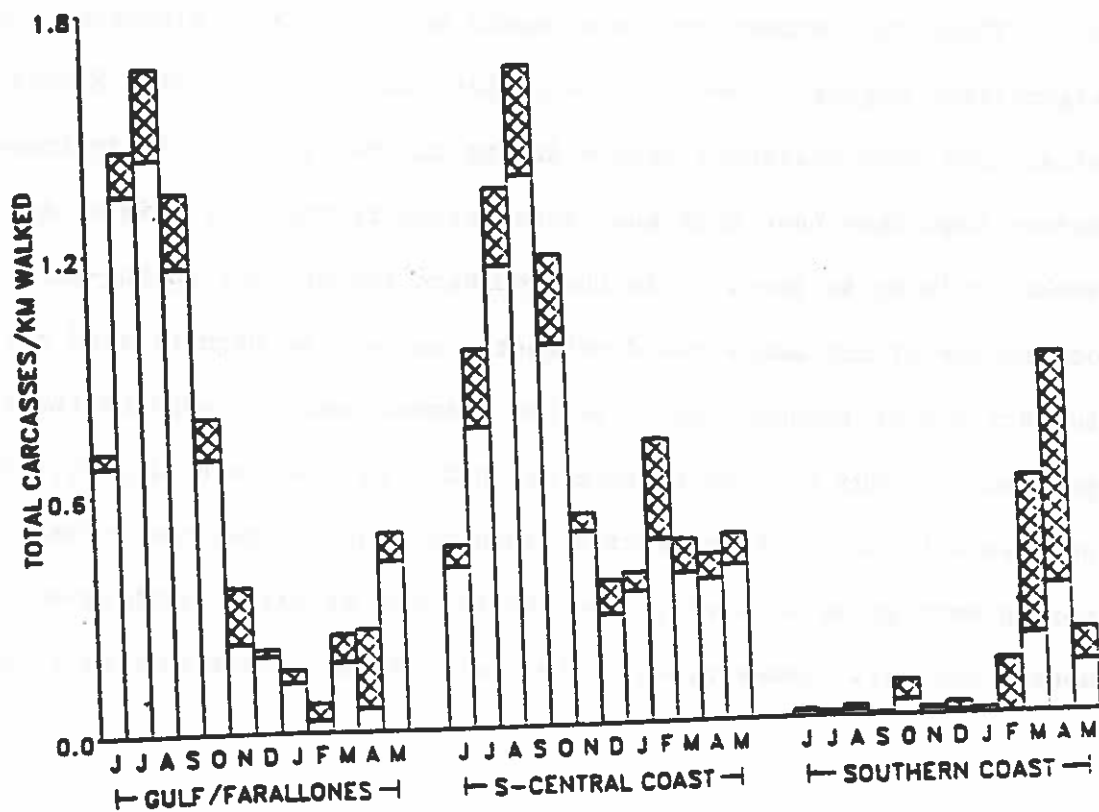


Fig. 60. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

COMMON MURRE CHICKS

FALL DATA ONLY

95

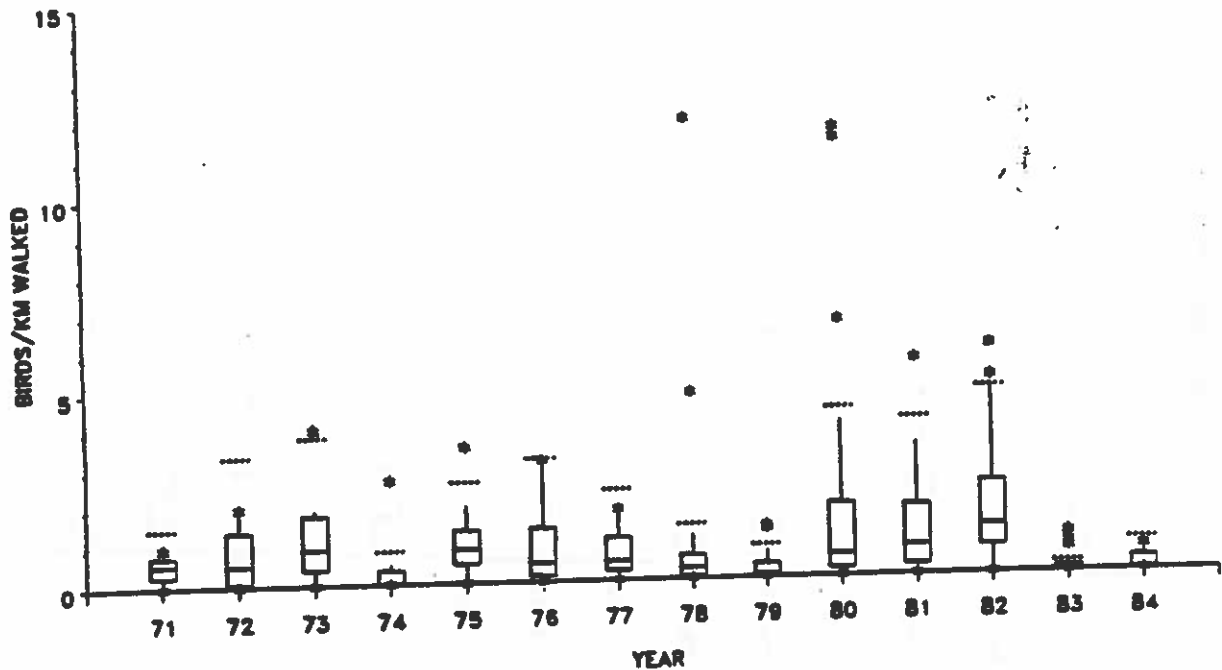


Fig. 61. Annual variation in carcass densities north of Point Conception. See methods for details.

COMMON MURRE ADULTS

FALL DATA ONLY

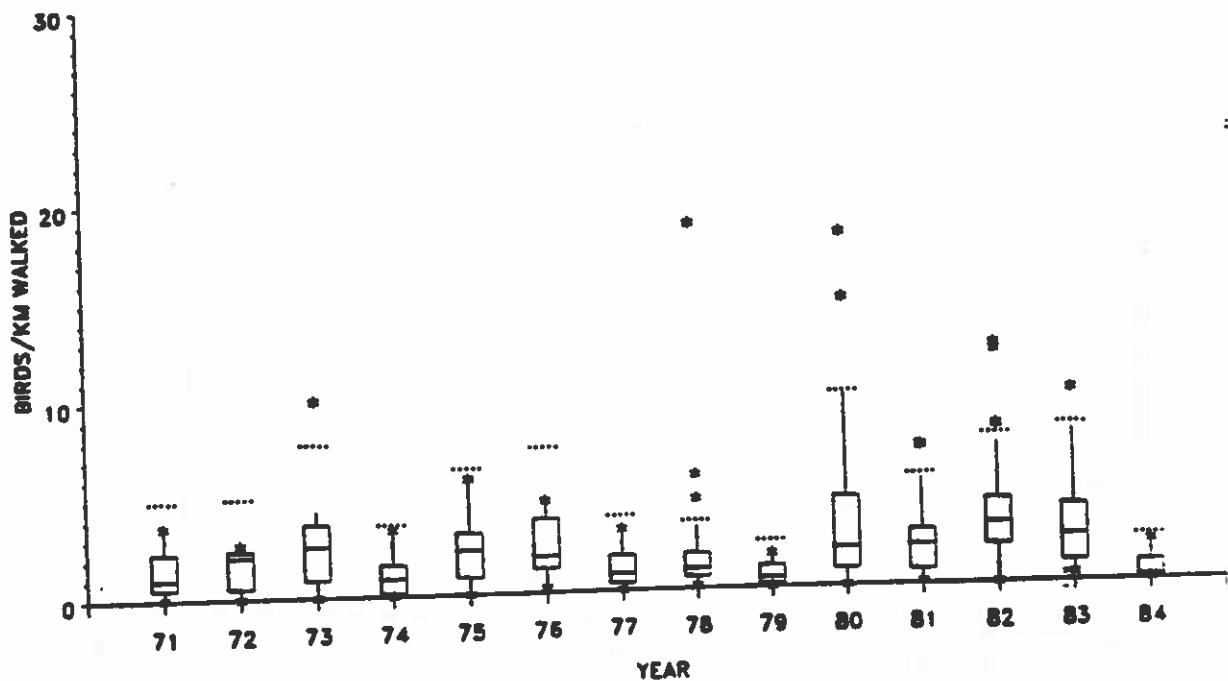


Fig. 62. Annual variation in carcass densities north of Point Conception. See methods for details.

COMMON MURRE

WINTER DATA ONLY

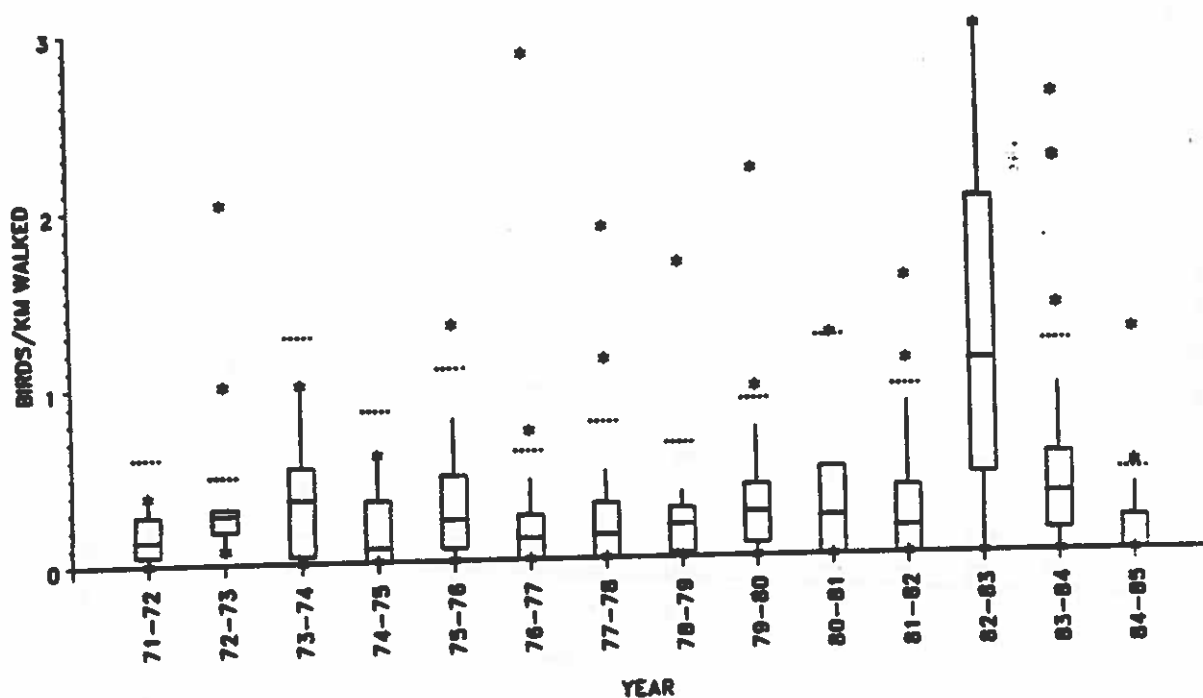


Fig. 63. Annual variation in carcass densities north of Point Conception. See methods for details.

COMMON MURRE

SPRING DATA ONLY

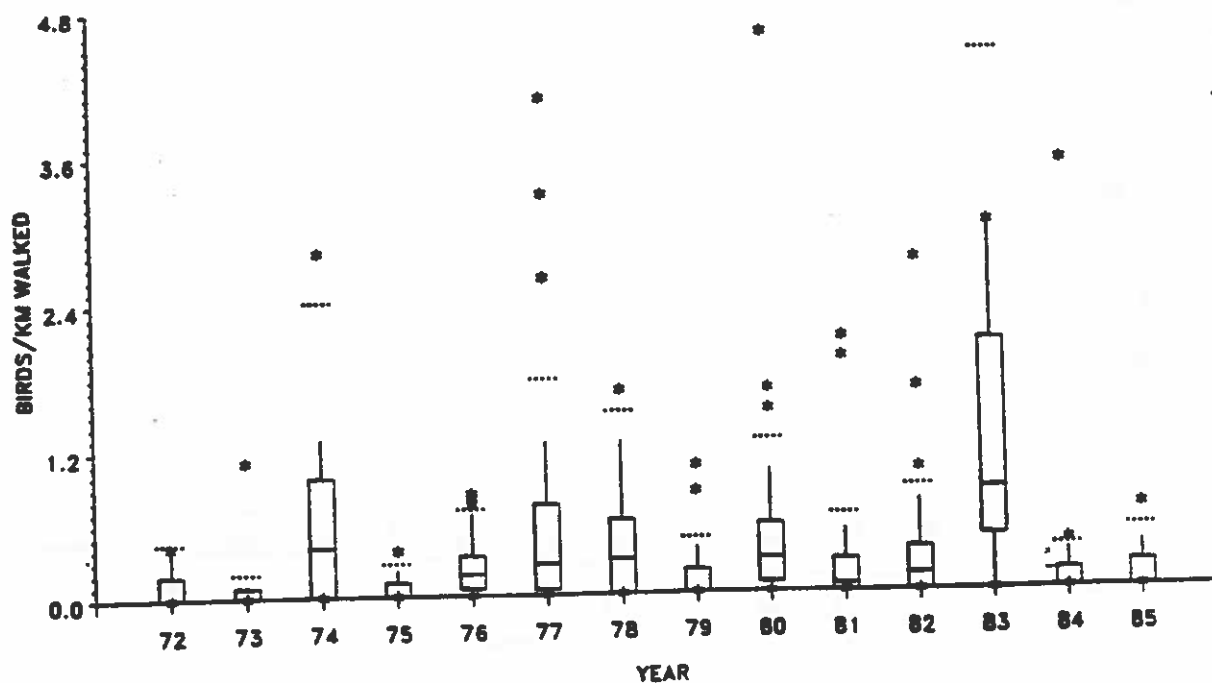


Fig. 64. Annual variation in carcass densities north of Point Conception. See methods for details.

dead in the southern area were oiled, a factor that complicates this hypothesis.

Annual variation in Common Murre densities was fairly high in all seasons. Murre chick densities in fall were highest in 1982, 1973, and 1975, almost as high in 1976, 1977, 1980, and 1981, and lowest in 1983 and 1984 (Fig. 61). Fall densities for adult-sized murre were highest from 1980 to 1983, in 1973, 1975, 1972, and 1976 and lowest in 1979 and 1984 (Fig. 62). Murre winter densities were much higher in 1982-83, somewhat high in 1983-84 and 1972-73, and lower in 1984-85 than other years (Fig. 63). Murre spring densities were much higher in 1983, somewhat higher in 1977, 1980, and 1976, and lower in 1979, 1984 and 1985 than in other years (Fig. 64).

Rhinoceros Auklet carcasses occurred at highest densities between Monterey Bay and the Santa Barbara Channel. They were found year round from the Gulf of the Farallones to Estero Bay and mostly from November through May in the other regions (Table 4). The Rhinoceros Auklet was encountered mainly during winter north of Point Conception (Fig. 65), consistent with known occurrence patterns. The southernmost known breeding population for this species is a small one within the south-central region. The greater number of individuals encountered in the latter region may be a function of preferred habitat being closer to shore here than in the other regions. The spring peak in carcass occurrence in the southern coast region might well reflect the edge of range phenomenon proposed above for murre. Densities were very low except in a few years: winter 1982-83, 1983-84, and 1977-78 to 1979-80, spring 1977 and 1981, and spring and fall of 1975 (Figs. 66-68).

RHINOCEROS AUKLET

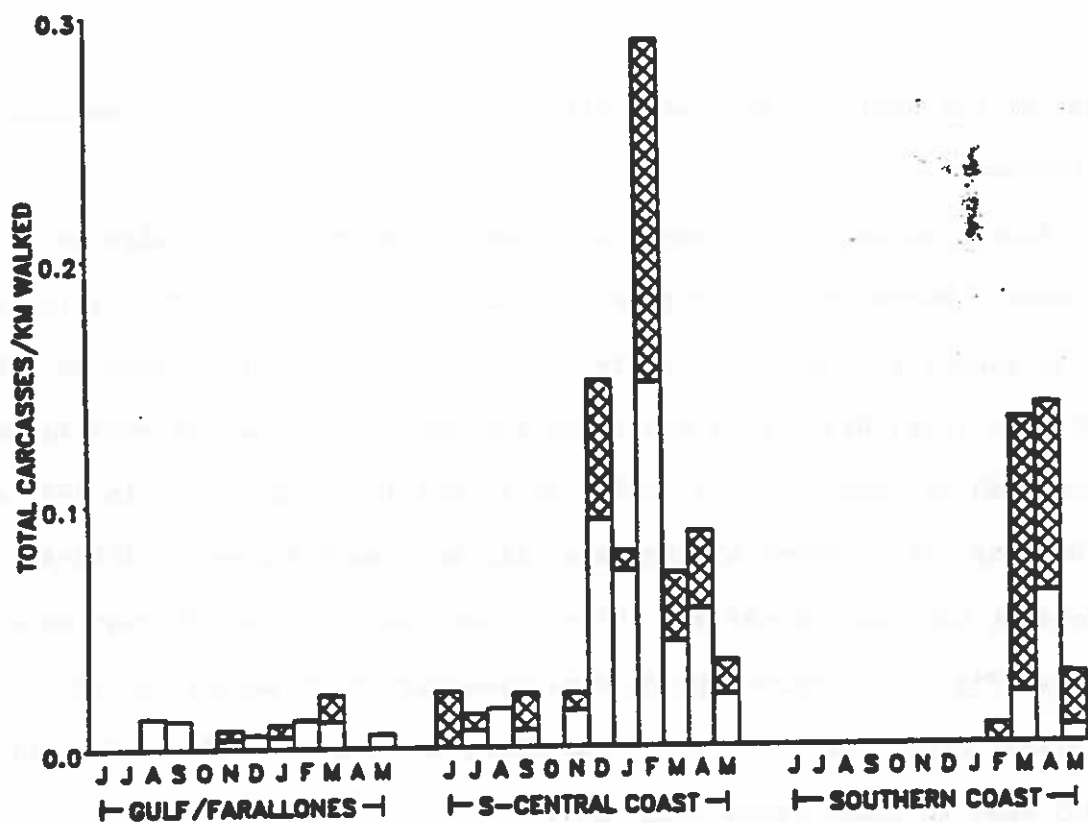


Fig. 65. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

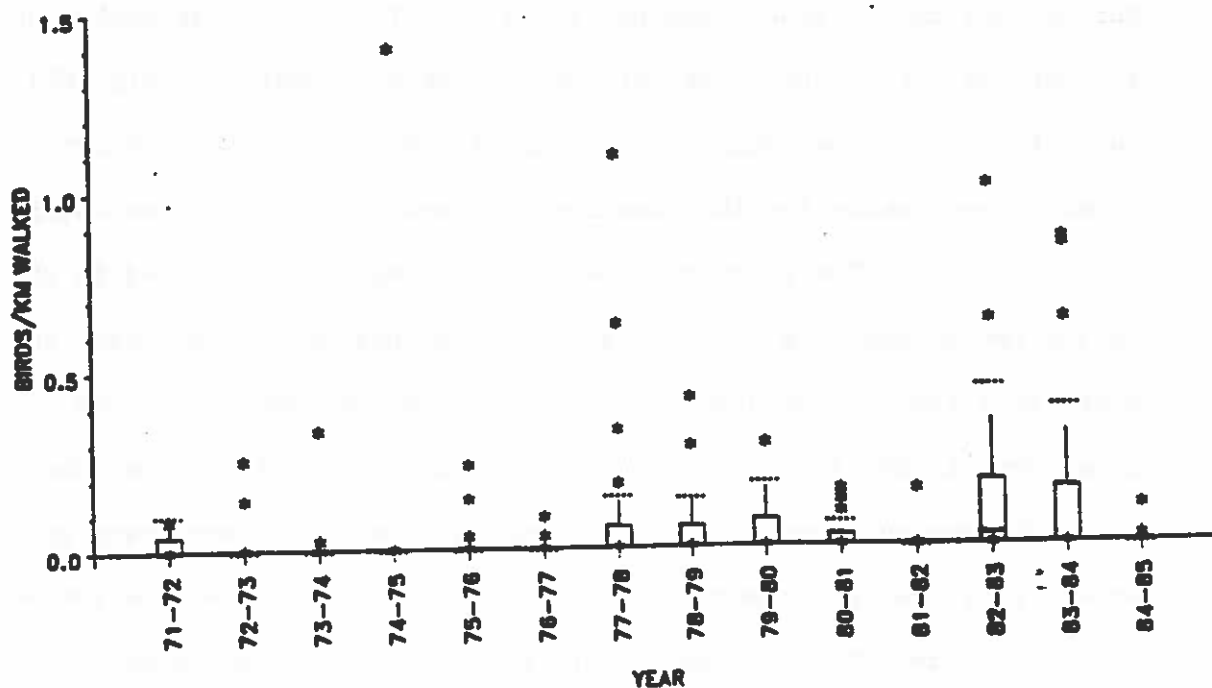
RHINOCEROS AUKLET
WINTER DATA ONLY

Fig. 66. Annual variation in carcass densities north of Point Conception. See methods for details.

RHINOCEROS AUKLET

SPRING DATA ONLY

99

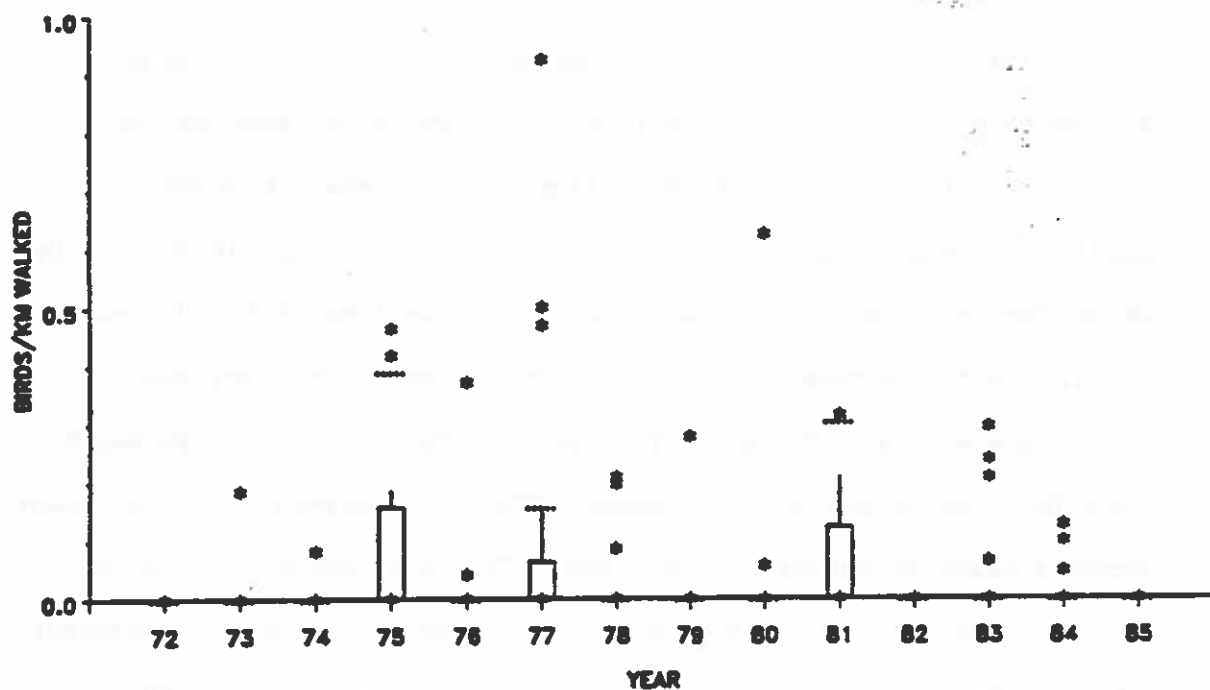


Fig. 67. Annual variation in carcass densities north of Point Conception. See methods for details.

RHINOCEROS AUKLET

FALL DATA ONLY

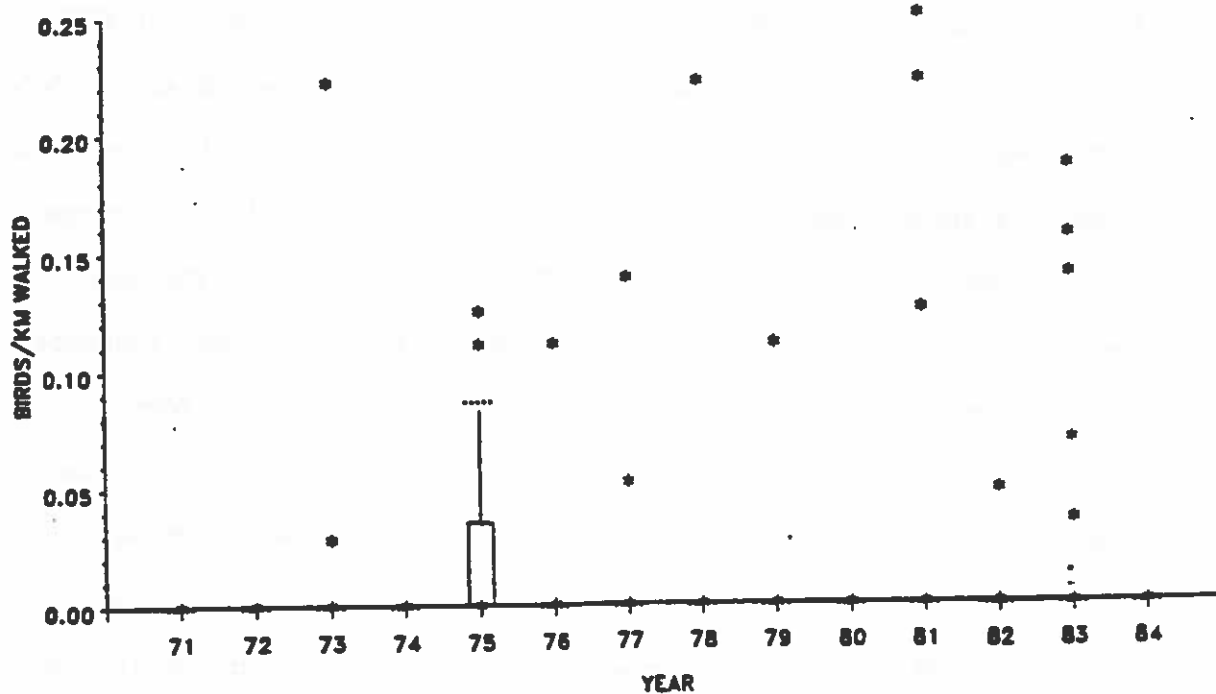


Fig. 68. Annual variation in carcass densities north of Point Conception. See methods for details.

The carcass occurrence of the two puffin species provides an interesting comparison, in light of their live occurrence in the eastern Pacific Ocean. Tufted Puffins breed in small numbers in California, mostly on the Farallones Islands and on Castle Rock in Del Norte County. The southern-most breeding locations of the Horned Puffin are in southeastern Alaska; they are considered vagrants in California waters. Tufted Puffins were found on Salmon Creek Beach in July 1981, on Dillon Beach in August 1980 and September 1974, on Point Reyes A Beach in October of 1977 and 1979 and in March of 1976 and 1977, on Ocean Beach in September 1976, on Pescadero Beach in September 1973, on Pajaro Dunes in June 1977, on Jetty Beach in June 1982, and on Torrance Beach in April 1977 (Table 4). Horned Puffins were found on Point Reyes A Beach in June 1978, July 1982, and January 1980, on Point Reyes C and Point Reyes B beaches in February 1980, on Limantour Beach in February 1976 and March 1980, on Ocean Beach in July 1975, at Pajaro Dunes in July 1975, on Marina Beach in July 1973 and August of 1974 and 1975, on Del Monte Beach in August 1975, on Hazard Creek Beach in June 1980, and on Torrance Beach in June 1975 (Table 4). The five carcasses from June through August 1975 coincided with an "invasion" of Horned Puffins that occurred in 1975 and 1976 (Roberson 1980). The four January to March 1980 records from the Point Reyes area may indicate another invasion; others reported from this period in California coastal waters were a live bird from south of Monterey Bay (Roberson 1985), a live bird from Salmon Creek mouth, Sonoma County 26 December 1979, and a carcass from Moonstone Beach, Humboldt County January 1980 (American Birds 34:303). Otherwise, we found Horned Puffins in 7 of 14

years, indicating that the species may be more common than heretofore thought. Unless mortality rates of Horned Puffins are higher than those of Tufted Puffins in California waters or impaired Horned Puffins are distributed closer to shore than impaired Tufted Puffins, there may be more Horned than Tufted puffins in California waters.

Small alcids comprised Marbled, Xantus', Craveri's, and Ancient murrelets and Cassin's and Parakeet auklets. Only Cassin's Auklet, Ancient Murrelet, and Marbled Murrelet occurred at densities as high as 0.01 birds/km walked in any region (Table 4).

Marbled Murrelets were found from Northern California to the Santa Barbara Channel, but attained a density of 0.01 birds/km only in Northern California (Table 4). They were found on North Mad River, Manchester, Salmon Creek, and Doran beaches in Northern California; four of the seven found in Northern California were from Salmon Creek Beach in September and October 1972. Five of the seven found in Northern California were from September and 20 of the 23 total were found from August through December. In the Gulf of the Parallones, Marbled Murrelets were found on Point Reyes C, Seadrift, Ocean, and North Half Moon Bay beaches. In Monterey Bay, two of the Marbled Murrelets were found on Laguna Creek Beach and four on Sunset Beach in November and December 1980. In Estero Bay they were found on Atascadero, Hazard Creek (three birds), and Purisima Point beaches. The only Marbled Murrelet in Santa Barbara Channel was found oiled on Las Varas Ranch Beach in September 1976. Marbled Murrelets breed only north of Monterey Bay but in winter extend to southern California.

Xantus' Murrelets occurred from Monterey Bay to Southern

California, but were only at densities as high as 0.01 birds/km walked in Southern California, where one race (E. h. scrippsi) breeds on the Channel Islands. There they were found from May through August and in November (Table 4). All Xantus' Murrelets found in the Santa Barbara Channel region were from San Nicolas Island in 1976 and 1977. At Estero Bay single birds were found at Cambria in February and March 1972 and on Morro Bay Spit in July 1981. In Monterey Bay, four of the five birds were found on Laguna Creek Beach (in August 1984, September and November 1979, and September 1980); the fifth was found on Zmudowski Beach in August 1973. Live Xantus' Murrelets are regularly recorded as far north as Monterey Bay from August to October (Roberson 1985).

The Craveri's Murrelet was found on Morro Bay Spit in December 1983. Craveri's Murrelets disperse north from their breeding ground in Mexico, mainly from August through October. They are reported almost annually off the southern coast during this period, particularly in warm water years. The warm water period of the 1983-84 ENSO episode encompassed the Estero Bay beaching.

Ancient Murrelet carcasses were most common in the Gulf of the Farallones and Monterey Bay. Live Ancient Murrelets regularly occur in small numbers in northern and central California in winter and extend to southern California in some winters. Combining all areas, over 90% of the carcass occurrences were between November and February, although many of the observations are from only a few beaches. In the Gulf of the Farallones, 75 of the 101 carcasses were found on one of the four Point Reyes beaches and 42 of the 75 were found in December 1979, when

CASSIN'S AUKLET

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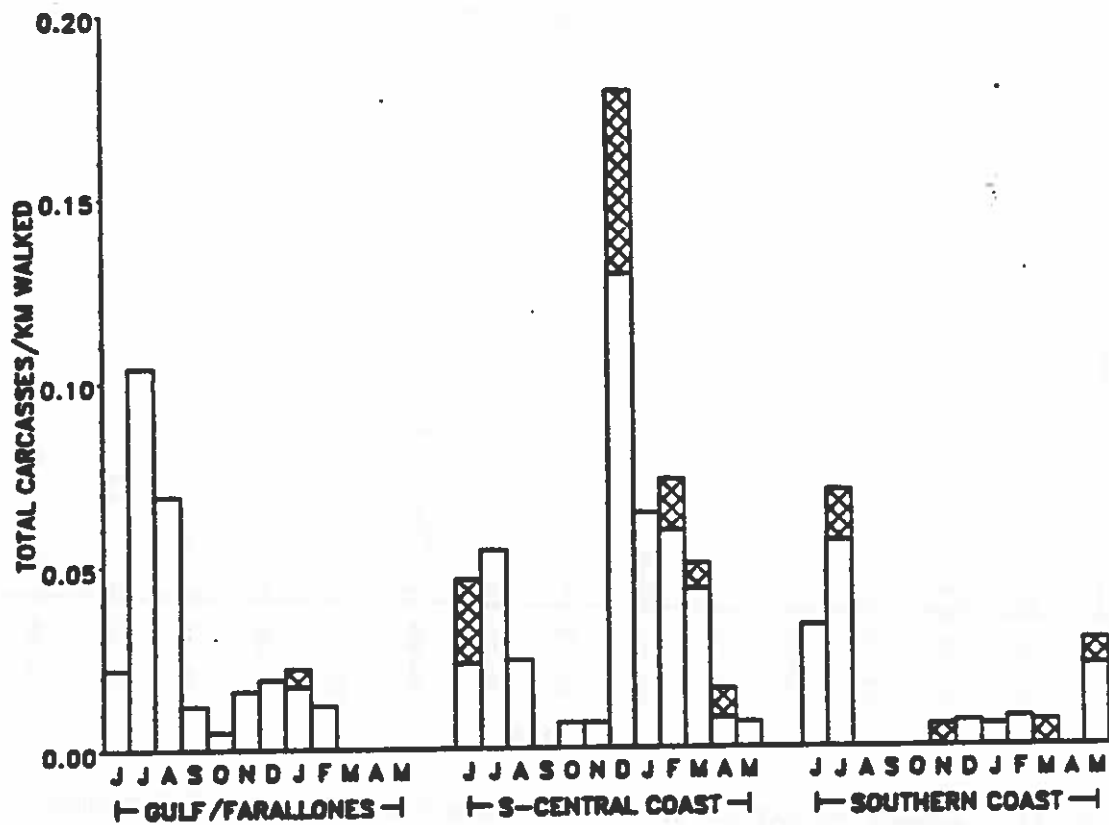


Fig. 69. Monthly (June to May) total carcass densities. Oiled carcasses indicated by cross-hatched portions of bars. See methods for details.

CASSIN'S AUKLET FALL DATA ONLY

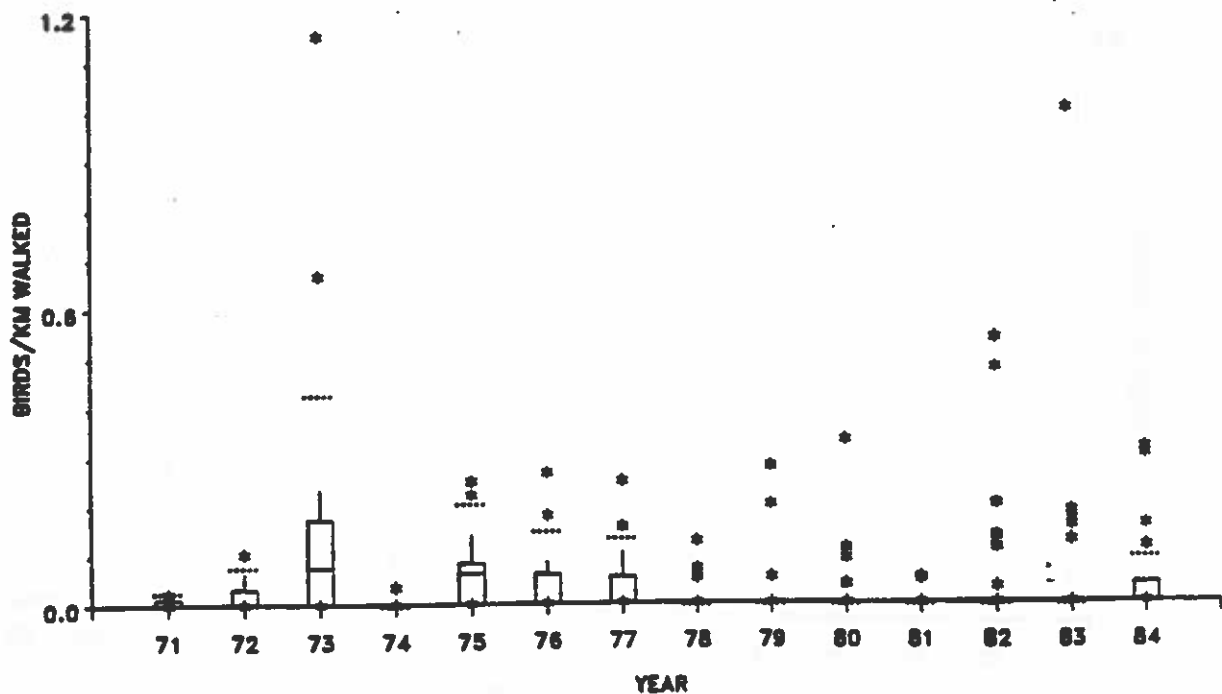


Fig. 70. Annual variation in carcass densities north of Point Conception. See methods for details.

CASSIN'S AUKLET

WINTER DATA ONLY

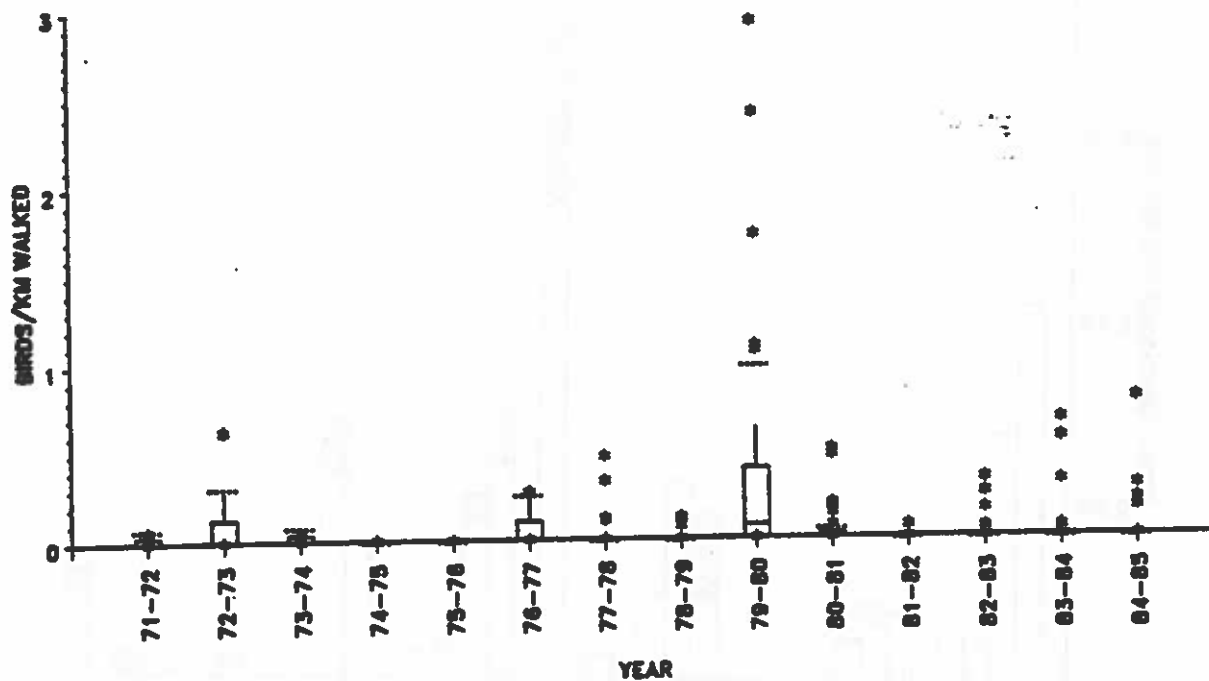


Fig. 71. Annual variation in carcass densities north of Point Conception. See methods for details.

CASSIN'S AUKLET

SPRING DATA ONLY

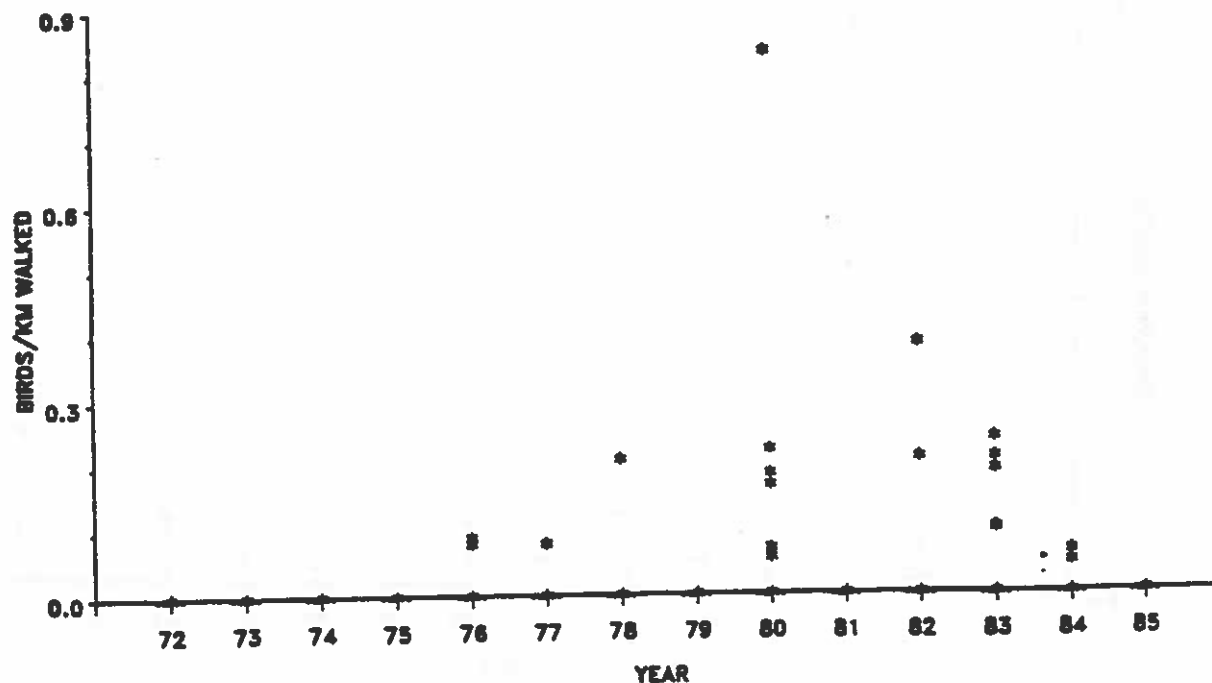


Fig. 72. Annual variation in carcass densities north of Point Conception. See methods for details.

a large influx of birds to California waters occurred (Garrett and Dunn 1981). Large numbers of Ancient Murrelet carcasses on single months were found at Point Reyes A (12 in December 1979), Point Reyes B (11 in December 1979), Point Reyes D (14 in December 1979), Del Monte (8 in December 1979), and Dillon (7 in November 1979).

Cassin's Auklet carcasses occurred in all regions, but at highest densities from the Gulf of the Farallones to Estero Bay (Table 4). Seasonal patterns varied between regions (Fig. 69). In the Gulf of the Farallones densities peaked in July and August, which is the post fledging period, and were relatively low from September to February. On the south-central coast densities peaked in June and July and in December, after which they declined to May. On the southern coast, densities were low from November through March then peaked from May through July. Fledging may be earlier in the southern populations, and this is reflected in the timing of carcass occurrence. In most years, Cassin's Auklets occurred uncommonly on surveys but in fall 1973 and 1975 and in winter 1979-80 densities were higher than in other years (Figs. 70-72).

The two Parakeet Auklets, both immatures, were from Pajaro Dunes in January 1973. This species was found off the California coast (particularly in Monterey Bay) occasionally from December through April early in the 1900s but has only been recorded twice recently (Roberson 1980).

Summary of Seasonal Trends and Annual Variation in Carcass Density

It is tempting to assume that changes in carcass densities on a beach reflect changes in mortality rates. However, carcass densities on periodic surveys may be a function of at least one factor concerning survey methodology, two factors concerning the environment, and four factors concerning the birds. We do not believe that variation in survey frequency, the methodological factor, played a role in variation in observed carcass densities since we used only the most regularly-covered beaches for the seasonal and annual analyses. Below, we discuss the roles that variation in environmental factors and bird behavior, abundance, and mortality rate may have played in variation in carcass densities.

Environmental factors included the rate of carcass persistence on the beach and the net effect of onshore deposition forces against factors that cause carcass loss at sea (hereafter, net deposition). The rate of carcass persistence should be closely related to predictable seasonal cycles of sand movement between the beach and subtidal offshore bars. Beach building occurs approximately between March and August and beach erosion between November and February. We expect a greater proportion of the birds that deposit on the beach to be found on surveys in spring and fall (March to October, the beach building period) than in winter (November to February, the erosion period).

Net deposition can be expressed as the probability that a carcass at sea will be deposited on shore; it should be a function of the strength and direction of winds and currents at a general location, the abundance of at-sea scavengers, and the distance that carcasses

originate from shore. Along the California coast, the prevailing winds are north-northeast, parallel to the general direction of the coastline, but winter storm winds tend to arrive off the ocean from a southwesterly direction, which is more directly onshore. Winds and currents are fairly similar between most years at any general location along the coast, except perhaps in winter, due to annual variation in storm severity and frequency. The effect of at-sea scavengers may have changed over the 14 years of study. It is possible that the abundance of sharks has increased in concert with local increases in California population sizes for some marine mammals in recent years. The effect of such an increase could be to decrease the proportion of carcasses at sea that deposit onshore. It is also possible that the abundance of at-sea scavengers changed seasonally. Since the distance a carcass originates from shore is closely tied to the birds' behavior, it is discussed below.

Environmental factors for net deposition and subsequent persistence of carcasses must vary considerably over a year. Net deposition is probably lower but persistence higher from spring to fall than in winter. The limited data on net deposition and carcass persistence on the southern Marin County coastline lend support to these generalizations (Page et al. 1982). Although we can predict that changes in the two environmental forces over a year will tend to cancel one another, we have no quantitative information on their relative importance in determining carcass densities at any time of year.

The four factors related to birds include mortality rate, the number of live birds in the adjacent ocean, their at-sea distribution, and their response to impairment. For most species, information on the

number of live birds is fairly good for seasonal patterns but not for annual variation. The general features of at-sea distribution for most species are fairly well described, but this is not so for local distributional anomalies. At-sea distribution, in particular, distance from shore, is known to vary seasonally for some species (Ainley and Boekelheide ms in prep.). Further, years of unusually low prey abundance may cause some annual variation in the distance of some species from shore, as described for the Common Murre in Ainley and Boekelheide (ms in prep.). The at-sea distribution factor may be complicated if sick, injured, or starving birds tend to be located farther from or closer to shore than healthy ones. A tendency for ailing birds to move closer than healthy birds to shore is suggested by the ill and injured seabirds that are sometimes found dying onshore. That tendency should be similar for individuals of a single species but not necessarily of different species. Therefore, variation in the tendency to move inshore will likely affect between-species comparisons of carcass densities but not spatial or temporal comparisons for individual species. Given all these points, our goal is to relate mortality rates to carcass densities.

We suspect that seasonal patterns of winds and currents, carcass persistence on beaches, live bird abundance, at-sea distribution, and scavenger abundance are the most serious variables disguising the true patterns of seasonal mortality. Highest carcass density peaks were exhibited by resident, breeding species such as the cormorants, Western Gull, Common Murre, and Cassin's Auklet between August and October when food availability is low in central California coast waters (Ainley and Boekelheide ms is prep.) and newly-fledged, inexperienced individuals

are abundant. For nonresident species, the information on seasonal carcass density patterns, previously reviewed in the species accounts, indicated that the presence or absence of carcasses of a given species had much to do with the presence or absence of a source population offshore; deposition rates were often highest in seasons when a species was known to be most abundant. This point is best illustrated by the carcass density patterns north of Point Conception for the fall to early winter visitants, such as the Brown Pelican and Heermann's Gull, and for the wintering species that breed farther north, such as the loons, grebes, and scoters. Carcass density peaks were unusual during spring north of Point Conception.

In contrast, among a number of northern species occurring near the southern end of their geographic ranges, there appeared to be an "out-of-season" mortality which involved species that should have already moved northward for breeding. In other words, a peak in carcass occurrence rates appeared during a time when the species is generally not considered to be present in any significant numbers. This was most evident in the southern region for loons, Northern Fulmar, Black-legged Kittiwake, Common Murre and Rhinoceros Auklet. It seemed that individuals of these species were caught in an environment with which they could not easily cope. Many of these birds, characterized by worn plumage that should have been molted, possibly lacked sufficient nutritional reserves to survive the spring.

We suspect that winds and currents, and carcass persistence were fairly similar from year to year for any season. There may have been some increase over the study period in the abundance of scavengers. However, we discount its importance since the predicted effect, a

reduction in the net deposition due to an increase in at-sea scavenging of carcasses, would have caused a decline in carcass densities over the period of study. We did not observe such a decline for any species. Therefore, the factors that must be considered most probable causes of interannual variation in carcass densities are variation in mortality rates, variation in live bird abundance, and variation in at-sea distribution.

Several pieces of evidence cause us to suspect that variation in mortality rates may have been a major factor affecting some variation in carcass densities. We could not ascribe a cause of death to the great majority of carcasses, as described below. Therefore, we hypothesize that most mortality (except during the gill net episode) must have been due to stress as a result of inadequate food procurement. If this hypothesis is true, then periods of high carcass densities should correspond to periods of known food web perturbation. The most obvious of these periods are the El Nino-Southern Oscillations (ENSO) when warm waters disrupt the food web (see Ainley and Boekleheide ms in prep., for review). The ENSOs of 1972-73, 1976 and 1982-83 occurred during the study period, and along with another exceptional warm-water period (spring 1978) led to poor food availability and poor reproductive performance of seabirds at the Farallon Islands.

Our rankings of years identified some seasons in which densities were exceptional high, although not necessarily for all species. Carcass densities were especially high in fall 1973, 1976, and 1980 to 1982, in winter 1979-80, and in spring 1977 and 1980; they also were high but more variable in fall 1975, in winter 1971-72, 1972-73, 1975-

76, and 1982-83, and in spring 1978 (Fig. 73). Except for the winter 1971-72, fall 1975 to winter 1975-76, and various 1979 to 1981 seasons, all of these periods included known ENSOs or other warm water periods. Further, all ENSOs and warm water periods included times of high carcass densities.

The converse of warm-water periods and disrupted food webs, are those periods when prey are exceedingly abundant. In central California (near the Farallones), such periods occurred in 1971, 1974-75, 1977, 1979 and 1985 (Ainley and Boekelheide ms in prep.). Our analysis indicated low carcass densities on beaches in fall 1979, and in spring 1979, 1984, and 1985; densities were generally low but variable in fall 1983 and 1984, and in winter 1984-85 (Fig. 73). Low carcass densities before the 1975-76 study year were not easily identified due to low sample sizes, although densities in fall 1974 and winter 1974-75 appeared to be lower than most years. Low densities in fall 1983 were particularly enigmatic, since this was an ENSO period.

The correspondence between periods of especially low and high carcass densities, and known periods of high and low food availability, respectively, in central California lend support to the hypothesis that much of the annual variation in carcass occurrence rates was due to mortality, or the lack thereof, as a function of physiological condition. It is possible that correspondence would have been even closer were it not for the gill netting which exacted a heavy toll beginning in 1980. Mortality in the latter year, in fact, ranked the highest, generally speaking, for the entire study period. Between then and 1983, populations of Farallon diving species dropped precipitously (Ainley and Boekelheide ms in prep.). In 1980, the food web may have

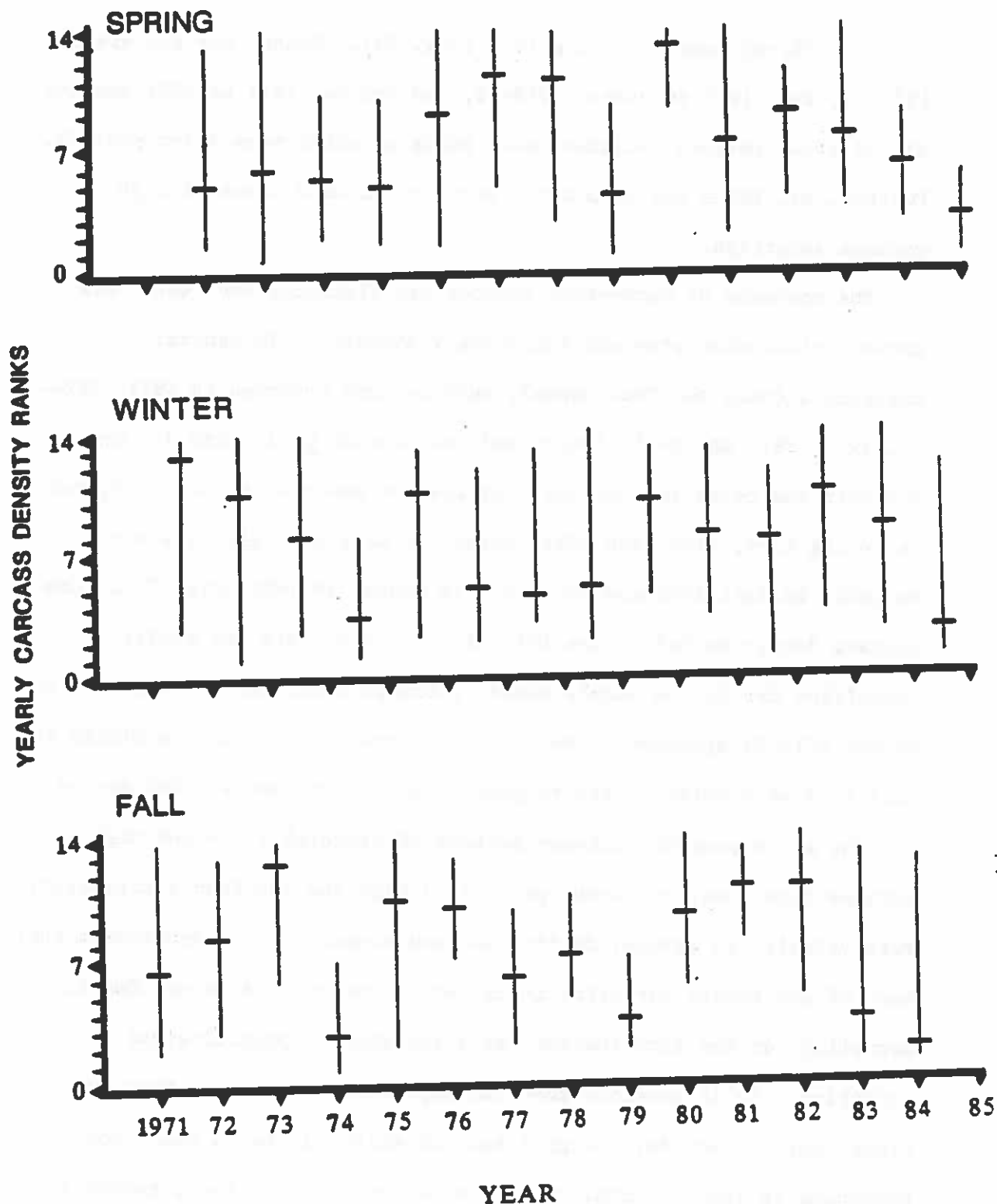


Fig. 73. Annual variation in yearly carcass density ranks for selected species or age classes. Vertical bar extends between minimum and maximum ranks, horizontal bar marks median rank for each year. See methods for details.

been perturbed enough by the mild conditions to bring diving species into nearshore waters, which is the pattern we have observed under such conditions. Nearshore, they encountered gill nets deployed in unprecedented numbers. It may be that without gill netting, the unusually heavy mortality of 1980 may not have occurred.

Cause of Death

Cause of death could not be determined for most carcasses due to the lack of definitive evidence for many natural causes such as disease and starvation, and the deteriorated condition in which many birds were found. Most identifiable causes were related to man's activities. Only 11.9% of all carcasses found were ascribed to a cause of death and, of those, 83.0% were oiled (Table 5). Comparing the 13 species groups with at least 20 known-cause carcasses, the percent oiled varied from 24.2% for waterfowl to 98.8% for small alcids (Table 5). The percent of known-cause carcasses that were oiled was at least 75% for 8 and 50% for 11 of the 13 groups (Table 5) further attesting to the importance of oil among causes of death. An additional 11.9% were found shot or tangled in fishing gear or plastic six-pack can holders; we believe the 4.5% that were found with broken wings to have been shooting or fishing gear victims, as described below. The 27 carcasses that were found with large fish blocking their throats (under the cause labeled choked in Table 5) fell into the one identifiable death category that was clearly unrelated to man's activities.

Among the ten species groups with at least 20 carcasses per region, several sustained either unusually high or unusually low oiling rates (percent of carcasses oiled) in most regions. Oiling rates for large

Table 5. Suspected cause of death: percent of carcasses attributed to various factors. Includes all birds found from June 1971 to May 1985. Birds attributed to oil were found with visible oil on plumage. Birds attributed to fishing line, plastic six-pack holders, and gill nets were found entangled in those articles. Choked indicates that the bird was found with an object, almost always a fish, stuck in its throat. Broken wing is explained in the results.

SPECIES GROUP	TOTAL	PERCENT KNOWN	KNOWN CAUSE	OILED	SHOT	FISHING LINE	6-PACK HOLDER	CHOKED	BROKEN WING	GILL NET
LOONS	1796	17.15	308	87.99	1.30	5.04	2.92	0.00	1.95	0.00
LARGE GREBES	3573	10.33	369	70.32	4.61	6.70	0.01	0.27	0.67	0.34
SMALL GREBES	701	15.04	97	89.69	1.03	1.03	1.03	0.00	6.19	1.03
LARGE TUBENOSES	5010	12.40	622	92.44	0.96	4.34	0.14	0.40	1.29	0.32
STORM PETRELS	90	2.04	2	100.00	0.00	0.00	0.00	0.00	0.00	0.00
CORMORANTS	3057	6.30	243	50.02	1.65	25.51	0.00	3.29	11.32	0.00
PELICANS	316	10.76	34	50.00	2.94	23.33	0.00	2.94	20.59	0.00
HERONS & EGRETS	22	4.55	1	0.00	0.00	100.00	0.00	0.00	0.00	0.00
SCOTERS	2264	4.95	112	83.93	1.79	5.36	0.00	0.00	0.93	0.00
OTHER WATERFOWL	313	19.01	62	24.19	64.52	1.61	0.00	3.23	6.45	0.00
RAILS & COOTS	137	5.04	0	50.00	0.00	12.50	0.00	0.00	37.50	0.00
PHALAROPES	990	3.64	36	85.33	0.33	2.70	0.00	0.00	5.56	0.00
OTHER SHOREBIRDS	313	16.29	51	47.06	17.65	7.04	0.00	0.00	27.45	0.00
JACOBES & SKuas	25	24.00	6	50.00	0.00	0.00	0.00	0.00	50.00	0.00
BULLS	5902	9.93	586	60.24	14.60	9.56	1.02	1.00	32.53	0.00
TERNS	55	10.10	6	66.67	0.00	33.33	0.00	0.00	0.00	0.00
LARGE ALCIDES	13109	15.00	2004	91.94	0.05	4.51	0.40	0.05	0.72	2.26
SMALL ALCIDES	897	9.59	86	98.84	0.00	0.00	0.00	0.00	1.16	0.00
ALL	39444	11.95	4713	82.96	3.69	6.51	0.64	0.57	4.52	1.10

Table 6. Percent of carcasses oiled on outer California coast, by region. Includes all birds from June 1971 to May 1985.

SPECIES GROUP	REGION											
	NORTHEAST CALIFORNIA			GULF OF THE FARALLONES			MONTEREY BAY			CENTRO BAY		
	PERCENT	TOTAL	OILED	PERCENT	TOTAL	OILED	PERCENT	TOTAL	OILED	PERCENT	TOTAL	OILED
LOONS	171	3.31	433	16.11	403	9.81	273	3.44	194	47.42	200	23.00
LARGE GREGGIES	401	0.73	1271	6.22	861	4.10	310	1.76	274	47.43	234	13.23
SMALL GREGGIES	60	0.00	134	3.60	173	6.94	96	6.23	106	31.09	129	6.90
LARGE TUBENOSSES	323	1.23	1322	0.62	1316	4.02	302	6.29	491	32.79	1062	19.21
STORM PETRELS	16	6.23	24	0.00	30	0.00	2	0.00	1	100.00	7	0.00
CORMORANTS	239	0.39	1006	1.00	1079	0.93	317	0.32	249	42.17	133	4.44
PELICANS	0	0.00	64	1.34	119	0.04	39	0.00	30	31.30	27	11.11
HERONS & EGRETS	3	0.00	3	0.00	2	0.00	4	0.00	2	0.00	1	0.00
SCOTERS	371	0.34	602	3.72	604	2.40	243	0.41	63	43.00	74	9.46
OTHER WATERFOWL	21	0.00	163	3.32	33	0.00	13	0.00	30	0.00	17	0.00
RAILS & COOTS	13	0.00	89	2.23	13	0.00	3	0.00	10	20.00	4	0.00
PHALAROPES	124	0.01	234	2.34	433	2.06	62	1.61	24	16.67	69	7.33
OTHER SNOODERDS	42	2.30	90	2.22	33	0.00	42	4.74	60	30.00	23	4.00
JACUERS & SKURS	1	0.00	0	0.00	3	0.00	2	0.00	2	100.00	0	23.00
GULLS	397	0.04	2320	4.90	1410	3.17	301	1.00	346	20.01	893	12.77
TERNS	4	0.00	7	0.00	11	0.00	2	0.00	3	66.67	3	40.00
LARGE ALCEIDS	1606	2.93	7272	13.03	3099	17.01	643	7.73	209	77.31	230	46.12
SMALL ALCEIDS	70	0.00	434	4.03	213	20.00	79	3.06	10	22.22	61	19.67
ALL	4096	1.73	14430	0.72	10263	0.00	2963	3.30	2221	41.20	3209	17.40

alcids were among the highest two (of the ten) rates in all six regions, those for loons among the highest two rates in four regions, and those for large tubenoses among the highest four rates in five regions (Table 6). In contrast, several species groups appeared to be relatively little affected by oil (Table 6). Oiling rates for cormorants were among the lowest two rates in five regions and those for phalaropes among the lowest four rates in five regions. The rates for shorebirds, other than phalaropes, were among the three lowest rates in four regions, but among the fourth highest in the other two regions (although rates in the latter regions were generally so low that these were still fairly low).

Among the four species groups with sample sizes of less than 20 carcasses in at least two regions, three sustained relatively low and one relatively high oiling rates (Table 6). Brown Pelican oiling rates were among the lowest four in four of the five region for which at least 20 were found. Oiling rates for waterfowl, other than scoters, were among the lowest three rates in three of the four regions with at least 20 carcasses. No storm-petrels were found oiled in the two regions with at least 20 carcasses. Oiling rates of small alcids, with at least 20 carcasses in five regions, were among the highest four rates in three regions.

Oiling rates were not clearly relatively high or low for grebes. Again considering ranks among the ten species groups for which the sample sizes in all regions were at least 20, oiling rates for small grebes were among the highest three in three regions but also among the lowest four in the other three regions (Table 6). Rates for large grebes ranged between the fourth lowest and the third highest in the

six regions (Table 6).

A striking feature of Table 6 is that the percent of carcasses oiled varies geographically, with percentages in regions south of Point Conception generally higher than those to the north. Here, we again consider the ten species groups with sample sizes of at least 20 in each region. The percent of carcasses oiled was highest in the Santa Barbara Channel region for all ten species groups. The second highest percentages were found in the Southern California region for nine species groups; the rank for the other group was third highest. Third highest percentages tended to occur in the Gulf of the Farallones; ranks were third highest for six groups, third lowest for two groups, and second lowest for two groups. Third lowest percentages tended to occur in Monterey Bay; ranks were lowest for one group, second lowest for one group, third lowest for five groups, and third highest for three groups. The second lowest percentages tended to occur in the Estero Bay region where oiling rates ranked lowest for two groups, second lowest for five groups, third lowest for two groups, but second highest for one group, shorebirds other than phalaropes. The lowest percentages of carcasses oiled occurred in Northern California for seven species groups; ranks for the other three groups were either second or third lowest.

Since different beaches presumably collect carcasses from different ocean areas within a region, we suspected that beaches were better sampling units than species groups for comparing regional oiling rates. In Figure 74 we compared oiling percentages among beaches in the six regions. Percentages for beaches in the Santa Barbara Channel region were obviously greater than those in the other regions, particularly

PERCENT OF CARCASSES OILED OUTER COAST BEACHES

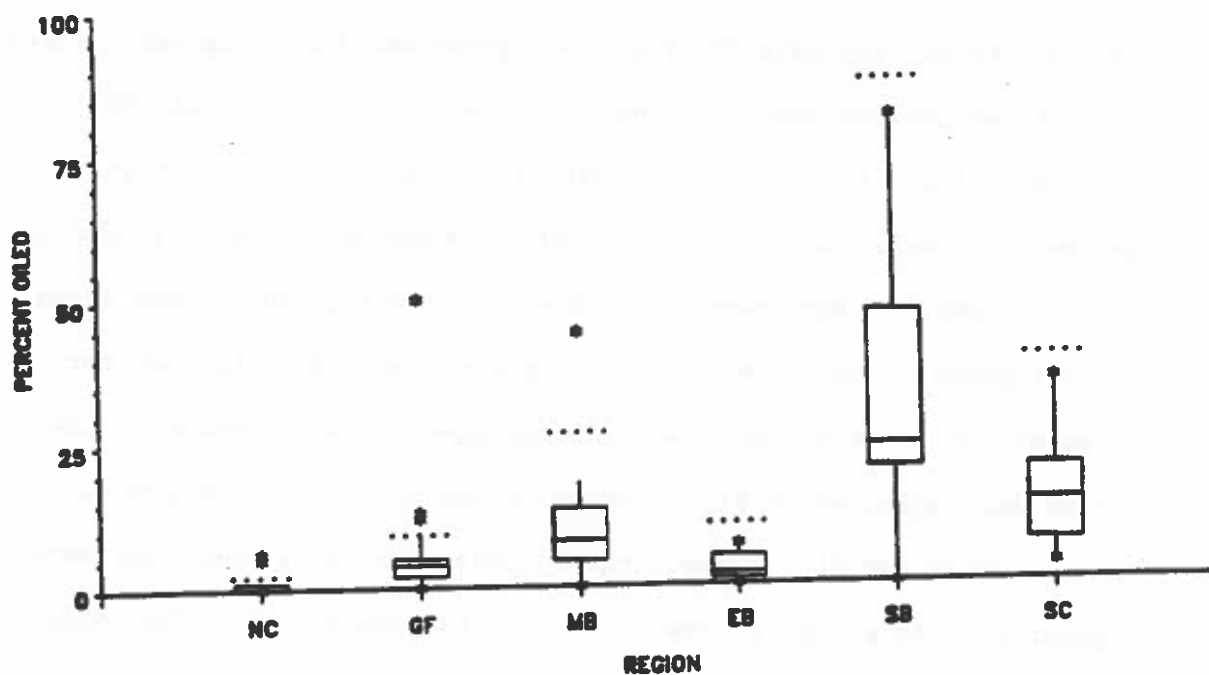


Fig. 74. Regional variation in percent of carcasses oiled. Sample sizes were 11 beaches for Northern California (NC), 25 for the Gulf of the Farallones (GF), 15 for Monterey Bay (MB), 6 for Estero Bay (EB), 13 for the Santa Barbara Channel (SB), and 10 for Southern California (SC). See methods for description of boxplots.

those north of Point Conception. The range of percentages in the Santa Barbara Channel region is increased by including San Nicolas Island, which, although in Ventura County, is considerably south of the Santa Barbara Channel. Percentages for two of the three beaches on San Nicolas Island were the lowest and second lowest for the region. If the three San Nicolas Island beaches are omitted from the sample, the minimum for the region becomes 19.6% oiled and the difference between the Santa Barbara Channel and the other regions becomes even greater.

Carcass oiling rates varied between nearby beaches in the Gulf of the Farallones and Monterey Bay, where we had sufficient samples of carcasses in fall and winter on individual beaches over several years for comparison. Annual fall oiling rates for Ocean and Cronkhite beaches, the two survey beaches closest to the Golden Gate entrance, were higher than those for Muir, Seadrift, RCA, Limantour, and Salmon Creek beaches (Fig. 75). In winter, oiling rates remained low for Muir and Salmon Creek beaches but were higher than in fall for Seadrift and RCA beaches; winter rates for Ocean Beach were similar to those for fall (Fig. 76). Too few carcasses were found on Cronkhite and Limantour beaches in winter for comparison. In Monterey Bay, fall oiling rates tended to be higher on Rio del Mar and Pajaro beaches than on Del Monte, Jetty, and Laguna beaches (Fig. 77). In winter, oiling rates on Laguna Beach were somewhat higher and on Jetty lower than on Del Monte and Pajaro Dunes beaches; there was only one year of data from Rio del Mar (Fig. 78).

Other causes of death (excluding visible oiling) affected some of the species groups. About 65% of the known-cause (or 12.8% of the total) waterfowl carcasses, excluding scoters, were found shot; except

GULF OF THE FARALLONES BEACHES

FALL MONTHS

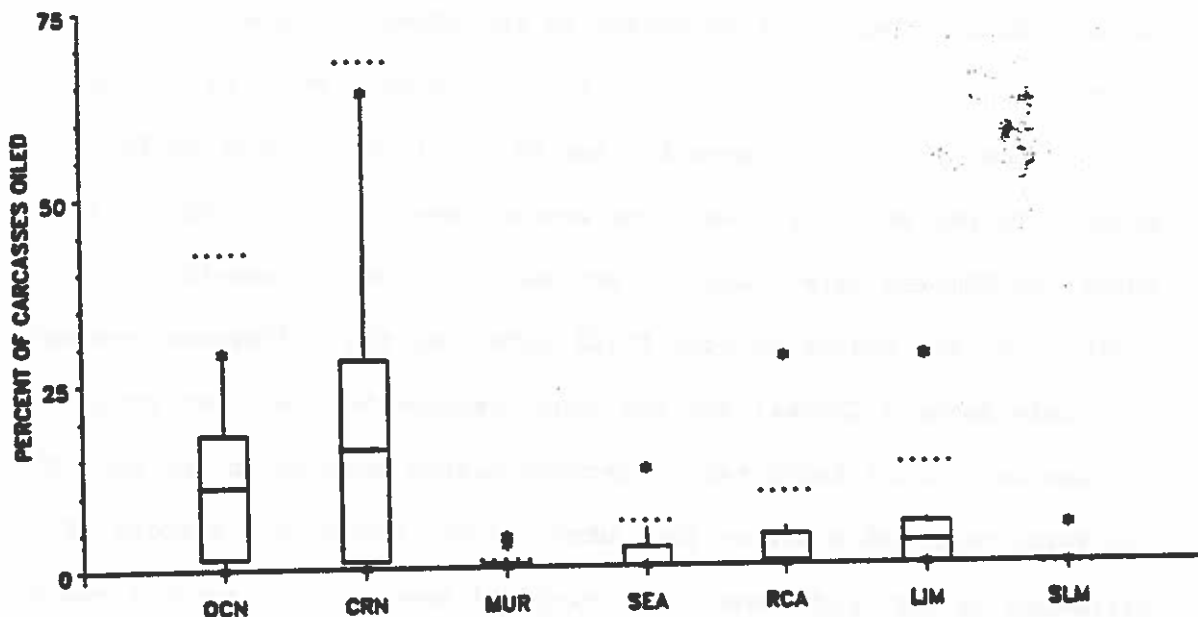


Fig. 75. Annual variation in percent of carcasses oiled for six beaches in the Gulf of the Farallones and Salmon Creek Beach. Sample sizes were 11 years for OCN (Ocean), 11 for CRN (Cronkhite), 11 for MUR (Muir), 12 for SEA (Seadrift), 8 for RCA, 7 for LIM (Limantour), and 5 for SLM (Salmon Creek). See methods for details.

GULF OF THE FARALLONES BEACHES

WINTER MONTHS

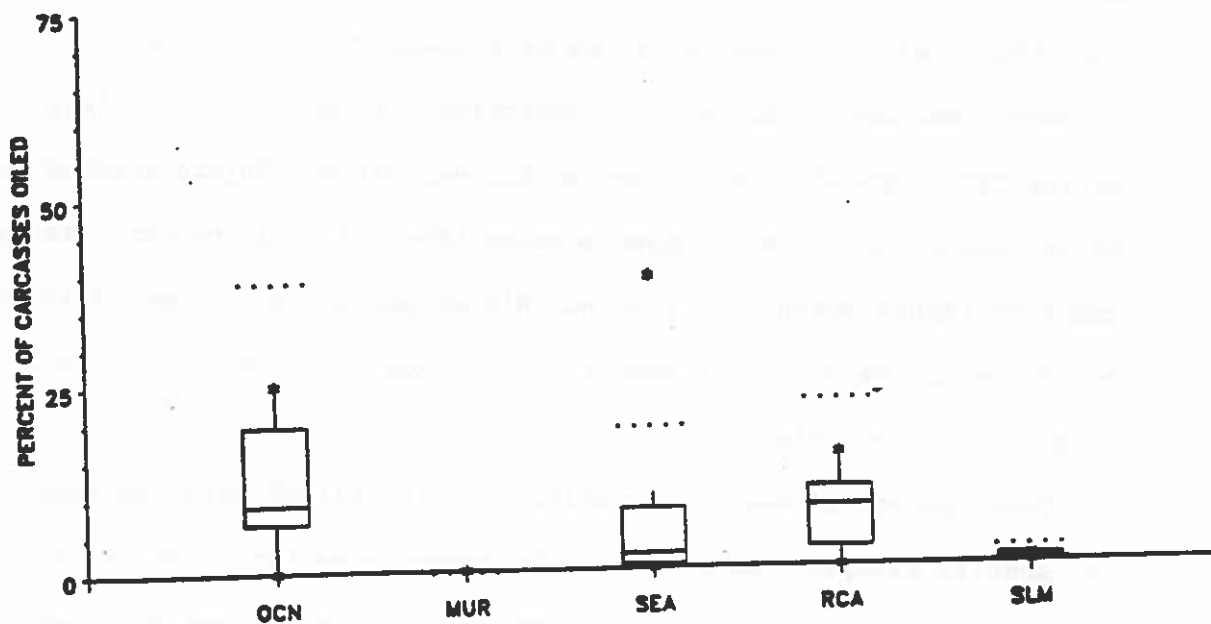


Fig. 76. Annual variation in percent of carcasses oiled for four beaches in the Gulf of the Farallones and Salmon Creek Beach. Sample sizes were 7 years for OCN (Ocean), 6 for MUR (Muir), 11 for SEA (Seadrift), 8 for RCA, and 2 for SLM (Salmon Creek). See methods for details.

MONTEREY BAY BEACHES FALL MONTHS

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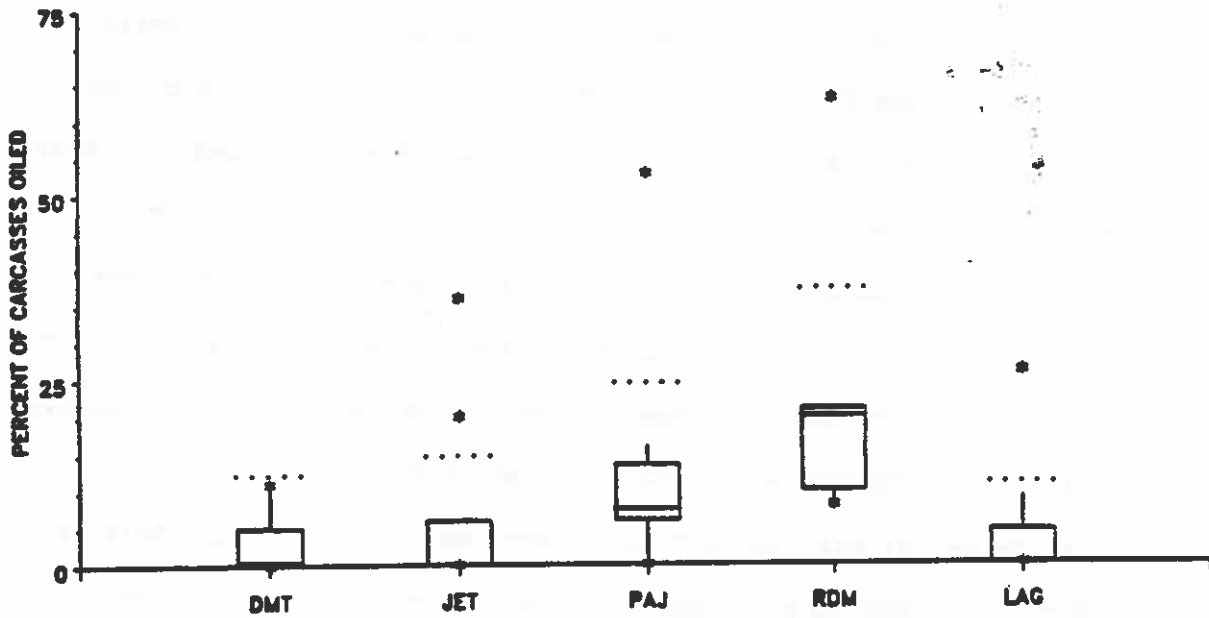


Fig. 77. Annual variation in percent of carcasses oiled for five beaches on Monterey Bay. Sample sizes were 10 years for DMT (Del Monte), 9 for JET (Jetty), 12 for PAJ (Pajaro Dunes), 6 for RDM (Rio del Mar), and 7 for LAG (Laguna). See methods for details.

MONTEREY BAY BEACHES WINTER MONTHS

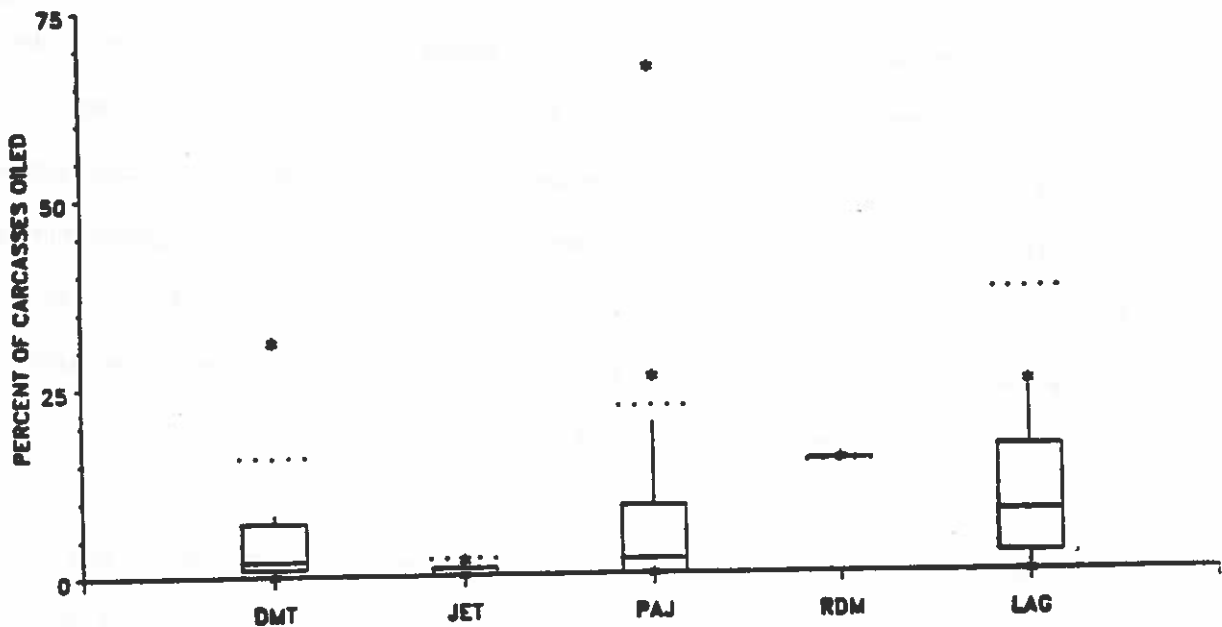


Fig. 78. Annual variation in percent of carcasses oiled for five beaches on Monterey Bay. Sample sizes were 10 years for DMT (Del Monte), 5 for JET (Jetty), 13 for PAJ (Pajaro Dunes), 1 for RDM (Rio del Mar), and 7 for LAG (Laguna). See methods for details.

for this group, large grebes, shorebirds, and gulls shooting appeared to be a negligible factor for most groups. About one fourth of the known-cause cormorants and Brown Pelicans were found tangled in fishing line; these represented 1.6% and 2.5%, respectively, of the total carcasses for these groups. Two of the six known-cause terns were found tangled in fishing line; although these numbers are small, they represent 6% of the 33 terns found. Among other groups, less than 1.0% of the total carcasses were found tangled in fishing line.

Incidences of gill net mortality were very common in the Gulf of the Farallones and Monterey Bay from 1980 to post 1985 (Wild 1984, 1986; Carter in Appendix B; Heneman in Appendix C). Fifty two carcasses were found on beaches tangled in gill net during our surveys; of these, 47 were Common Murres. Except for the 52 carcasses, most gill net casualties could not be identified as such at the times of our surveys. Nevertheless, there was one instance, on a beach onshore of a gill net fishing area, of a catastrophic kill of Common Murres that was obviously caused by the fishery. On 6 August 1983, 455 freshly-killed, adult-sized, non-oiled murres were found on Montara Beach, San Mateo County. Four days later 463 decomposing, adult-sized, non-oiled murres were found on this same beach. These 918 birds were the highest number found in any single month on a surveyed beach (Table 4). All these birds had obviously arrived on the beach at about the same time since they were all in the same state of decomposition on each day. The magnitude of this kill is underlined by the fact that those 918 birds represent about one seventh of all murres found on surveys in the Gulf of the Farallones in the 14-year study. In most cases, surveys were not conducted immediately after a gill net wreck was deposited onshore

and carcass loss from beaches between the time of deposition and the time of the survey tended to diminish the apparent magnitude of the mortality. Elevated carcass densities for several species from spring 1980 to spring 1982, before mortality due to an ENSO was apparent, were probably due mostly if not entirely to the gill nets.

A category of mortality that encompasses birds killed by shooting and fishing gear is labeled "broken wing" in Table 5. We noted that the wings also were broken on many of the shot and tangled carcasses, as did Spear et al. (1987). With the exception of waterfowl (excluding scoters) bird groups with combined percentages of shot and tangled carcasses exceeding 20% of the total known-cause carcasses (cormorants, pelicans, shorebirds other than phalaropes, and gulls) were the same ones with the highest percentages of broken wings. We suspect that carcasses with broken wings were probably shooting or fishing line victims but, by the time they were found, lacked the evidence necessary to so assign them.

RESULTS PART II: IMPACT OF THE PUERTO RICAN OIL SPILL (PROS)

The movement of oil at sea during the PROS was well documented by U.S. Coast Guard, PRBO, and U.C. Santa Cruz (Herz and Kopec 1985, PRBO 1985). The T/V Puerto Rican held 91,984 barrels (bbs) of lube oil and 8500 bbs of bunker (crude) oil when it exploded a few miles seaward of the Golden Gate early on the morning of 31 October 1984. A small oil slick was first noted later that day as the T/V Puerto Rican was towed away from shore. On 1 and 2 November, the T/V Puerto Rican was held in position by tugs between 10 and 20 miles S of the Farallon Islands. On 2 November, it began to leak badly and, that night, broke in half, releasing 39,753 barrels of oil. This discharge included: Bunker C fuel oil (8500 bbs), OLOA 246B (9348 bbs), WITCO 233 TR (11,730 bbs), Polybutene 24 (4614 bbs), Alkane 60 (10,425 bbs), Alkane 56 (3425 bbs), and diesel, lube, and hydraulic oils (211 bbs). An additional 52,231 bbs of oil remained in the stern section which sank. On 3 November, slicks extended for 10 miles SW to SE of the breakup location. That afternoon, about 2500 gallons of oil dispersant COREXIT 9527 was sprayed on the larger slicks. Slicks remained in this general area on 4 and 5 November but by 6 November, were suddenly carried north to the Farallon Islands with a rapid advance of the Davidson Inshore Current front. The main slicks continued northwards on 7 and 8 November. By afternoon on 8 November, oil had come ashore at Point Reyes A Beach (PRBO, unpubl. data). Extensive overflights on 9 November showed that slicks had moved both south and north of Point Reyes. Slicks had reached Limantour Estero by 9 November but did not move farther south. From 8 to 11 November, slicks moved along the north side of the Point

Reyes peninsula, entered Bodega Bay and Harbor, and then continued north past Bodega Head. Oil was reported on all beaches north of Point Reyes and on Drakes Beach (south of Point Reyes) by 9 November (PRBO 1985, unpubl. data).

Beached birds on eight Marin County beaches during the PROS

At least 308 Common Murres (86.4% oiled), 34 loons (94.1% oiled), and 21 Western/Clark's grebes (66.7% oiled) were reported on Bolinas, RCA, Limantour, and Drakes beaches and on the four sections of Point Reyes Beach from 7 to 11 November 1984 during the PROS. These totals do not include 43 live, ailing murres and 3 live, ailing grebes that were not removed from beaches when first found and could have been among the birds found the following day. Some of these 46 birds may have left the beach and not have been among the carcasses found the following day. In that case, up to 351 Common Murres (86.0% oiled) and 24 Western/Clark's grebes (58.3% oiled) may have been deposited on these eight beaches during the five day period. We do not include these 46 birds in our analysis of the impact of the PROS.

Live oiled birds first came ashore on 6 November at the Farallon Islands and peaked in number there on 7 November after the main slicks had moved 8 to 16 kms northward (PRBO 1985, unpubl. data). Live oiled birds were first reported on the mainland at Bolinas, RCA, and Drakes beaches on 7 November. Oil did not reach shore until 8 November. The difference in timing could be accounted for by a shoreward movement of debilitated birds, which accelerated their arrival over the passively transported oil. The peak number of live oiled beached birds, both south and north of Point Reyes, coincided with the movement of oil

slicks close to shore on 8 November. On all beaches, visibly oiled birds were thinly coated with light-brown lube oil or had a thick matting of dark-brown crude oil on their feathers. Numbers of live oiled birds had decreased by 9 November, as the main slicks passed beaches on the north side of Point Reyes. Large numbers of dead oiled birds, which beached on 8 and 9 November, coincided with onshore west winds north of Point Reyes on the same dates. During offshore S-SE winds on 10 and 11 November, only small numbers of live and dead oiled birds beached north of Point Reyes. South of Point Reyes, where these winds were onshore, a second peak of dead oiled birds occurred, primarily on Drakes and Limantour beaches. Large numbers of live and dead oiled birds beached between 10 and 12 November in the Bodega Bay area (PRBO 1985, Page and Carter 1986).

Common Murres

The vast majority of birds that beached south of Bodega Harbor during the PROS were Common Murres. Large numbers of murres probably were not oiled until 5 and 6 November when slicks moved near the Farallon Islands. At this time murres occurred in low density on the outer shelf, except around the Farallon Islands (PRBO 1985). Between 7 and 9 November, large numbers of murres probably also were oiled as slicks moved into high densities of murres on inner shelf waters between the Farallon Islands and both sides of the Point Reyes peninsula (PRBO 1985). Thus, there was up to a day delay from when murres were oiled at sea to when they reached mainland beaches in large numbers on 8 and 9 November. The largest number of dead murres beached south of Point Reyes on 10 and 11 November, indicating a delay of 2-3

days for carcasses to reach shore. The delay for murre carcasses was shorter (1-2 days) north of Point Reyes where slicks moved closer to shore. This contrast suggests that more at-sea loss of impacted birds occurred to the south than north of Point Reyes. A difference in at-sea carcass loss may also account partly for lower numbers of murre south than north of Point Reyes, although the strong current that carried most oil to the north of Point Reyes also may have carried most birds (live and dead) in that direction.

By 10 November, Common Murres were beaching north of Point Reyes in low numbers. These beaches were not checked again until 19 November when nine dead murre were found. Most of these, as well as seven murre found on 29 and 30 November, probably were oiled in PROS slicks that passed this area on 8 and 9 November. However, some may have been impacted by a second small discharge from the sunken stern noted on 14 November (PRBO 1985). The possibility of oiling from a second event is supported by the finding of 4 live and 3 dead oiled murre on 29-30 November and the renewed presence of oil on beaches north of Point Reyes at this time.

South of Point Reyes on 10 and 11 November, large numbers of dead oiled murre were still coming ashore on Drakes and Limantour beaches (Table 7). Although only eight dead murre were found on 19 November on the southern beaches, a significant number may have continued to beach, at least until 12 November. Many of these carcasses could have disappeared before 19 November by being being washed back out to sea, buried in the sand, or removed by scavengers. This extended period of beaching is consistent with the greater distance from this shore that birds were oiled and the greater length of time it would take these to

Table 7. Daily numbers of oiled (o) and not visibly oiled (NO) birds for three taxa found on eight beaches between 7 and 11 November 1984 during the PROS. Beaches ordered from south to north (1-8): Bolinas, RCA, Limantour, Drakes, Point Reyes D, C, B, A. O indicates oiled birds, NO indicates not visibly-oiled birds, T indicates total birds.

Species	Beach	November 1984										Total			Days	PR rate	
		7		8		9		10		11						(birds/day)	
		O	NO	O	NO	O	NO	O	NO	O	NO	O	NO	T		O	TOTAL
Common Murre	1	5	0	4	1	5	0	1	0	2	0	17	1	18	5	3.40	3.60
	2	3	0	5	3	1	1	1	0	5	0	15	4	19	5	3.00	3.80
	3	-	-	8	1	5	1	14	19	-	-	27	21	48	4	6.75	12.00
	4	2	0	5	3	0	0	-	-	11	0	18	3	21	5	3.60	4.20
	5	-	-	18	3	51	0	3	0	-	-	72	3	75	4	18.00	18.75
	6	-	-	52	3	3	0	1	0	-	-	56	3	59	4	14.00	14.75
	7	-	-	9	3	15	3	8	0	-	-	32	6	38	4	8.00	9.50
	8	-	-	21	0	4	1	4	0	-	-	29	1	30	4	7.25	7.50
Loons	1	0	0	0	0	1	0	0	0	0	0	1	0	1	4	0.25	0.25
	2	0	0	1	0	0	0	0	0	3	0	4	0	4	4	1.00	1.00
	3	-	-	1	0	1	1	1	0	-	-	3	1	4	3	1.00	1.33
	4	0	0	2	0	0	0	-	-	2	0	4	0	4	4	1.00	1.00
	5	-	-	0	0	10	0	0	0	-	-	10	0	10	3	3.33	3.33
	6	-	-	0	0	0	0	1	0	-	-	1	0	1	3	0.33	0.33
	7	-	-	0	0	0	0	4	0	-	-	4	0	4	3	1.33	1.33
	8	-	-	2	1	1	0	2	0	-	-	5	1	6	3	1.67	2.00
Western/ Clark's grebes	1	0	1	0	0	0	1	1	0	0	0	1	2	3	4	0.25	0.75
	2	0	0	0	0	0	0	1	0	1	0	2	0	2	4	0.50	0.50
	3	-	-	1	0	0	0	0	2	-	-	1	2	3	3	0.33	1.00
	4	0	0	1	1	1	0	-	-	2	0	4	1	5	4	1.00	1.25
	5	-	-	0	0	1	0	0	0	-	-	1	0	1	3	0.33	0.33
	6	-	-	1	1	0	0	0	0	-	-	1	1	2	3	0.33	0.67
	7	-	-	1	0	0	0	1	0	-	-	2	0	2	3	0.67	0.67
	8	-	-	1	1	0	0	1	0	-	-	2	1	3	3	0.67	1.00

make it to shore south of, compared to north of Point Reyes.

Loons

Loons probably were oiled in much the same places and times as murre. Loons and murre were recovered on the Farallon Islands and seen around slicks south of Point Reyes on 8 November (PRBO 1985). On aerial censuses they occurred in the same areas as murre, but unlike murre did not occur in higher densities around the Farallon Islands. Loons occurred in highest densities in inner shelf and shoreline habitats (PRBO 1985). Thus, a higher proportion of impacted loons than murre probably were oiled very near shore; consequently, loons as a whole probably experienced less at-sea loss. Loons were not found on beaches until 8 November. North of Point Reyes, beached live and dead oiled loons peaked on 9 November when the main slicks passed close to shore but live loons continued to beach on 10 November. Seven dead loons were found on 19 November. Loon beachings extended to 29 and 30 November when 6 live and 11 dead loons were found. South of Point Reyes, numbers of beached live oiled loons peaked on 8 and 9 November, and again on 11 November. Dead oiled loons beached in low numbers from 8 to 11 November. One live oiled loon on 16 November and two dead ones on 19 November suggested that an extended period of loon beachings also occurred south of Point Reyes.

Western/Clark's Grebes

Since Western/Clark's grebes were distributed almost solely in shoreline habitats (PRBO 1985), they probably were not oiled in any number until slicks reached shore on 8 and 9 November. None were

Table 8. Numbers of the three species found on 8 beaches on 16, 19, 29, and 30 November 1984 after the PROS. Includes birds in all stages of decomposition by excludes two Common Murres that were known to have died from other causes (plastic strangling). For beach 8 on 30 November, excludes one Common Murre and three loons that were live, oiled, and not removed on 29 November. Beach identifications and O, NO, and T as in Table 7. Days are days since previous survey.

Species	Beach	November 1984												Total		
		16			19			29			30			O	NO	T
		days	O	NO	days	O	NO	days	O	NO	days	O	NO			
Common Murre	1	5	0	0	-	-	-	-	-	-	-	-	-	0	0	0
	2	5	0	0	-	-	-	-	-	-	-	-	-	0	0	0
	3	-	-	-	9	3	0	-	-	-	-	-	-	3	0	3
	4	-	-	-	8	3	2	-	-	-	-	-	-	3	2	5
	5	-	-	-	9	2	1	-	-	-	-	-	-	2	1	3
	6	-	-	-	9	0	0	-	-	-	11	1	0	1	0	1
	7	-	-	-	9	0	1	-	-	-	11	2	0	2	1	3
	8	-	-	-	9	1	4	10	2	0	1	2	0	5	4	9
Loons	1	5	1	0	-	-	-	-	-	-	-	-	-	1	0	1
	2	5	0	0	-	-	-	-	-	-	-	-	-	0	0	0
	3	-	-	-	9	1	0	-	-	-	-	-	-	1	0	1
	4	-	-	-	8	1	1	-	-	-	-	-	-	1	1	2
	5	-	-	-	9	1	0	-	-	-	-	-	-	1	0	1
	6	-	-	-	9	1	0	-	-	-	11	0	0	1	0	1
	7	-	-	-	9	1	0	-	-	-	11	3	2	4	2	6
	8	-	-	-	9	4	0	10	7	1	1	4	0	15	1	16
Western/ Clark's grebes	1	5	0	0	-	-	-	-	-	-	-	-	-	0	0	0
	2	5	0	0	-	-	-	-	-	-	-	-	-	0	0	0
	3	-	-	-	9	0	0	-	-	-	-	-	-	0	0	0
	4	-	-	-	8	0	0	-	-	-	-	-	-	0	0	0
	5	-	-	-	9	0	0	-	-	-	-	-	-	0	0	0
	6	-	-	-	9	0	0	-	-	-	-	-	-	0	0	0
	7	-	-	-	9	0	0	-	-	-	11	0	0	0	0	0
	8	-	-	-	9	0	0	10	4	0	1	1	1	5	1	6

recovered on the Farallon Islands (PRBO 1985). One non-oiled grebe was found on beaches surveyed on 7 November. Live oiled grebes occurred only on 8 November north of Point Reyes but occurred daily in low numbers from 8 to 11 November south of Point Reyes. Dead oiled grebes occurred in low numbers on all beaches from 8 November until 10 or 11 November. No grebes were found either north or south of Point Reyes on 16 and 19 November, suggesting that beachings from the main oiling incident had ended earlier. Six dead (five oiled) grebes found on Kehoe Beach 29-30 November (Table 8) may be explained by the second oiling event discussed previously for Common Murres. Since grebes probably were oiled close to shore, there probably was little at-sea loss of birds before reaching shore, and little delay between debilitation and beaching. A greater proportion of beached grebes were found dead than either murres or the loons, suggesting that grebes died more quickly after oiling, or were less likely to come ashore when still alive.

Magnitude of the PROS Compared to 1971-1983 Survey Data

Loons and Western/Clark's grebes were frequently not found on October and November surveys between 1971 and 1983, in contrast to Common Murre which occurred rather regularly. Loons occurred on 0-25% (median = 10%) of surveys conducted on each of the eight beaches and Western/Clark's grebes on 21-100% (median = 41%; Table 9). Consequently, median estimated daily carcass deposition rates (EDCDR) on all eight beaches were low for these species: all were 0.00 birds/day for loons and 0.00-0.19 (median = 0.00) birds/day for Western/Clark's grebes (Table 9). Common Murres occurred on 26-100%

Table 9. Beached bird rates observed during the PRBO Beached Bird survey (BBP), 1971-1983. See Table 7 for beach identifications. N is the number of surveys conducted in October and November 1971 to 1983. BBP bird rate includes zero and non-zero counts and is adjusted for carcass loss between surveys (see methods).

Species	Beach	N	% surveys >0 carcasses	BBP Bird rate (birds/day)		
				Median	75%ile	Maximum
Common Murre	1	19	26.3	0.00	0.18	2.11
	2	31	58.1	0.20	0.59	3.24
	3	25	76.0	0.19	0.52	3.27
	4	5	80.0	0.19	-	0.56
	5	3	100.0	0.17	-	0.70
	6	4	75.0	0.34	-	1.20
	7	2	50.0	0.09	-	0.17
	8	14	78.6	0.28	1.34	2.75
Loons	1	19	5.3	0.00	0.00	0.30
	2	31	3.2	0.00	0.00	0.18
	3	25	16.0	0.00	0.00	1.19
	4	5	20.0	0.00	-	0.17
	5	3	0.0	0.00	-	0.00
	6	4	25.0	0.00	-	0.17
	7	2	0.0	0.00	-	0.00
	8	14	14.3	0.00	0.00	0.18
Western/ Clark's grebes	1	19	42.1	0.00	0.20	0.90
	2	31	41.9	0.00	0.19	1.21
	3	25	40.0	0.00	0.18	0.69
	4	5	100.0	0.19	-	0.19
	5	3	33.0	0.00	-	0.17
	6	4	25.0	0.00	-	0.17
	7	2	50.0	0.09	-	0.17
	8	14	21.4	0.00	0.00	0.25

(median = 76%) of October and November surveys from 1971 to 1983; EDCDRs were 0.00-0.34 (median = 0.19) birds/day (Table 9). In contrast to median EDCDRs, maximum EDCDRs were closely related to the number of surveys conducted on each beach, probably because high deposition periods are relatively unusual. The four highest maximum EDCDRs for all three species groups occurred on the four beaches with the largest samples sizes (beaches 1, 2, 3, and 8; Table 9). Using only these four beaches, Common Murre maximum EDCDRs rates ranged from 2.11 to 3.27 birds/day, loon maxima from 0.18 to 1.19 birds/day, and Western/Clark's grebe maxima from 0.25 to 1.21 birds/day (Table 9).

Before comparing the PROS impact with the survey data, it is important to consider the differing nature of these rates (Tables 7 and 9). The PROS rate is the mean daily rate over 7-11 November 1984 (Table 7). Daily Common Murre numbers exhibited strong peaks of live and dead birds during this period while less pronounced peaks in daily numbers occurred for loons and Western/Clark's grebes (Fig. 79). Also, the extended period of loon beachings (until at least 30 November) and probable second oiling event were not included. Thus, the PROS rates for Common Murres and Western/Clark's grebes were determined over the relatively short period when most birds came ashore, whereas for loons the PROS bird rate was determined over only the first few days of a prolonged beaching event.

Factors that might affect the EDCDRs determined from previous surveys also must be considered. Irregularly-occurring, short intervals between surveys could bias rates downwards. When carcasses were not found on a survey, there was no obvious method to estimate the number of carcasses that had deposited and disappeared since the

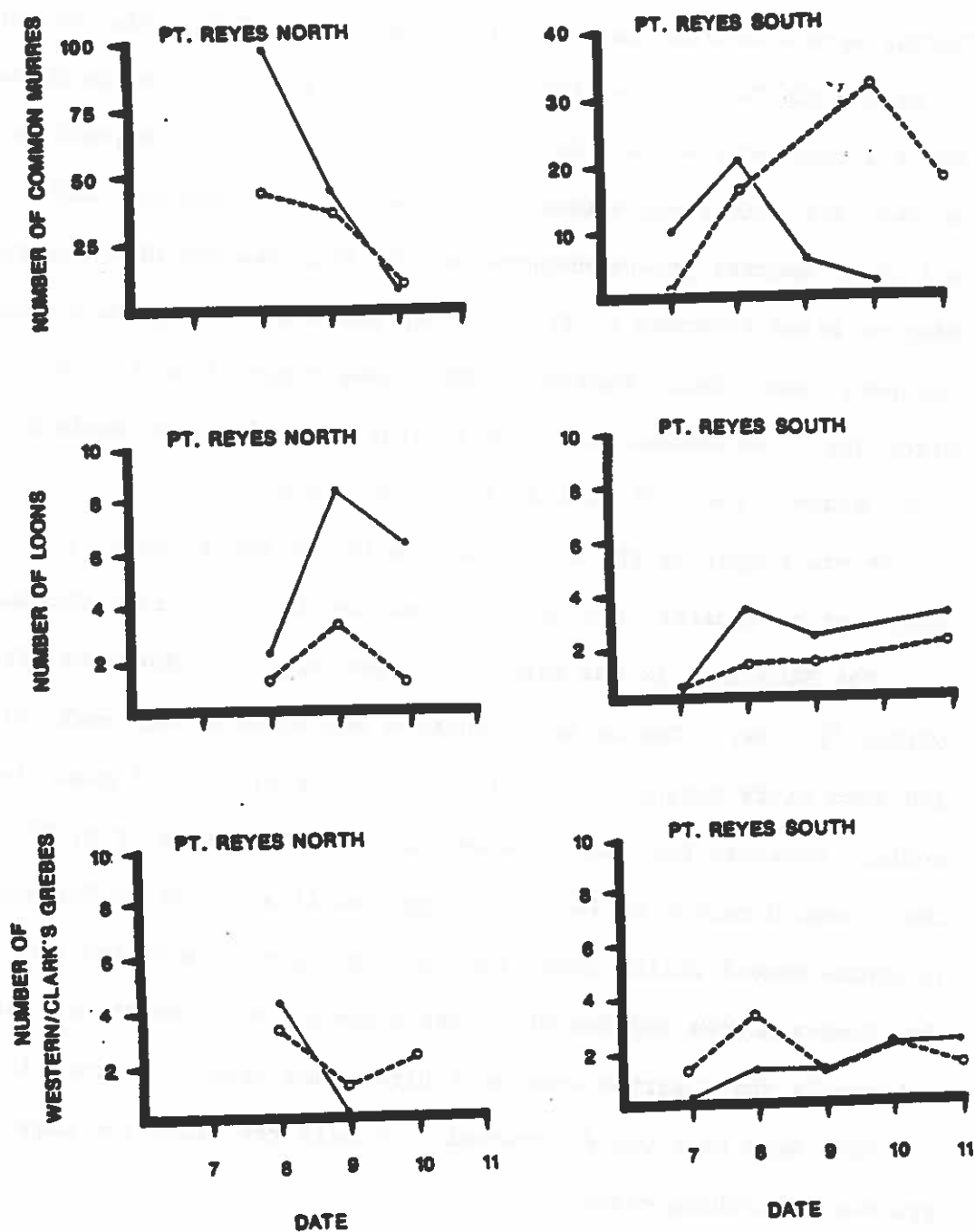


Figure 79. Daily numbers of three species of birds coming ashore between 7 and 11 November 1984 on 4 beaches north of Point Reyes, and 4 beaches south of Point Reyes. Solid and open dots represent live and dead birds, respectively.

previous survey. Spurious zero counts could result if intervals were irregular and some were too short to encompass the deposition of uncommon carcass species. If these problems had occurred, they might have caused some slight downward bias in estimated rates for the loons and grebes. A situation that could bias rates upwards would be created if the baseline of data comprised surveys done mostly in response to some factor that might cause "pulses" of deposition, such as oil spills, gill net kills, or severe storms. Neither of these factors were a problem with any of the beaches examined in these analyses.

Deposition on these beaches for the three to five initial days of the PROS were 15.0-105.9 (median = 34.8) times greater than "usual" levels for Common Murres, 2.5-33.3 (median = 10.0) times greater for loons, and 2.5-7.4 (median = 4.2) greater for Western/Clark's grebes. If all the seemingly non-oiled birds that beached during the same period had in fact been killed by the PROS then these ratios would be 19.0-110.3 (median = 39.7) for murres, 2.5-33.3 (median = 11.7) for loons, and 3.3-10.0 (median = 7.1) for grebes. These ratios also can be viewed as the number of "usual" days of carcass deposition for that time of year that occur on an single spill day, based on the number of carcasses that beach on an average day of the spill period. To appreciate the magnitude of the PROS, these five days represent 174 (266, using all possible carcasses) days of "usual" deposition for the Common Murre, 100 (117, all carcasses) days for loons, and 33 (58, all carcasses) days for Western/Clark's grebes, if normal deposition rates tend to be fairly stable. We feel that these calculations are conservative for the murre, because "usual" densities declined after November, but are liberal for the grebes, since normal densities in

December were slightly higher than in October and November. For loons, they are probably conservative; even though Arctic and Red-throated loon densities increased in December before declining again in January, Common Loon densities declined after November and the PROS rate does not include loons that beached after 11 November, in the extended period of PROS loon deposition (see Figs. 5, 6, 11, and 60).

It is also worth noting which individuals were likely affected by the PROS, given the timing of the spill. In the Gulf of the Farallones, Common Murre mortality was normally highest from July to September (Fig. 60), although this was partly related to gill net mortality at this time. Since the annual peak period of murre carcass densities occurred before the PROS, mortality was focused on individuals that were most likely to survive into and reproduce in the future. In the Gulf of the Farallones, carcass densities of Arctic/Red-throated loons were high from November to January and for the Common Loon high in November (Figs. 5, 6). Thus, PROS mortality occurred at the beginning of the period of usual peak carcass densities for loons in this area and some of the impacted birds might have died regardless of the spill. Western/Clark's grebe carcass densities were highest from October or November through April (Fig. 11), indicating that, like loons, the PROS probably impacted some birds that might not have survived the winter anyway. Therefore, the impact of the PROS was greater for Common Murres than for loons and Western/Clark's grebes both in number and possibly "quality" of birds affected. In addition, most murres impacted likely originated from the local breeding population in central California whereas impacted loons and grebes were likely a mixture of birds from several distant breeding populations.

Therefore, high impact probably occurred on the eight murre colonies in central California.

It is useful to compare the magnitude of the PROS mortality with other high mortality events. PROS deposition rates of conspicuously oiled carcasses were 0.9-47.1 (median = 4.5) times greater than maximum EDCDRs from previous surveys for Common Murre, 0.8-33.3 (median = 5.7) times greater for loons, and 0.3-5.3 (median = 1.9) times greater for Western/Clark's grebes. Using all birds potentially effected by the PROS these ratios become 1.2-55.9 (median = 5.6) times greater for Common Murre, 0.8-33.3 (median = 5.7) time greater for loons, and 0.4-6.6 (median = 2.9) for Western/Clark's grebes. In this sense, PROS mortality of Common Murres and loons was of greater magnitude, relative to other high mortality events, than that of Western/Clark's grebes.

The circumstances that caused other maxima probably were both natural and human-induced. Instances of high carcass densities in October and November for the four beaches with the larger sample sizes are listed in Table 10. Many of the highest values for all three species occurred during ENSO conditions, especially in falls of 1973 and 1982. However, for Common Murres, high values in 1980, and in 1982, also were related to gill net mortality. On seven of the eight beaches during the PROS, Common Murre daily deposition rates were the highest ever recorded while on the eighth beach, the rate was similar to other high mortalities. For loons, four beaches had highest-ever rates, two beaches were of similar magnitude to other high mortalities, and two beaches exhibited non-exceptional rates. For Western/Clark's grebes, three beaches had similar magnitude to other high mortalities, and five beaches had non-exceptional rates. It is important to note

Table 10. Highest bird rates from 1971-1983 beached bird project. N is the number of birds observed on survey date. Dates are period from which bird rate was calculated. The last date of the period is the survey date. ENSO is El Nino-Southern Oscillation, GN is gill net kills, and ? is unknown.

Species	Bird rate Birds/day	Beach (number)	N	Dates	Probable cause
Common Murre	3.27	Limantour (3)	11	14-19 Nov 1973	ENSO
	3.24	RCA (2)	13	25 Sep-1 Oct 1971	?
	3.24	RCA (2)	18	10 Oct-3 Nov 1982	GN/ENSO
	3.01	RCA (2)	16	21 Sep-6 Oct 1980	GN/ENSO
	2.75	Pt. Reyes, A (8)	16	24 Sep-24 Oct 1982	GN/ENSO
	2.11	Bolinas (1)	7	8-13 Nov 1973	ENSO
	2.05	Limantour (3)	12	18 Jul-26 Oct 1982	GN/ENSO
	1.25	Limantour (3)	7	18 Sep-6 Oct 1980	GN/ENSO
Loons	1.19	Limantour (3)	4	14-19 Nov 1973	ENSO
	0.86	Limantour (3)	5	22 Oct-27 Nov 1979	?
	0.63	Limantour (3)	3	19-29 Nov 1973	ENSO
	0.30	Bolinas (1)	1	8-13 Nov 1973	ENSO
Western/Clark's grebes	1.21	RCA (2)	4	31 Oct-5 Nov 1971	?
	1.09	RCA (2)	6	5-27 Nov 1971	?
	0.90	Bolinas (1)	3	8-13 Nov 1973	ENSO

that these comparisons do not include other large oil spills since none occurred in this region between 1971 and 1983.

It appears that Western/Clark's grebe mortality during the PROS was similar to that of high natural mortalities that occur during ENSO years, whereas Common Murre and loon mortality was much higher than in ENSO years. Bird populations can withstand ENSO levels of mortality, but such natural mortalities are periodic, and between ENSO years populations build up such that they can withstand the next ENSO. For Common Murres, PROS mortality added to persistent high levels of mortality from 1980-1987 from gill net fishing (mainly), and the 1986 Apex Houston spill (Page and Carter 1986). This high mortality has resulted in drastic declines at all eight breeding colonies in central California (Carter in Appendix B; PRBO and USFWS, unpubl. data).

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APPENDICES

A: Baseline data on carcass occurrence and carcass densities for beaches in the Gulf of the Farallones and Monterey Bay. Doran and Salmon Creek beaches included in the Gulf of the Farallones. Fall includes June to October; Winter, November to February; and Spring, March to May. N is the number of individual months in which the species or species group was found. P is the proportion of surveyed months on which the species or species group was found. (For example, 66 fall month surveys were conducted on Pajaro Dunes beach. Beached birds were found on 62 months, or 0.94 of the total months, as shown on page 1 of Appendix A.) The median, 75th percentile, and maximum (max) carcass densities of the N non-zero months are also given. This summary includes all data from June 1971 to May 1985.

Carcasses that were identified as one of the species in the species groups described below were included in the combined species summaries. All loon spp. included Red-throated, Arctic, Common, and Yellow-billed loons. Small grebe spp. included Eared and Horned grebes. All cormorant spp. included Double-crested, Brandt's, and Pelagic cormorants; large cormorant spp. included Double-crested and Brandt's cormorants. Phalarope spp. included Red-necked and Red phalaropes. Six gull spp. included at least Mew, Ring-billed, California, Western, Glaucous-winged, and Herring gulls, and also may have included hybrid and Thayer's gulls among the unidentified gulls.

B: Carter, H. R. 1986. Rise & fall of the Farallon Common Murre. Reprint from Newsletter 72 of the Point Reyes Bird Observatory.

C: Heneman, B. 1986/7. Gill nets: the search for solutions. Reprint
from Newsletter 75 of the Point Reyes Bird Observatory.

ALL SPECIES COMBINED: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING				
	N	P	MEQIAN	75%	MAX	N	P	MEQIAN	75%	MAX	
AMO NUEVO	6	1.00	0.40	0.62	1.11	2	1.00	0.21	0.20	0.20	0.72
BOLINAS	22	0.65	1.05	2.22	5.19	33	0.94	1.11	2.10	0.15	11.40
CROMCHITE	53	0.91	6.67	15.56	64.44	33	0.63	1.11	3.22	7.70	6.94
DILLON	23	1.00	2.73	6.14	13.10	34	1.00	3.23	7.39	10.10	12.27
DOORAN	27	0.94	2.65	4.12	8.82	27	1.00	3.24	7.06	17.06	20.00
DOUBLE POINT	18	0.72	1.29	2.07	3.71	19	0.76	0.06	1.43	4.29	5.14
ORAKES	4	1.00	3.44	5.47	5.63	11	1.00	3.33	5.00	10.03	6.67
EDGEHAR	11	1.00	6.15	10.77	14.62	2	0.40	1.15	1.34	1.34	3.83
FORT POINT	12	0.43	0.63	1.25	3.13	18	0.90	3.13	4.53	12.50	5.63
HALF MOON BAY, NORTH	26	0.96	4.69	6.64	20.31	24	0.92	2.34	4.92	15.94	12.01
HALF MOON BAY, SOUTH	13	0.93	3.24	6.91	30.54	9	0.82	1.25	2.03	10.00	4.06
LINAMTOUR	40	0.87	0.96	1.47	4.74	38	0.97	0.00	1.62	5.96	17.37
LINDA MAR	6	1.00	6.54	10.96	12.31	3	0.75	7.69	0.46	0.46	6.92
MONTARA	6	1.00	5.16	107.11	287.81	1	0.17	1.25	1.25	1.25	39.17
MUIR	54	0.97	6.00	15.25	56.00	36	0.64	3.00	5.50	22.00	24.00
OCEAN	55	0.96	2.50	5.63	12.19	43	0.88	1.25	3.19	4.69	14.50
PESADERO	21	0.88	5.00	6.67	12.22	9	0.64	2.22	3.75	5.34	5.20
POINT REYES, A	24	1.00	3.21	7.32	23.81	25	0.96	3.10	6.19	13.10	18.33
POINT REYES, B	1	1.00	1.97	1.97	1.97	7	1.00	2.19	2.62	7.54	3.20
POINT REYES, C	2	1.00	3.67	3.67	5.67	6	0.86	5.33	13.50	16.00	5.67
POINT REYES, D	1	1.00	3.91	3.91	3.91	7	1.00	3.70	9.70	13.70	3.40
RCA	53	1.00	1.94	3.77	10.94	45	0.96	0.85	1.01	5.20	5.20
SALMON CREEK	23	0.96	4.62	10.26	15.30	15	1.00	4.10	6.41	17.69	6.15
SEADRIFT	62	0.97	2.31	4.10	14.10	52	1.00	2.31	4.04	11.03	10.51
SHARP PARK	17	1.00	9.33	12.00	41.33	8	0.62	3.33	3.05	7.33	17.33
STINSON	4	1.00	9.64	22.32	25.00	5	0.83	2.14	3.37	3.37	3.37
						20	0.80	1.45	3.10	6.92	5.00

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BEACH	FALL			WINTER			SPRING			
	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX
OAVENPORT, EAST	13	0.36	2.00	2.00	6.00	10	0.33	2.00	2.00	3.00
OAVENPORT, WEST	3	0.75	0.00	10.00	10.00	2	0.50	2.00	2.00	2.00
OCEL MONTE	45	0.98	5.00	10.31	22.50	45	1.00	13.44	20.00	56.56
JETTY	44	1.00	7.81	14.06	31.08	28	0.97	6.00	11.41	45.00
LAGUNA CREEK	29	0.72	4.29	8.27	14.29	30	0.94	3.21	4.40	7.14
MAJORS CREEK	31	0.94	2.50	6.25	13.75	17	0.63	2.50	5.00	5.00
MARINA	20	1.00	4.65	6.65	12.36	25	1.00	1.70	2.97	7.22
PAJARO DUNES	62	0.94	3.50	6.08	19.00	49	0.88	2.50	4.00	7.75
RIO DEL MAR	29	0.85	1.50	3.00	16.50	13	0.40	0.50	1.75	3.00
SALINAS RIVER	5	1.00	0.94	2.66	2.01	4	1.00	5.00	6.00	6.00
SCOTT CREEK	25	0.71	4.17	6.25	18.35	17	0.65	1.67	2.50	3.13
SEASCAPE-APTOS	21	0.95	10.65	15.00	25.00	17	1.00	9.00	15.00	5.00
SEASIDE	23	0.92	2.00	5.69	10.21	21	0.91	2.08	3.23	4.00
SUNSET	22	0.88	1.25	2.66	6.00	16	0.80	1.88	2.97	8.75
WILDER	19	0.50	2.86	4.29	11.43	11	0.38	1.43	1.43	7.14
YELLOW BANK CREEK	13	1.00	5.00	12.22	32.78	10	1.00	3.89	4.44	7.22
ZMUONSKI	13	1.00	5.00	12.22	32.78	10	1.00	3.89	4.44	7.22

ALL LOOM SPP: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	N	P	FALL MEDIAN	75%	MAX	N	P	WINTER MEDIAN	75%	MAX	N	P	SPRING MEDIAN	75%	MAX
AND NUEVO	1	0.17	0.03	0.03	0.03	0	0.00	0.37	0.37	1.11	1	0.30	0.03	0.03	0.03
BOLINAS	0	0.00	1.11	1.11	1.11	7	0.20	0.65	1.11	1.11	3	0.13	0.37	2.22	2.22
CROWNITE	2	0.03	0.43	0.43	0.43	2	0.04	0.35	1.02	2.27	2	0.03	1.11	1.11	1.11
OILION	1	0.04	0.29	0.39	0.39	12	0.35	1.36	1.18	2.63	10	0.42	0.43	0.91	1.02
DORAN	6	0.21	0.14	0.14	0.14	12	0.44	0.39	0.29	0.29	12	0.60	0.39	1.40	2.06
DOUBLE POINT	1	0.04	0.31	0.42	0.42	2	0.08	0.29	0.29	0.29	3	0.14	0.29	0.29	0.29
ORAKES	2	0.50	0.31	0.42	0.42	3	0.43	0.42	0.94	1.23	2	0.23	0.83	0.83	0.83
COGEMAR	0	0.00	0.31	0.31	0.31	0	0.00	1.23	1.23	1.23	1	0.23	0.77	0.77	0.77
FORT POINT	0	0.00	0.31	0.31	0.31	1	0.03	1.23	1.23	1.23	0	0.00	1.80	2.01	2.01
HALF MOON BAY, NORTH	7	0.26	0.31	0.31	0.31	4	0.13	1.23	1.00	0.27	3	0.14	0.47	0.63	0.63
HALF MOON BAY, SOUTH	1	0.07	0.31	0.31	0.31	1	0.09	0.27	0.27	0.27	6	0.17	0.10	0.22	0.33
LIMANTOUR	6	0.13	0.18	0.22	0.22	12	0.31	0.18	0.24	0.08	4	0.17	1.15	1.34	1.34
LINDA MAR	0	0.00	0.63	0.63	0.63	1	0.23	0.77	0.77	0.77	2	1.00	0.42	0.42	0.42
MONTARA	1	0.17	0.63	0.63	0.63	0	0.00	1.00	4.00	4.00	1	0.02	2.00	2.00	2.00
MUIR	4	0.06	1.00	1.00	1.00	3	0.03	0.31	0.31	0.94	7	0.17	0.31	0.31	1.23
OCEAN	7	0.12	0.31	0.31	0.31	6	0.12	0.31	1.67	1.67	2	0.17	0.42	0.36	0.36
PESCAOERO	0	0.00	0.24	0.48	0.48	3	0.21	0.48	1.07	1.43	2	0.14	0.24	0.24	0.24
POINT REYES, A	6	0.23	0.33	0.33	0.33	0	0.31	0.27	0.49	0.49	3	1.00	0.49	0.66	0.66
POINT REYES, B	0	0.00	0.33	0.33	0.33	2	0.29	0.33	0.33	0.33	1	0.23	0.33	0.33	0.33
POINT REYES, C	1	0.30	0.33	0.33	0.33	3	0.43	1.20	1.20	1.20	3	0.73	0.22	0.22	0.22
POINT REYES, D	0	0.00	0.28	0.49	0.49	7	0.13	0.28	0.42	0.36	4	0.12	0.28	0.49	0.36
RCA	0	0.13	0.26	0.30	0.31	8	0.33	0.26	0.43	1.03	3	0.29	0.26	0.26	0.26
SALMON CREEK	3	0.21	0.30	0.51	0.51	19	0.37	0.26	0.32	0.51	17	0.49	0.26	0.64	1.03
SEADRIFT	4	0.06	0.67	0.67	0.67	0	0.00	1.43	1.43	1.43	0	0.00	0.36	0.63	0.63
SHARP PARK	1	0.06	0.67	0.67	0.67	1	0.13	0.30	1.23	1.23	6	0.00	0.36	0.63	0.63
SYNISON	0	0.00	0.48	0.63	0.63	3	0.09	0.30	1.23	1.23	0	0.00	0.36	0.63	0.63
THORNTON	3	0.13	0.48	0.63	0.63	3	0.09	0.30	1.23	1.23	0	0.00	0.36	0.63	0.63

REGION-MONTEREY BAY

BEACH	N	P	FALL MEDIAN	75%	MAX	N	P	WINTER MEDIAN	75%	MAX	N	P	SPRING MEDIAN	75%	MAX
DAYENPORT, EAST	0	0.00	0.63	1.41	3.73	2	0.07	1.30	2.00	2.00	0	0.00	1.00	2.13	0.13
DAYENPORT, WEST	0	0.00	0.63	1.23	1.08	31	0.49	1.23	2.30	11.23	22	0.08	0.63	1.36	4.30
DEL MONTE	10	0.23	0.63	1.23	1.43	11	0.38	0.71	1.07	3.13	15	0.43	1.43	2.14	2.14
JETTY	3	0.07	0.71	1.43	1.43	3	0.16	1.00	2.30	2.30	3	0.14	0.63	0.63	0.63
LAGUNA CREEK	0	0.00	0.43	0.73	0.73	2	0.07	1.00	0.26	0.36	2	0.10	0.19	0.30	0.69
MAJORS CREEK	2	0.10	0.43	0.73	0.73	12	0.48	0.30	0.30	0.30	9	0.64	0.30	1.23	2.00
MARINA	3	0.03	1.00	1.50	1.50	7	0.13	0.30	1.00	1.00	10	0.23	0.30	0.30	0.30
PAJARO DUMES	2	0.06	0.73	1.00	1.00	2	0.07	1.00	1.00	1.00	0	0.00	0.30	0.30	0.30
RIO DEL MAR	0	0.00	0.73	1.00	1.00	1	0.23	0.30	0.30	0.30	0	0.00	0.30	0.30	0.30
SALINAS RIVER	0	0.00	0.73	1.00	1.00	1	0.20	1.23	1.23	1.23	0	0.00	1.67	1.67	1.67
SCOTT CREEK	0	0.00	0.73	1.00	1.00	0	0.00	1.23	1.23	1.23	1	0.03	1.67	1.67	1.67
SEASCAPE-APTOS	3	0.14	1.00	2.00	2.00	0	0.47	1.30	2.00	12.00	6	0.33	3.00	8.23	12.00
SEASIDE	2	0.00	0.17	0.21	0.21	3	0.22	0.42	0.63	0.63	3	0.31	0.42	0.76	0.83
SUNSET	0	0.00	0.17	0.21	0.21	2	0.10	0.03	1.23	1.23	2	0.13	0.52	0.63	0.63
WILDER	0	0.00	0.17	0.21	0.21	0	0.00	0.03	1.23	1.23	0	0.00	0.56	0.56	0.56
YELLOW BANK CREEK	0	0.00	0.17	0.21	0.21	1	0.10	0.03	0.36	0.36	2	0.23	0.56	0.56	0.56
ZHUBOWSKI	2	0.13	0.36	0.56	0.56	1	0.10	0.36	0.36	0.36	0	0.00	0.56	0.56	0.56

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REGION-QUIF OF THE FARALLONES

REGION-HOMERBY DAY

REGION-HOMERBY DAY

BEACH	FALL			MAX	75%	WINTER	75%	MAX	M	P	MEDIAN	SPRING	75%	MAX
	M	P	MEDIAN											
DAYENPORT, EAST	0	0.00	.	.	.	.	.	.	0	0.00	.	.	.	.
DAYENPORT, WEST	0	0.00	.	.	.	1.25	2.01	3.13	0	0.00	.	.	1.25	1.26
OEL MONTE	0	0.00	.	.	.	0.94	1.25	1.25	4	0.09	0.63	0.63	0.63	0.63
JETTY	0	0.00	.	.	.	0.07	0.71	0.71	2	0.07	0.71	0.71	0.71	0.71
LAGUNA CREEK	0	0.00	.	.	.	0.03	0.71	0.71	1	0.03	0.71	0.71	0.71	0.71
MAJORS CREEK	0	0.00	.	.	.	0.00	0.14	0.20	0	0.00	0.14	0.14	0.14	0.14
MARINA	1	0.05	0.19	0.19	0.50	0.20	0.25	0.28	3	0.07	0.25	0.25	0.30	0.30
PAJARO OUMES	1	0.02	0.50	0.50	0.50	0.00	0.50	0.50	0	0.00	.	.	.	.
RIO OEL MAR	1	0.03	0.50	0.50	0.50	0.04	0.50	0.50	0	0.00	.	.	.	.
SALINAS RIVER	0	0.00	.	.	.	0.00	.	.	0	0.00	.	.	.	.
SCOTT CREEK	0	0.00	.	.	.	0.00	.	.	0	0.00	1.67	1.67	1.67	1.67
SEASCAP-APIOS	0	0.00	.	.	.	0.00	1.00	1.00	1	0.05	2.30	2.30	4.00	4.00
SEASLOE	0	0.00	.	.	.	0.06	0.26	0.26	2	0.16	0.42	0.42	0.76	0.83
SUNSET	1	0.04	0.21	0.21	0.21	0.17	0.21	0.28	4	0.17	0.63	0.63	0.63	0.63
WILDER	0	0.00	.	.	.	0.10	0.52	0.63	2	0.10	0.63	0.63	0.63	0.63
YELLOW BANK CREEK	0	0.00	.	.	.	0.00	.	.	0	0.00	0.56	0.56	0.56	0.56
MUOOWSKI	0	0.00	.	.	.	0.00	.	.	0	0.00	0.56	0.56	0.56	0.56

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING			
	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX
AMO NUEVO	1	0.17	0.05	0.05	0.05	0	0.00			
BOLINAS	0	0.00				1	0.03	0.25	0.25	0.25
CHRONHITE	2	0.03	1.11	1.11	1.11	0	0.00			
OILION	1	0.04	0.45	0.45	0.45	6	0.10	0.45	0.45	0.45
ODRAN	3	0.10	0.29	0.29	0.29	6	0.22	0.29	0.39	0.39
ODUBLE POINT	0	0.00				0	0.00			
ORAKES	1	0.25	0.21	0.21	0.21	0	0.00			
COGEMAR	0	0.00				0	0.00			
FORT POINT	0	0.00				0	0.00			
HALF MOON BAY, NORTH	7	0.26	0.31	0.31	0.31	3	0.12	0.31	0.63	0.63
HALF MOON BAY, SOUTH	0	0.00				0	0.00			
LIMANTOUR	3	0.07	0.10	0.10	0.10	3	0.00	0.09	0.10	0.10
LINDA MAR	0	0.00				0	0.00			
MONTARA	0	0.00				0	0.00			
MUIR	1	0.02	1.00	1.00	1.00	1	0.02	0.40	0.40	0.40
OCUAN	4	0.07	0.51	0.51	0.51	1	0.02	0.16	0.16	0.16
PESCADERO	0	0.00				0	0.00			
POINT REYES, A	0	0.00				1	0.04	0.06	0.06	0.06
POINT REYES, B	0	0.00				0	0.00			
POINT REYES, C	0	0.00				0	0.00			
POINT REYES, D	0	0.00				0	0.00			
RCA	3	0.09	0.20	0.20	0.20	2	0.14	0.22	0.22	0.22
SALMON CREEK	2	0.00	0.19	0.26	0.26	1	0.07	0.00	0.09	0.09
SEACRIFT	1	0.02	0.13	0.13	0.13	1	0.02	0.14	0.14	0.14
SHARP PARK	0	0.00				0	0.00			
STINSON	0	0.00				0	0.00			
MORNINGTON	1	0.02	0.40	0.40	0.40	1	0.03	0.63	0.63	0.63

REGION-MONTEREY BAY

BEACH	FALL			WINTER			SPRING			MAX			
	N	P	MEAN	75%	MAX	N	P	MEAN	75%		N	P	MEAN
OAYENPORT, EAST	0	0.00	.	.	.	1	0.03	1.00	1.00	1	0.00	.	.
OAYENPORT, WEST	0	0.00	.	.	.	0	0.00	.	.	0	0.00	.	.
DEL MONTE	3	0.07	0.63	1.25	1.25	10	0.40	0.94	1.41	14	0.36	0.63	0.94
JETTY	6	0.14	0.63	0.70	1.25	10	0.34	0.63	1.41	11	0.37	0.63	1.25
LAJUNA CREEK	0	0.00	.	.	.	1	0.03	0.48	0.48	2	0.10	1.07	1.43
MAJORS CREEK	0	0.00	.	.	.	0	0.00	.	.	1	0.03	0.63	0.63
MARINA	1	0.03	0.19	0.19	0.19	3	0.12	0.19	0.30	3	0.21	0.14	0.19
PAJARO GUNES	2	0.03	0.50	0.50	0.50	2	0.11	0.50	0.50	1	0.02	0.50	0.50
RIO DEL MAR	1	0.03	0.50	0.50	0.50	6	0.07	0.50	0.50	0	0.00	.	.
SALINAS RIVER	0	0.00	.	.	.	0	0.00	.	.	.	0.00	.	.
SCOTT CREEK	0	0.00	.	.	.	1	0.20	0.63	0.63	0	0.00	.	.
SEASCAPE-APTOS	0	0.00	.	.	.	0	0.00	.	.	0	0.00	1.50	2.35
SEASIDE	0	0.00	.	.	.	3	0.29	1.00	2.50	4	0.36	.	.
SUNSET	0	0.00	.	.	.	2	0.09	0.28	0.42	0	0.00	.	.
WILDER	0	0.00	.	.	.	0	0.00	.	.	0	0.00	.	.
YELLOW BANK CREEK	0	0.00	.	.	.	0	0.00	.	.	0	0.00	.	.
MUDOVSKI	0	0.00	.	.	.	0	0.00	.	.	0	0.00	.	.

WESTERN/CLARK'S GREBE: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	FALL		75%		MAX	WINTER		75%		MAX	SPRING		75%		MAX
	M	P	MEAN			M	P	MEAN			M	P	MEAN		
AND NUEVO	0	0.00	0.37	0.03	1.11	0	0.00	0.37	0.74	1.83	1	0.30	0.07	0.07	0.07
BOLINAS	6	0.10	2.22	2.22	2.22	22	0.43	1.11	1.11	1.11	9	0.38	0.37	1.30	2.39
CROMKITE	3	0.03	0.68	0.91	0.91	0	0.13	1.11	1.11	1.11	3	0.12	1.11	1.11	1.11
OILLOM	4	0.16	0.29	0.44	0.59	22	0.03	0.91	2.39	3.64	13	0.34	0.43	1.36	1.02
OBAM	3	0.10	0.14	0.14	0.14	22	0.01	1.10	1.62	2.94	12	0.40	0.74	1.99	3.00
DOUBLE POINT	1	0.04	0.42	0.42	0.42	6	0.24	0.29	0.29	0.29	4	0.19	0.29	0.30	0.37
ORAKES	3	0.73	0.42	0.42	0.42	9	0.02	0.42	0.03	0.03	4	0.50	0.03	1.36	1.67
EGGEMAR	2	0.10	0.77	0.77	0.77	1	0.20	0.77	0.77	0.77	1	0.25	0.77	0.77	0.77
FORT POINT	4	0.00	0.63	1.29	1.41	13	0.73	1.25	3.13	3.75	6	0.43	0.63	0.63	0.63
HALF MOON BAY, NORTH	4	0.13	0.41	0.34	0.34	19	0.73	0.94	2.19	3.31	13	0.39	0.63	1.23	6.00
HALF MOON BAY, SOUTH	2	0.14	0.10	0.33	0.33	3	0.43	0.34	0.93	1.00	3	0.30	0.31	0.31	0.31
LIMANTOUR	2	0.07	0.10	0.33	0.33	21	0.34	0.10	0.44	1.40	11	0.31	0.33	0.33	0.00
LIMOA MAR	2	0.33	0.51	0.77	0.77	1	0.25	0.77	0.77	0.77	1	0.30	2.31	2.31	2.31
MONTARA	0	0.00	1.00	1.00	1.00	0	0.00	2.00	2.00	2.00	1	0.25	0.21	0.21	0.21
MUIR	11	0.18	0.39	0.94	1.23	14	0.25	0.51	0.63	2.01	11	0.26	0.63	0.70	1.36
OCEAN	1	0.04	1.11	1.11	1.11	23	0.43	0.03	1.39	2.22	2	0.17	0.03	1.11	1.11
PESCADERO	3	0.13	0.24	0.40	0.40	13	0.30	0.40	0.71	1.43	3	0.21	0.43	1.43	1.43
POINT REYES, A	0	0.00	0.33	0.33	0.33	3	0.71	0.33	0.82	1.31	3	1.00	0.33	0.33	0.33
POINT REYES, B	1	1.00	0.22	0.22	0.22	4	0.37	0.22	0.34	0.63	1	0.23	0.43	0.43	0.43
POINT REYES, C	9	0.17	0.19	0.20	0.31	23	0.33	0.37	0.56	1.39	9	0.29	0.20	0.63	1.94
POINT REYES, D	3	0.13	0.31	0.63	0.63	12	0.00	0.57	1.12	2.31	3	0.34	0.31	1.34	3.39
RCA	16	0.23	0.26	0.43	1.79	44	0.00	0.77	1.07	3.39	19	0.30	0.67	1.33	1.33
SALMON CREEK	0	0.00	1.33	1.33	1.33	3	0.23	0.67	1.43	2.14	2	0.33	0.71	0.71	0.71
SERDAPT	4	0.10	0.30	0.63	0.63	9	0.20	0.63	1.03	1.23	0	0.32	0.20	0.44	0.63
SHARP PARK															
STIMSON															
THORNTON															

REGION-MONTEREY BAY

BEACH	FALL		75%		MAX	WINTER		75%		MAX	SPRING		75%		MAX
	M	P	MEAN			M	P	MEAN			M	P	MEAN		
DAVENPORT, EAST	0	0.00	0.43	1.13	2.13	3	0.10	1.00	2.00	2.00	0	0.00	1.23	1.00	9.30
DAVENPORT, WEST	0	0.00	0.63	1.09	2.30	0	0.00	2.19	4.30	9.30	0	0.00	1.23	1.23	0.73
OEL MONTE	0	0.17	0.63	0.71	0.71	41	0.91	1.00	2.66	3.63	17	0.68	1.23	1.23	1.63
JETTY	1	0.02	0.71	0.71	0.71	22	0.76	0.03	1.43	1.43	4	0.19	1.07	1.43	1.23
LAGUNA CREEK	0	0.00	0.19	0.19	0.19	0	0.23	1.23	1.23	1.23	2	0.10	0.94	1.23	1.23
MAJORS CREEK	1	0.03	0.30	0.30	0.30	4	0.13	0.42	0.57	0.97	2	0.30	0.30	0.57	0.97
MARINA	1	0.03	0.30	0.30	0.30	11	0.44	0.50	1.23	3.00	7	0.30	1.00	1.00	2.00
PAJARO CREEK	1	0.03	0.30	0.30	0.30	21	0.30	0.50	0.50	0.50	12	0.30	1.00	1.00	2.00
RIO DEL MAR	2	0.40	0.47	0.63	0.63	3	0.11	0.50	1.00	1.00	3	0.13	1.00	2.00	2.00
SALINAS RIVER	2	0.06	1.67	1.67	1.67	2	0.40	0.70	0.94	1.00	1	0.33	0.31	0.31	0.31
SCOTT CREEK	6	0.27	1.00	2.00	2.00	7	0.27	0.03	0.03	0.03	4	0.20	0.03	1.46	1.67
SEASCAPE-APTOS	4	0.16	0.31	0.42	0.42	11	0.63	2.00	4.00	6.00	3	0.43	4.00	7.50	0.00
SUNSET	1	0.04	1.00	1.00	1.00	12	0.32	0.26	0.42	1.23	6	0.30	0.42	0.96	0.97
WILDER	0	0.00	1.00	1.00	1.00	3	0.13	0.63	0.63	0.63	3	0.19	3.13	6.00	6.00
YELLOW BANK CREEK	0	0.00	1.00	1.00	1.00	1	0.03	0.71	0.71	0.71	2	0.09	1.43	1.43	1.43
ZNUOWSKI	0	0.00	1.00	1.00	1.00	6	0.40	1.11	1.67	1.67	3	0.63	1.11	1.39	1.67

**CARCO GREGG: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983**

----- REGION-GULF OF THE FARALLONES -----

BEACH	FALL			WINTER			SPRING		
	M	P	MAX	M	P	MAX	M	P	MAX
AMO NUEVO	1	0.17	0.03	0	0.00	0.37	0	0.00	.
BOLINAS	0	0.00	.	1	0.03	0.37	0	0.00	.
CHONKHITE	0	0.00	.	0	0.00	.	1	0.02	1.11
OILLOM	0	0.00	.	4	0.12	0.91	0	0.00	1.11
DORAN	0	0.00	.	4	0.13	0.80	2	0.10	0.29
DOUBLE POINT	0	0.00	.	2	0.08	0.29	0	0.00	.
ORAKES	0	0.00	.	1	0.09	0.83	0	0.00	.
EDGEWATER	0	0.00	.	0	0.00	.	0	0.00	.
FORT POINT	0	0.00	.	0	0.00	.	0	0.00	.
HALF MOON BAY, NORTH	0	0.00	.	1	0.04	0.31	0	0.00	.
HALF MOON BAY, SOUTH	0	0.00	.	0	0.00	.	0	0.00	.
LIMANTOUR	0	0.00	.	3	0.08	0.80	0	0.00	.
LIMOA MAR	0	0.00	.	0	0.00	.	0	0.00	.
MONTARA	0	0.00	.	0	0.00	.	0	0.00	.
MUIR	0	0.00	.	1	0.02	0.31	2	0.05	0.31
OCEAN	0	0.00	.	0	0.00	.	0	0.00	.
PESCADEIRO	0	0.00	0.24	2	0.08	0.24	0	0.07	0.24
POINT REYES, A	1	0.04	0.24	0	0.00	0.31	1	0.00	0.24
POINT REYES, B	0	0.00	.	0	0.00	0.33	0	0.00	.
POINT REYES, C	0	0.00	.	1	0.14	0.33	0	0.00	.
POINT REYES, D	0	0.00	.	1	0.14	0.22	0	0.00	.
RCA	0	0.00	.	1	0.02	0.14	0	0.00	.
SALMON CREEK	0	0.00	.	0	0.00	0.14	0	0.00	.
SEARIFT	1	0.02	0.13	3	0.10	0.24	0	0.00	.
SHARP PARK	0	0.00	.	1	0.08	0.67	0	0.00	.
STINSON	0	0.00	.	0	0.00	.	0	0.00	.
THORNTON	0	0.00	.	0	0.00	.	1	0.04	0.63

----- REGION-MONTEREY BAY -----

BEACH	FALL			WINTER			SPRING		
	M	P	MAX	M	P	MAX	M	P	MAX
DAVENPORT, EAST	0	0.00	.	0	0.00	.	1	0.03	1.00
DAVENPORT, WEST	0	0.00	1.00	0	0.00	.	0	0.00	1.00
OEL MONTE	3	0.07	1.00	24	0.33	3.75	11	0.04	2.50
JETTIV	1	0.02	1.25	3	0.10	0.63	0	0.00	.
LAGUNA CREEK	0	0.00	.	1	0.03	0.71	0	0.00	.
MAJORS CREEK	0	0.00	.	1	0.04	1.25	0	0.00	.
MARINA	0	0.00	.	6	0.24	0.28	2	0.14	0.36
PAJARO DUMES	1	0.02	0.50	3	0.09	0.80	0	0.00	.
RIO DEL MAR	0	0.00	.	1	0.04	0.50	0	0.00	.
SALINAS RIVER	0	0.00	.	1	0.23	0.50	0	0.00	.
SCOTT CREEK	0	0.00	.	1	0.28	0.31	0	0.00	.
SEASCAPE-APTOS	0	0.00	.	0	0.00	.	0	0.00	.
SEASIDE	3	0.14	1.00	2	0.12	1.00	1	0.09	1.00
SUNSET	0	0.00	.	6	0.26	0.21	0	0.00	.
WILDER	0	0.00	.	0	0.00	.	0	0.00	.
YELLOW BANK CREEK	0	0.00	.	0	0.00	.	1	0.04	1.43
ZMUDDYSKI	0	0.00	.	0	0.00	.	0	0.00	.

SMALL GREBE SPP: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	N	P	FALL MEDIAN	75%	MAX	M	P	WINTER MEDIAN	75%	MAX	M	P	SPRING MEDIAN	75%	MAX
AMO NUEVO	1	0.17	0.05	0.05	0.05	0	0.00	0.37	0.37	0.37	0	0.00	0.37	0.37	0.37
BOLINAS	0	0.00				2	0.06	1.11	1.11	1.11	1	0.04	2.22	2.22	2.22
CROMKHUTE	0	0.00				1	0.02	0.68	1.14	2.27	3	0.13	0.43	1.36	1.36
DILLOW	0	0.00				10	0.29	0.29	0.00	1.10	7	0.33	0.00	2.94	3.24
GORAM	1	0.04	0.29	0.29	0.29	11	0.41	0.29	0.29	0.29	1	0.03	0.29	0.29	0.29
DOUBLE POINT	0	0.00				2	0.08	0.29	0.83	0.83	0	0.00			
DRAKES	0	0.00				2	0.18	0.63	0.63	0.63	0	0.00			
EDGEHAR	0	0.00				3	0.23	0.63	0.63	0.63	0	0.00			
FORT POINT	0	0.00				3	0.08	0.31	0.31	0.31	1	0.03	0.31	0.31	0.31
HALF MOON BAY, NORTH	0	0.00				0	0.00				0	0.00			
HALF MOON BAY, SOUTH	0	0.00				0	0.00				3	0.09	0.10	0.70	0.70
LIMANTOUR	0	0.00				4	0.10	0.93	0.83	0.83	0	0.00			
LINDA MAR	0	0.00				0	0.00				0	0.00			
LONTARA	0	0.00				0	0.00				0	0.00			
MUIR	0	0.00				0	0.00				2	0.03	0.31	0.31	0.31
OCEAN	0	0.00				3	0.10	0.31	0.70	0.94	0	0.00			
PESCADERO	0	0.00				0	0.00				0	0.00			
POINT REYES, A	1	0.04	0.24	0.24	0.24	4	0.15	0.24	0.24	0.24	3	0.21	0.71	1.67	1.67
POINT REYES, B	0	0.00				1	0.14	0.16	0.16	0.16	1	0.33	0.16	0.16	0.16
POINT REYES, C	0	0.00				1	0.14	0.33	0.33	0.33	0	0.00			
POINT REYES, D	0	0.00				2	0.29	0.16	0.22	0.22	0	0.00			
POINT REYES, E	0	0.00				4	0.13	0.20	0.31	0.42	1	0.00	0.09	0.09	0.09
RCA	1	0.02	0.14	0.14	0.14	6	0.13	0.26	0.63	0.63	0	0.00			
SALMON CREEK	1	0.04	0.26	0.26	0.26	3	0.20	0.26	0.50	0.77	4	0.11	0.30	0.31	0.31
SEABRIFT	1	0.02	0.13	0.13	0.13	10	0.19	0.26	0.67	0.67	0	0.00			
SHARP PARK	0	0.00				1	0.08	0.67	0.67	0.67	0	0.00			
STINSON	0	0.00				0	0.00				0	0.00			
THORNTON	0	0.00				1	0.03	0.31	0.31	0.31	1	0.04	0.63	0.63	0.63

REGION-MONTEREY BAY

BEACH	N	P	FALL MEDIAN	75%	MAX	M	P	WINTER MEDIAN	75%	MAX	M	P	SPRING MEDIAN	75%	MAX
DAVENPORT, EAST	0	0.00				0	0.00				1	0.03	1.00	1.00	1.00
DAVENPORT, WEST	0	0.00				0	0.00				0	0.00			
DEL MONTE	4	0.09	0.63	2.03	2.50	29	0.64	0.63	1.41	4.30	14	0.36	1.25	1.25	2.50
JETTY	3	0.07	0.63	1.25	1.25	6	0.21	0.63	1.02	1.25	1	0.03	0.31	0.32	0.31
LAGUNA CREEK	0	0.00				2	0.06	1.07	1.43	1.43	0	0.00			
MAJORS CREEK	0	0.00				1	0.04	1.25	1.25	1.25	0	0.00			
MARTHA	0	0.00				6	0.24	0.19	0.20	0.20	2	0.14	0.37	0.36	0.36
PAJARO DUNES	1	0.02	0.50	0.50	0.50	7	0.13	0.50	0.50	0.50	1	0.02	0.30	0.30	0.30
RIO DEL MAR	0	0.00				2	0.07	0.50	0.50	0.50	0	0.00			
SALINAS RIVER	0	0.00				2	0.20	0.31	0.31	0.31	0	0.00			
SCOTT CREEK	0	0.00				1	0.20	0.31	0.31	0.31	0	0.00			
SEASCAPE-APTOS	0	0.00				0	0.00				0	0.00			
SEASIOE	3	0.14	1.00	1.00	1.00	3	0.18	1.00	1.00	1.00	1	0.09	1.00	1.00	1.00
SUNSET	0	0.00				0	0.00				0	0.00			
WILDER	0	0.00				1	0.03	0.63	0.63	0.63	0	0.00			
YELLOW BANK CREEK	0	0.00				0	0.00				1	0.04	1.43	1.43	1.43
ZHUDDOWSKI	1	0.00	0.56	0.56	0.56	1	0.10	0.56	0.56	0.56	0	0.00			

ALL CORMORANT SPP: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION-GULF OF THE FARALLONES

BEACH	FALL		WINTER		SPRING		75%		MAX	
	N	P	M	P	M	P	M	P	M	P
AND NUEVO	3	0.30	0.05	0.23	0.23	0.37	0.37	0.11	0.19	0.19
BOLINAS	3	0.13	0.37	1.67	2.41	1.11	1.11	0.93	1.03	1.03
CROMKITE	32	0.35	2.70	4.17	22.22	1.11	1.11	2.22	3.00	3.00
DILLON	13	0.52	0.43	0.91	0.91	0.43	0.43	0.43	0.91	1.36
DORAN	14	0.37	0.37	0.59	0.00	0.29	0.74	0.00	0.00	2.35
DOUBLE POINT	13	0.32	0.37	1.21	1.43	0.29	0.67	0.29	1.21	2.57
DRAKES	3	0.25	1.04	1.67	1.67	0.21	0.99	0.42	1.67	2.00
COOKEAR	6	0.33	1.34	2.31	2.31	0.00	0.00	0.23	0.77	0.77
FORT POINT	1	0.04	0.63	0.63	0.63	0.63	0.63	0.63	1.23	1.00
HALF MOON BAY, NORTH	15	0.36	0.31	1.23	2.19	0.31	1.23	0.31	0.63	0.63
HALF MOON BAY, SOUTH	7	0.50	0.31	0.81	1.00	0.34	0.34	0.47	0.63	1.40
LIMANTOUR	17	0.37	0.10	0.26	0.80	0.10	0.33	0.35	0.44	1.40
LINDA MAR	5	0.03	1.34	1.92	2.31	0.77	0.77	1.92	3.00	3.00
MONTARA	2	0.33	0.63	0.63	0.63	0.31	0.31	0.00	2.00	12.00
MUIR	29	0.47	2.00	4.00	16.00	2.00	4.00	0.43	2.00	7.50
OCEAN	38	0.67	0.63	0.94	3.13	0.31	0.63	0.56	1.11	1.11
PESADERO	10	0.42	0.36	0.65	1.11	0.14	1.11	0.24	0.60	1.19
POINT REYES, A	0	0.00	0.24	0.60	2.14	0.35	0.48	0.64	0.33	0.33
POINT REYES, B	1	0.30	0.33	0.33	0.33	0.17	0.31	0.30	0.67	0.67
POINT REYES, C	0	0.00	0.42	0.73	0.33	0.67	0.67	0.43	1.09	1.09
POINT REYES, D	0	0.00	0.33	0.33	0.33	0.33	0.33	0.42	0.69	0.69
RCA	33	0.62	0.42	0.73	1.01	0.30	0.30	0.41	0.31	0.77
SALMON CREEK	17	0.71	1.03	1.41	3.00	0.32	0.56	0.31	1.13	4.10
SEADRIFT	37	0.50	0.30	0.77	3.33	0.30	0.50	0.50	1.33	3.33
SHARP PARK	11	0.63	0.67	2.00	3.33	0.67	0.67	0.67	1.43	1.43
STINSON	4	1.00	0.71	0.71	0.71	0.71	0.71	0.67	1.43	1.43
THORNTON	24	0.60	0.70	1.23	3.00	0.30	0.63	0.40	1.23	1.43

REGION-MONTEREY BAY

BEACH	FALL		WINTER		SPRING		75%		MAX	
	N	P	M	P	M	P	M	P	M	P
DAVEPORT, EAST	1	0.03	2.00	2.00	2.00	1.00	1.00	1.00	1.00	6.00
DAVEPORT, WEST	3	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.30
DEL MONTE	34	0.74	1.23	3.13	6.00	0.70	1.00	0.96	3.75	19.30
JERTY	17	0.39	1.23	1.08	3.73	0.63	1.25	0.47	1.25	8.01
LAGUNA CREEK	7	0.17	0.71	1.43	2.86	0.19	1.43	0.10	0.99	1.43
MAJORS CREEK	6	0.10	1.25	1.56	2.30	0.19	1.25	0.24	0.63	1.25
MARINA	9	0.43	0.19	0.33	0.37	0.14	0.21	0.06	0.30	0.56
PAJARO DUMES	15	0.23	0.50	1.30	4.00	0.14	0.50	0.20	0.75	11.50
RIO DEL MAR	4	0.23	0.75	1.38	3.00	0.04	0.50	0.17	0.50	1.00
SALINAS RIVER	1	0.20	0.31	0.31	0.31	0.00	1.50	0.33	0.31	0.31
SCOTT CREEK	2	0.06	0.83	0.83	0.83	0.12	0.83	0.20	2.50	2.50
SEASCAPE-APTOS	13	0.68	2.00	3.00	7.00	0.33	4.50	0.73	3.08	7.00
SEASIDE	10	0.40	0.31	0.52	4.79	0.39	0.42	0.19	0.63	0.83
SUNSET	6	0.24	0.63	0.78	1.25	0.30	1.25	0.31	0.63	0.83
WILDER BANK CREEK	5	0.13	1.43	2.38	2.86	0.07	1.43	0.13	1.43	1.43
YUDDONSKI	1	0.08	0.56	0.56	0.56	0.20	1.11	0.50	1.11	7.70

REGION-GULF OF THE FARALLONES

BEACH	FALL			75%	MAX	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	WINTER			75%	MAX	N	P	MEDIAN	SPRING			75%	MAX
	N	P	MEDIAN											N	P	MEDIAN						N	P	MEDIAN		
AMO NUEVO	5	0.50	0.05	0.23	0.23	0	0.00		0.37	0.56		1.00	0.11	0.19				2	1.00	0.11	0.19					
BOLINAS	4	0.12	0.46	1.94	2.41	9	0.26		1.11	1.11		0.50	0.74	1.76				12	0.50	0.74	1.76					
CROMKHYTE	27	0.47	3.35	5.35	22.22	14	0.27		0.45	1.14		0.46	2.22	5.56				19	0.46	2.22	5.56					
DILLON	11	0.44	0.45	0.45	0.91	6	0.10		0.29	0.59		0.38	0.45	0.91				9	0.38	0.45	0.91					
ODRAM	13	0.46	0.29	0.59	0.00	6	0.22		0.59	0.59		0.60	0.59	0.59				12	0.60	0.59	0.59					
DOUBLE POINT	9	0.36	0.57	0.79	1.45	0	0.32		0.29	0.29		0.33	0.57	1.14				7	0.33	0.57	1.14					
DRAKES	2	0.50	1.35	1.67	1.67	4	0.56		0.21	0.99		0.50	0.42	1.67				4	0.50	0.42	1.67					
EDGEHAR	6	0.55	1.54	2.31	2.31	0	0.00		0.63	0.63		0.25	0.77	2.00				1	0.25	0.77	2.00					
FORT POINT	1	0.04	0.65	0.65	0.65	7	0.35		0.51	1.25		0.18	0.51	1.25				4	0.18	0.51	1.25					
HALF MOON BAY, NORTH	12	0.44	0.31	0.74	1.56	7	0.27		0.63	0.63		0.35	0.63	1.88				7	0.35	0.63	1.88					
HALF MOON BAY, SOUTH	6	0.43	0.43	0.67	0.81	0	0.00		0.10	0.35		0.35	0.47	0.63				2	0.35	0.47	0.63					
LIMAMTOUR	12	0.26	0.18	0.55	0.00	11	0.20		0.10	0.35		0.37	0.18	0.44				13	0.37	0.18	0.44					
LIMOA HAR	4	0.67	1.15	2.12	2.51	0	0.00		0.31	0.31		1.00	1.54	2.51				2	1.00	1.54	2.51					
MONTARA	2	0.35	0.65	0.65	0.65	1	0.17		0.31	0.31		0.00	2.00	4.00				0	0.00	2.00	4.00					
MUIR	26	0.42	2.00	4.25	15.00	14	0.25		2.00	4.50		0.45	0.63	2.03				10	0.45	0.63	2.03					
OCEAN	34	0.60	0.65	0.94	2.01	14	0.29		0.51	0.65		0.52	0.56	0.97				21	0.52	0.56	0.97					
PESCADEO	5	0.21	0.56	0.85	1.11	2	0.14		0.05	1.11		0.35	0.36	0.65				4	0.35	0.36	0.65					
POINT REYES, A	15	0.65	0.24	0.48	1.45	0	0.31		0.36	0.48		0.45	0.36	0.65				6	0.45	0.36	0.65					
POINT REYES, B	0	0.00				1	0.14		0.16	0.16		1.00	0.53	0.35				3	1.00	0.53	0.35					
POINT REYES, C	1	0.50	0.33	0.33	0.33	4	0.57		0.67	0.67		0.50	0.50	0.67				2	0.50	0.50	0.67					
POINT REYES, D	0	0.00				1	0.14		0.22	0.54		0.75	0.43	0.87				3	0.75	0.43	0.87					
RCA	50	0.57	0.50	0.65	1.67	13	0.20		0.20	0.42		0.36	0.51	1.30				12	0.36	0.51	1.30					
SALMON CREEK	16	0.67	0.77	1.25	2.56	8	0.53		0.26	0.45		0.29	0.51	0.51				5	0.29	0.51	0.51					
SEARIFT	54	0.53	0.26	0.77	3.08	23	0.44		0.26	0.77		0.37	0.51	1.35				20	0.37	0.51	1.35					
SHARP PARK	9	0.53	0.67	1.53	5.55	2	0.15		0.67	0.67		0.40	1.53	2.00				4	0.40	1.53	2.00					
STINSON	4	1.00	0.71	0.71	0.71	4	0.50		0.71	0.71		0.67	1.45	1.45				4	0.67	1.45	1.45					
THORNTON	22	0.55	0.71	1.25	5.00	6	0.19		0.55	0.65		0.36	0.65	1.45				9	0.36	0.65	1.45					

REGION-MONTEREY BAY

[illegible]

BRANT'S CORMORANT: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING			MAX			75%			MAX		
	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN
AMO NUEVO	3	0.50	0.05	0	0.00	0.37	2	1.00	0.11	2	1.00	0.11	2	1.00	0.11	0.19	0.19	0.19
BOLINAS	4	0.12	0.46	7	0.20	0.37	12	0.50	0.74	12	0.50	0.74	12	0.50	0.74	1.74	1.74	6.67
CROMWITE	24	0.41	2.22	13	0.25	1.11	19	0.46	2.22	19	0.46	2.22	19	0.46	2.22	5.33	5.33	13.33
DILLON	7	0.20	0.45	4	0.12	0.45	6	0.25	2.13	6	0.25	2.13	6	0.25	2.13	0.91	0.91	0.91
DORAN	0	0.29	0.29	4	0.15	0.44	11	0.55	0.59	11	0.55	0.59	11	0.55	0.59	1.74	1.74	1.74
DOUBLE POINT	6	0.24	0.36	5	0.20	0.29	6	0.29	1.71	6	0.29	1.71	6	0.29	1.71	1.21	1.21	1.43
DRAKES	2	0.50	0.03	3	0.21	0.21	3	0.50	1.25	3	0.50	1.25	3	0.50	1.25	2.00	2.00	2.00
COGHEAR	2	0.18	1.92	0	0.00	0.63	0	0.00	0.63	0	0.00	0.63	0	0.00	0.63	1.54	1.54	1.00
FORT POINT	1	0.04	0.63	3	0.15	0.63	4	0.10	0.31	4	0.10	0.31	4	0.10	0.31	0.55	0.55	0.63
HALF MOON BAY, NORTH	11	0.41	0.31	6	0.23	0.31	2	0.33	1.41	2	0.33	1.41	2	0.33	1.41	0.63	0.63	0.63
HALF MOON BAY, SOUTH	6	0.43	0.43	0	0.00	0.10	13	0.37	0.10	13	0.37	0.10	13	0.37	0.10	0.44	0.44	1.40
LINAMTOUR	10	0.22	0.10	10	0.26	0.10	1	0.50	0.35	1	0.50	0.35	1	0.50	0.35	2.31	2.31	2.31
LINOA WAR	4	0.67	1.15	0	0.00	0.67	0	0.00	0.67	0	0.00	0.67	0	0.00	0.67	11.00	11.00	11.00
MONTARA	2	0.35	0.63	12	0.21	2.00	20	0.50	0.63	20	0.50	0.63	20	0.50	0.63	2.11	2.11	7.19
MUIR	24	0.39	2.00	11	0.07	0.31	4	0.33	0.94	4	0.33	0.94	4	0.33	0.94	0.97	0.97	1.11
OCEAN	30	0.53	0.63	1	0.07	0.36	6	0.43	0.71	6	0.43	0.71	6	0.43	0.71	0.63	0.63	1.19
PESCADERO	5	0.21	0.54	0	0.31	0.36	2	0.67	0.48	2	0.67	0.48	2	0.67	0.48	0.33	0.33	0.33
POINT REYES, A	14	0.50	0.24	1	0.14	0.16	2	0.50	0.16	2	0.50	0.16	2	0.50	0.16	0.67	0.67	0.67
POINT REYES, B	0	0.00	0.00	1	0.14	0.67	3	0.15	0.67	3	0.15	0.67	3	0.15	0.67	0.67	0.67	0.67
POINT REYES, C	0	0.00	0.00	4	0.17	0.22	11	0.33	0.54	11	0.33	0.54	11	0.33	0.54	0.67	0.67	0.67
POINT REYES, D	0	0.00	0.00	12	0.26	0.20	19	0.54	1.11	19	0.54	1.11	19	0.54	1.11	0.51	0.51	1.30
RCA	21	0.51	0.20	4	0.27	0.26	5	0.29	0.51	5	0.29	0.51	5	0.29	0.51	0.51	0.51	0.51
SALMON CREEK	13	0.54	0.77	21	0.40	0.26	4	0.40	1.34	4	0.40	1.34	4	0.40	1.34	1.54	1.54	3.05
SEARIFT	32	0.50	0.26	2	0.15	0.67	4	0.40	0.67	4	0.40	0.67	4	0.40	0.67	2.00	2.00	2.00
SHARP PARK	8	0.47	0.67	4	0.50	0.71	4	0.67	0.71	4	0.67	0.71	4	0.67	0.71	1.43	1.43	1.43
STINSON	4	1.00	0.71	5	0.16	0.31	7	0.20	0.63	7	0.20	0.63	7	0.20	0.63	1.25	1.25	1.25
THORNTON	22	0.55	0.63	3	0.20	0.85	4	0.50	1.11	4	0.50	1.11	4	0.50	1.11	1.43	1.43	1.43

REGION-MONTEREY BAY

BEACH	FALL			WINTER			SPRING			MAX			75%			MAX		
	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN	M	P	MEDIAN
DAVENPORT, EAST	0	0.00	0.00	1	0.05	1.00	2	0.10	5.00	2	0.10	5.00	2	0.10	5.00	6.00	6.00	6.00
DAYENPORT, WEST	2	0.50	2.00	0	0.00	1.25	0	0.00	3.75	0	0.00	3.75	0	0.00	3.75	10.79	10.79	10.79
DEL MONTE	30	0.65	1.09	33	0.73	0.63	24	0.96	1.09	24	0.96	1.09	24	0.96	1.09	1.25	1.25	1.25
JETTY	9	0.20	1.25	4	0.14	0.63	10	0.33	1.25	10	0.33	1.25	10	0.33	1.25	1.43	1.43	1.43
LAJUNA CREEK	3	0.07	1.43	5	0.16	0.71	2	0.10	0.94	2	0.10	0.94	2	0.10	0.94	1.43	1.43	1.43
MAJORS CREEK	3	0.09	1.25	4	0.15	0.94	2	0.10	0.94	2	0.10	0.94	2	0.10	0.94	1.25	1.25	1.25
MARIWA	5	0.25	0.19	3	0.12	0.14	11	0.79	0.19	11	0.79	0.19	11	0.79	0.19	0.30	0.30	0.42
PAJARO CUNES	13	0.20	1.00	4	0.11	0.50	7	0.17	1.00	7	0.17	1.00	7	0.17	1.00	1.00	1.00	1.00
RIO DEL MAR	4	0.11	0.75	0	0.00	0.50	3	0.13	0.50	3	0.13	0.50	3	0.13	0.50	0.50	0.50	0.50
SALINAS RIVER	0	0.00	0.00	2	0.50	0.75	0	0.00	1.00	0	0.00	1.00	0	0.00	1.00	2.50	2.50	2.50
SCOTT CREEK	2	0.06	0.03	0	0.00	0.03	3	0.15	0.03	3	0.15	0.03	3	0.15	0.03	4.04	4.04	6.00
SEASCAPE-APTOS	11	0.50	2.00	9	0.53	1.00	0	0.73	3.58	0	0.73	3.58	0	0.73	3.58	0.42	0.42	0.42
SEASIOE	8	0.32	0.21	5	0.22	0.42	1	0.06	0.42	1	0.06	0.42	1	0.06	0.42	0.63	0.63	0.63
SUNSET	3	0.12	0.63	2	0.10	0.73	3	0.13	0.63	3	0.13	0.63	3	0.13	0.63	1.43	1.43	1.43
WILDER	4	0.11	1.19	2	0.07	1.43	4	0.50	1.43	4	0.50	1.43	4	0.50	1.43	1.43	1.43	1.43
YELLOW BANK CREEK	1	0.08	0.56	2	0.20	0.85	4	0.50	1.11	4	0.50	1.11	4	0.50	1.11	6.25	6.25	7.70
ZHUOWSKI	1	0.08	0.56	2	0.20	0.85	4	0.50	1.11	4	0.50	1.11	4	0.50	1.11	6.25	6.25	7.70

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING			
	N	P	MEAN	75%	MAX	N	P	MEAN	75%	MAX
AMO NUEVO	0	0.00	0.37	0.37	0.37	0	0.00	0.37	0.37	0.37
BOLINAS	2	0.06	1.11	1.11	1.11	7	0.20	1.11	1.11	1.11
CROWNITE	12	0.21	0.43	0.80	0.91	2	0.04	0.43	0.43	0.43
OILLOM	4	0.16	0.29	0.29	0.29	2	0.06	0.29	0.29	0.29
ODRAM	6	0.21	0.29	0.57	0.86	4	0.15	0.29	0.74	0.86
DOUBLE POINT	8	0.32	0.29	0.37	0.42	9	0.36	0.29	0.71	0.86
ORANES	1	0.25	0.42	0.42	0.42	0	0.00	0.29	0.71	0.86
EOGEMAR	0	0.00	0.31	0.59	1.56	0	0.00	0.31	0.47	0.63
FORT POINT	0	0.00	0.31	0.59	1.56	0	0.00	0.31	0.47	0.63
HALF MOON BAY, NORTH	8	0.30	0.27	0.27	0.27	3	0.19	0.34	0.54	0.54
HALF MOON BAY, SOUTH	3	0.21	0.18	0.18	0.18	2	0.16	0.18	0.18	0.18
LIMANTOUR	6	0.13	0.77	0.77	0.77	0	0.00	0.77	0.77	0.77
LINDA MAR	2	0.33	0.77	0.77	0.77	1	0.23	0.77	0.77	0.77
MONTARA	0	0.00	1.00	2.00	3.00	0	0.00	1.00	1.00	1.00
MUIR	9	0.15	0.31	0.31	0.31	1	0.02	0.31	0.31	0.31
OCEAN	8	0.14	0.56	0.60	0.74	1	0.02	0.56	0.56	0.56
PESCADERO	6	0.23	0.24	0.36	0.71	0	0.00	0.30	0.40	0.40
POINT REYES, A	9	0.38	0.00	0.00	0.00	2	0.08	0.00	0.00	0.00
POINT REYES, B	0	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
POINT REYES, C	0	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
POINT REYES, D	0	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
RCA	13	0.25	0.14	0.30	0.63	4	0.14	0.22	0.22	0.22
SALMON CREEK	12	0.30	0.26	0.31	0.77	1	0.09	0.26	0.26	0.26
SEACRIFT	14	0.22	0.26	0.29	0.51	2	0.13	0.26	0.26	0.26
SHARP PARK	4	0.24	1.00	1.83	2.00	7	0.13	0.26	0.51	0.77
STINSON	0	0.00	0.38	0.36	0.63	0	0.00	0.38	0.63	0.63
WORMION	4	0.10	0.38	0.36	0.63	1	0.03	0.38	0.63	0.63

REGION-MONTEREY BAY

BEACH	FALL			75%			MAX			WINTER			75%			MAX			SPRING			75%			MAX		
	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX		
DAVENPORT, EAST	1	0.03	2.00	2.00	2.00	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.		
DAVENPORT, WEST	1	0.25	2.00	2.00	2.00	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.		
DEL MONTE	20	0.43	0.63	1.00	3.13	15	0.33	1.25	1.25	2.50	10	0.44	1.25	1.25	2.50	10	0.44	1.25	1.25	2.50	10	0.44	1.25	1.25	4.00		
JETTY	6	0.14	0.94	1.25	1.25	4	0.14	0.63	1.00	1.25	3	0.10	1.25	1.25	1.25	3	0.10	1.25	1.25	1.25	3	0.10	1.25	1.25	1.25		
LAGUNA CREEK	3	0.13	0.71	1.43	1.43	1	0.03	0.40	0.40	0.40	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	1.25		
MAJORS CREEK	3	0.09	1.23	1.23	1.23	1	0.04	0.63	0.63	0.63	2	0.10	0.94	1.25	1.25	2	0.10	0.94	1.25	1.25	2	0.10	0.94	1.25	1.25		
MARINA	4	0.20	0.23	0.33	0.30	1	0.04	0.14	0.14	0.14	3	0.21	0.14	0.20	0.20	3	0.21	0.14	0.20	0.20	3	0.21	0.14	0.20	0.20		
PAJARO DUNES	4	0.02	0.30	0.30	0.30	1	0.02	0.30	0.30	0.30	1	0.02	0.30	0.30	0.30	1	0.02	0.30	0.30	0.30	1	0.02	0.30	0.30	0.30		
RIO DEL MAR	4	0.11	0.30	0.00	1.00	1	0.04	0.30	0.30	0.30	1	0.04	0.30	0.30	0.30	1	0.04	1.00	1.00	1.00	1	0.04	1.00	1.00	1.00		
SALINAS RIVER	.	.	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.		
SCOTT CREEK	1	0.20	0.31	0.31	0.31	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	0.03		
SEASCOPE-APTOS	0	0.00	.	.	.	1	0.04	0.03	0.03	0.03	1	0.03	0.03	0.03	0.03	1	0.03	0.03	0.03	0.03	1	0.03	0.03	0.03	0.03		
SEASIOE	9	0.41	1.00	3.00	4.00	6	0.35	1.13	2.00	2.00	3	0.45	1.00	2.00	2.00	3	0.45	1.00	2.00	2.00	3	0.45	1.00	2.00	2.00		
SUNSET	3	0.12	0.63	4.79	4.79	4	0.17	0.14	0.35	0.42	4	0.19	0.42	0.63	0.63	4	0.19	0.42	0.63	0.63	4	0.19	0.42	0.63	0.63		
WILDER	3	0.12	0.63	1.25	1.25	4	0.20	1.25	1.25	1.25	4	0.25	0.63	0.63	0.63	4	0.25	0.63	0.63	0.63	4	0.25	0.63	0.63	0.63		
YELLOW BANK CREEK	3	0.08	1.43	1.43	1.43	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.		
MUDDOWSKI	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.		

WHITE-WINGED SCOTER: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION-GULF OF THE FARALLONES

BEACH	FALL		WINTER		SPRING		MAX	
	M	P	M	P	M	P	M	P
AMO NUEVO	0	0.00	1	0.50	0.09	0.09	0.09	0.09
BOLINAS	0	0.00	2	0.06	0.20	0.37	0.37	0.37
CROMWELL	0	0.00	1	0.02	1.11	1.11	1.11	1.11
OILION	3	0.12	8	0.24	0.45	0.80	1.36	1.36
ODRAM	3	0.11	17	0.63	0.29	0.80	2.06	2.06
ODUBLE POINT	2	0.00	1	0.04	0.10	0.10	0.10	0.10
DRAXES	0	0.00	4	0.36	0.42	1.04	1.25	1.25
FOGEMAR	1	0.09	0	0.00	0.63	0.63	0.63	0.63
FORT POINT	0	0.00	1	0.05	0.63	0.63	0.63	0.63
HALF MOON BAY, NORTH	0	0.00	3	0.12	0.63	0.63	0.63	0.63
HALF MOON BAY, SOUTH	0	0.00	1	0.09	0.14	0.14	0.14	0.14
LIMANTOUR	1	0.02	9	0.23	0.10	0.10	0.70	0.70
LIMOA MAR	0	0.00	1	0.25	0.77	0.77	0.77	0.77
MONTARA	0	0.00	0	0.00	1.00	1.00	1.00	1.00
MUIR	1	0.02	2	0.04	0.31	0.31	0.31	0.31
OCEAN	0	0.00	6	0.12	0.39	0.39	0.39	0.39
PESCADERO	0	0.00	0	0.00	0.24	0.24	0.24	0.24
POINT REYES, A	2	0.08	5	0.19	0.24	0.24	0.24	0.24
POINT REYES, B	0	0.00	0	0.00	0.33	0.33	0.33	0.33
POINT REYES, C	0	0.00	5	0.43	0.33	0.33	0.33	0.33
POINT REYES, D	0	0.00	0	0.00	0.14	0.14	0.14	0.14
RCA	1	0.02	1	0.02	0.14	0.14	0.14	0.14
SALMON CREEK	4	0.17	6	0.40	0.51	0.51	0.51	0.51
SEADRIFT	0	0.00	16	0.31	0.26	0.26	0.26	0.26
SHARP PARK	2	0.12	1	0.00	0.67	0.67	0.67	0.67
STINSON	0	0.00	1	0.13	0.71	0.71	0.71	0.71
THORNTON	1	0.02	1	0.03	1.00	1.00	1.00	1.00

REGION-MONTEREY BAY

BEACH	FALL		WINTER		SPRING		MAX	
	M	P	M	P	M	P	M	P
DAVENPORT, EAST	0	0.00	1	0.03	1.00	1.00	1.00	1.00
DAVENPORT, WEST	0	0.00	0	0.00	1.25	1.25	1.25	1.25
DEL MONTE	0	0.00	19	0.42	0.63	0.63	0.63	0.63
JETTY	0	0.00	7	0.24	0.71	0.71	0.71	0.71
LAGUNA CREEK	1	0.02	5	0.16	1.25	1.25	1.25	1.25
MAJORS CREEK	0	0.00	3	0.11	0.63	0.63	0.63	0.63
MARINA	0	0.00	3	0.12	0.19	0.19	0.19	0.19
PAJARO DUMES	0	0.00	9	0.16	0.50	0.50	0.50	0.50
RIO DEL MAR	0	0.00	5	0.19	0.50	0.50	0.50	0.50
SALINAS RIVER	0	0.00	1	0.25	0.50	0.50	0.50	0.50
SCOTT CREEK	0	0.00	0	0.00	0.83	0.83	0.83	0.83
SEASCAPE-APTOS	0	0.00	5	0.19	1.00	1.00	1.00	1.00
SEASTOE	3	0.14	5	0.29	1.00	1.00	1.00	1.00
SUNSET	2	0.08	7	0.30	0.21	0.21	0.21	0.21
WILCOX	0	0.00	0	0.00	0.24	0.24	0.24	0.24
YELLOW BANK CREEK	0	0.00	0	0.00	0.36	0.36	0.36	0.36
ZHUONSKI	0	0.00	0	0.00	0.56	0.56	0.56	0.56

PHALAROPE SPP: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			75%			SPRING			75%			MAX		
	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN
AMO NUEVO	0	0.00	.	0	0.00	0.12	0	0.00	0.49	0	0.00	.	.	.	.	.	.	.
BOLINAS	0	0.00	.	3	0.09	.	1	0.49	0.49	0	0.00	.	.	.	.	.	.	.
CROMWITE	0	0.00	.	0	0.00	.	0	0.00	.	0	0.00	.	.	.	.	.	.	.
OILLOW	1	0.04	0.43	5	0.15	0.43	5	0.15	1.36	1	0.04	0.43	0.43	0.43	0.43	0.43	0.43	0.43
DORAN	3	0.11	0.29	7	0.24	0.29	7	0.24	1.10	1.47	0	0.00	.	.	.	.	.	.
DOUBLE POINT	0	0.00	.	1	0.04	0.10	0	0.00	0.10	0.10	0	0.00	.	.	.	.	.	.
ORAKES	0	0.00	.	3	0.27	0.42	0	0.00	0.03	0.03	0	0.00	.	.	.	.	.	.
EDGEHAR	0	0.00	.	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
FORT POINT	0	0.00	.	1	0.05	0.43	0	0.00	0.43	0.43	0	0.00	.	.	.	.	.	.
HALF MOON BAY, NORTH	0	0.00	.	2	0.00	0.94	1	0.05	1.25	1.25	1	0.05	2.01	2.01	2.01	2.01	2.01	2.01
HALF MOON BAY, SOUTH	0	0.00	.	1	0.09	0.01	1	0.09	0.01	0.01	1	0.17	0.19	0.19	0.19	0.19	0.19	0.19
LIMANTOUR	0	0.00	.	5	0.13	0.10	1	0.03	0.70	0.00	1	0.03	0.35	0.35	0.35	0.35	0.35	0.35
LINDA MAR	0	0.00	.	2	0.50	2.69	0	0.00	4.62	4.62	0	0.00	.	.	.	.	.	.
MONTARA	0	0.00	.	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
MUIR	0	0.00	.	3	0.05	1.00	3	0.05	3.00	3.00	1	0.02	3.00	3.00	3.00	3.00	3.00	3.00
OCEAN	0	0.00	.	2	0.04	0.31	2	0.04	0.31	0.31	1	0.02	1.25	1.25	1.25	1.25	1.25	1.25
PESCAERO	1	0.04	1.67	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
POINT REYES, A	6	0.25	0.24	5	0.19	0.24	3	0.21	4.32	4.32	1	0.07	0.60	0.60	0.60	0.60	0.60	0.60
POINT REYES, B	0	0.00	.	1	0.14	0.16	0	0.00	0.16	0.16	0	0.00	.	.	.	.	.	.
POINT REYES, C	0	0.00	.	3	0.43	1.00	1	0.00	1.00	1.00	0	0.00	.	.	.	.	.	.
POINT REYES, D	1	1.00	0.22	2	0.29	0.54	0	0.00	0.07	0.07	0	0.00	.	.	.	.	.	.
RCA	2	0.04	1.22	4	0.09	0.69	2	0.09	1.47	1.47	1	0.03	0.93	0.93	0.93	0.93	0.93	0.93
SALMON CREEK	3	0.13	0.51	3	0.20	1.41	0	0.00	0.05	0.05	2	0.12	0.51	0.51	0.51	0.51	0.51	0.51
SEARIFT	1	0.02	0.13	9	0.17	0.77	1	0.41	1.54	1.54	1	0.03	2.31	2.31	2.31	2.31	2.31	2.31
SHARP PARK	1	0.06	0.67	2	0.15	1.33	2	0.00	2.00	2.00	1	0.10	1.33	1.33	1.33	1.33	1.33	1.33
STIMSON	0	0.00	.	1	0.13	0.71	0	0.00	0.71	0.71	0	0.00	.	.	.	.	.	.
THORNTON	1	0.02	0.77	2	0.06	2.43	4	0.23	4.23	4.23	2	0.00	0.27	0.27	0.27	0.27	0.27	0.27

REGION-MONTEREY BAY

BEACH	FALL			WINTER			75%			SPRING			75%			MAX		
	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN	N	P	MEAN
DAVENPORT, EAST	0	0.00	.	2	0.07	0.03	1	0.00	1.00	1.00	0	0.00	.	.	.	.	.	.
DAVENPORT, WEST	0	0.00	.	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
OEL MONTE	2	0.04	0.94	15	0.33	1.56	3	0.13	39.30	39.30	4	0.16	0.63	0.63	0.63	10.70	10.70	10.70
JETTY	1	0.02	0.63	7	0.24	0.63	2	0.19	5.63	5.63	2	0.07	0.47	0.47	0.47	0.63	0.63	0.63
LAGUNA CREEK	4	0.10	0.60	4	0.13	2.14	2	0.14	2.14	2.14	0	0.00	.	.	.	.	.	.
MAJORS CREEK	2	0.06	0.94	2	0.07	2.01	5	0.00	5.00	5.00	0	0.00	.	.	.	.	.	.
MARINA	1	0.05	0.14	3	0.12	0.19	0	0.00	0.20	0.20	2	0.14	4.17	4.17	4.17	7.92	7.92	7.92
PAJARO GUMES	3	0.05	0.50	5	0.09	0.50	2	0.00	3.00	3.00	2	0.05	2.00	2.00	2.00	3.50	3.50	3.50
RIO OEL MAR	0	0.00	.	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
SALINAS RIVER	0	0.00	.	0	0.00	.	0	0.00	0.50	0.50	0	0.00	.	.	.	.	.	.
SCOTT CREEK	1	0.03	0.03	1	0.04	0.03	0	0.00	0.03	0.03	1	0.05	1.67	1.67	1.67	1.67	1.67	1.67
SEASCAPE-APTOS	0	0.00	.	2	0.12	2.50	4	0.00	4.00	4.00	0	0.00	.	.	.	.	.	.
SEASIDE	0	0.00	.	5	0.22	0.42	2	0.15	3.06	3.06	1	0.06	0.21	0.21	0.21	0.21	0.21	0.21
SUNSEY	0	0.00	.	0	0.00	.	0	0.00	.	.	0	0.00	.	.	.	.	.	.
WILDER	0	0.00	.	1	0.03	0.71	0	0.00	0.71	0.71	0	0.00	.	.	.	.	.	.
YELLOW BANK CREEK	0	0.00	.	2	0.20	0.03	1	0.11	1.11	1.11	2	0.25	6.67	6.67	6.67	9.44	9.44	9.44
ZMUODWSKI	0	0.00	.	2	0.20	0.03	1	0.11	1.11	1.11	2	0.25	6.67	6.67	6.67	9.44	9.44	9.44

NEO PHALAROE: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION-GULF OF THE FARALLONES

BEACH	FALL		75%		MAX		WINTER		75%		MAX		SPRING		75%		MAX	
	M	P	MEDIAN				M	P	MEDIAN				M	P	MEDIAN			
AMO NUEVO	0	0.00	.	.	.	.	0	0.00	.	0.12	0.49	0.49	0	0.00	.	.	.	.
BOLINAS	0	0.00	.	.	.	.	3	0.09	0.12	0.49	0.49	0.49	0	0.00	.	.	.	.
CROMHITE	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
OILLOM	1	0.04	0.43	0.43	0.43	0.43	5	0.13	0.43	1.36	1.02	1.02	0	0.00	.	.	.	.
DORAM	2	0.07	0.29	0.29	0.29	0.29	7	0.26	0.29	1.10	1.47	1.47	0	0.00	.	.	.	.
DOUBLE POINT	0	0.00	.	.	.	.	1	0.04	0.10	0.10	0.10	0.10	0	0.00	.	.	.	.
ORAKES	0	0.00	.	.	.	.	3	0.27	0.42	0.83	0.83	0.83	0	0.00	.	.	.	.
EDGEWATER	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
FORT POINT	0	0.00	.	.	.	.	1	0.03	0.63	0.63	0.63	0.63	0	0.00	.	.	.	.
HALF MOON BAY, NORTH	0	0.00	.	.	.	.	1	0.04	0.63	0.63	0.63	0.63	1	0.03	2.50	2.50	2.50	2.50
HALF MOON BAY, SOUTH	0	0.00	.	.	.	.	1	0.09	0.81	0.81	0.81	0.81	0	0.00	.	.	.	.
LIMAMOUR	0	0.00	.	.	.	.	5	0.13	0.10	0.70	0.00	0.00	1	0.03	0.35	0.35	0.35	0.35
LIMOA MAR	0	0.00	.	.	.	.	2	0.50	2.69	4.62	4.62	4.62	0	0.00	.	.	.	.
MONIARA	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
MUIR	0	0.00	.	.	.	.	2	0.04	2.00	3.00	3.00	3.00	1	0.02	2.00	2.00	2.00	2.00
OCEAN	0	0.00	.	.	.	.	2	0.04	0.31	0.31	0.31	0.31	1	0.02	1.25	1.25	1.25	1.25
PESCADERO	1	0.04	1.67	1.67	1.67	1.67	0	0.00	.	.	.	.	1	0.00	1.67	1.67	1.67	1.67
POINT REYES, A	3	0.13	0.40	0.40	0.40	0.40	5	0.19	0.24	3.10	4.29	4.29	1	0.07	0.40	0.40	0.40	0.40
POINT REYES, B	0	0.00	.	.	.	.	1	0.14	0.16	0.16	0.16	0.16	0	0.00	.	.	.	.
POINT REYES, C	0	0.00	.	.	.	.	3	0.43	1.00	1.00	1.00	1.00	0	0.00	.	.	.	.
POINT REYES, D	1	1.00	0.22	0.22	0.22	0.22	2	0.29	0.54	0.07	0.07	0.07	0	0.00	.	.	.	.
RCA	1	0.02	1.00	1.00	1.00	1.00	4	0.09	0.69	1.67	1.94	1.94	1	0.03	0.74	0.74	0.74	0.74
SALMON CREEK	1	0.04	0.26	0.26	0.26	0.26	3	0.20	1.41	0.85	0.85	0.85	1	0.06	0.77	0.77	0.77	0.77
SEADRIFT	0	0.00	.	.	.	.	9	0.17	0.77	1.41	1.54	1.54	1	0.03	1.79	1.79	1.79	1.79
SHARP PARK	1	0.06	0.67	0.67	0.67	0.67	2	0.15	1.33	2.00	2.00	2.00	1	0.10	1.33	1.33	1.33	1.33
STIMSON	0	0.00	.	.	.	.	1	0.13	0.71	0.71	0.71	0.71	0	0.00	.	.	.	.
THORNTON	1	0.02	0.77	0.77	0.77	0.77	2	0.06	2.43	4.23	4.23	4.23	2	0.00	0.27	0.30	0.30	0.30

REGION-MONTEREY BAY

BEACH	FALL		75%		MAX		WINTER		75%		MAX		SPRING		75%		MAX	
	M	P	MEDIAN				M	P	MEDIAN				M	P	MEDIAN			
DAVENPORT, EAST	0	0.00	.	.	.	.	2	0.07	0.83	1.00	1.00	1.00	0	0.00	.	.	.	.
DAVENPORT, WEST	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
DEL MONTE	2	0.04	0.94	1.25	1.25	1.25	15	0.33	1.56	3.13	39.50	39.50	3	0.12	0.63	14.17	14.17	14.17
JETTY	0	0.00	.	.	.	.	2	0.07	0.63	0.63	0.63	0.63	0	0.00	.	.	.	.
LAGUNA CREEK	0	0.00	.	.	.	.	4	0.13	2.14	2.14	2.14	2.14	0	0.00	.	.	.	.
MAJORS CREEK	0	0.00	.	.	.	.	2	0.07	2.01	5.00	5.00	5.00	0	0.00	.	.	.	.
MARINA	0	0.00	.	.	.	.	3	0.12	0.19	0.20	0.20	0.20	2	0.14	4.10	7.92	7.92	7.92
PAJARO OUMES	1	0.02	1.00	1.00	1.00	1.00	4	0.07	0.50	2.30	3.00	3.00	2	0.05	1.50	2.50	2.50	2.50
RIO DEL MAR	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
SALINAS RIVER	0	0.00	.	.	.	.	2	0.50	0.50	0.50	0.50	0.50	0	0.00	.	.	.	.
SCOTT CREEK	1	0.03	0.83	0.83	0.83	0.83	0	0.00	.	.	.	.	0	0.00	.	.	.	.
SEASCAPE-APTOS	0	0.00	.	.	.	.	1	0.04	0.83	0.83	0.83	0.83	1	0.05	1.67	1.67	1.67	1.67
SEASIOE	0	0.00	.	.	.	.	2	0.12	2.50	4.00	4.00	4.00	0	0.00	.	.	.	.
SUMSET	0	0.00	.	.	.	.	4	0.17	0.31	0.52	0.56	0.56	1	0.06	0.21	0.21	0.21	0.21
WILDER	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
YELLOW BANK CREEK	0	0.00	.	.	.	.	0	0.00	.	.	.	.	0	0.00	.	.	.	.
ZIMODANSKI	0	0.00	.	.	.	.	1	0.10	1.11	1.11	1.11	1.11	2	0.25	6.39	8.89	8.89	8.89

NEERMANN'S GULL: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			75%			SPRING			75%			MAX		
	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN
AMO NUEVO	1	0.17	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0	0.00	0.12	0.12	0.12	0.12	0	0.00	
BOLINAS	1	0.03	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0	0.00	0.12	0.12	0.12	0.12	0	0.00	
CAONKHITE	0	0.14	1.11	2.22	2.22	2.22	2.22	2.22	2.22	0	0.00	0.43	0.43	0.43	0.43	0	0.00	
DILLON	0	0.00								1	0.03	0.43	0.43	0.43	0.43	1	0.04	0.23
DORAN	4	0.14	0.29	0.29	0.29	0.29	0.29	0.29	0.29	2	0.07	0.22	0.22	0.22	0.22	0	0.00	
DOUBLE POINT	0	0.00								0	0.00					0	0.00	
ORAKES	1	0.23	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0	0.00					0	0.00	
EDGEWATER	2	0.10	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0	0.00					0	0.00	
FORT POINT	1	0.04	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0	0.00					0	0.00	
HALF MOON BAY, NORTH	6	0.22	0.31	0.31	0.31	0.31	0.31	0.31	0.31	1	0.04	0.31	0.31	0.31	0.31	0	0.00	
HALF MOON BAY, SOUTH	3	0.21	0.31	0.31	0.31	0.31	0.31	0.31	0.31	1	0.09	0.34	0.34	0.34	0.34	0	0.00	
LIMANTOUR	4	0.09	0.18	0.18	0.18	0.18	0.18	0.18	0.18	1	0.03	0.18	0.18	0.18	0.18	0	0.00	
LINDA MAR	1	0.17	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0	0.00					0	0.00	
MONTARA	0	0.00								0	0.00					0	0.00	
MUIR	6	0.10	1.30	2.00	2.00	2.00	2.00	2.00	2.00	4	0.07	1.00	1.73	2.00	2.00	0	0.00	
OCEAN	12	0.21	0.31	0.31	0.31	0.31	0.31	0.31	0.31	1	0.02	0.31	0.31	0.31	0.31	0	0.00	
PESCADERO	3	0.13	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0	0.00					0	0.00	
POINT REYES, A	3	0.21	0.12	0.24	0.24	0.24	0.24	0.24	0.24	0	0.00					0	0.00	
POINT REYES, B	1	1.00	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0	0.00					0	0.00	
POINT REYES, C	0	0.00								0	0.00					0	0.00	
POINT REYES, D	0	0.00								0	0.00					0	0.00	
RCA	3	0.06	0.31	0.31	0.31	0.31	0.31	0.31	0.31	1	0.02	0.14	0.14	0.14	0.14	0	0.00	
SALMON CREEK	4	0.17	0.26	0.33	0.33	0.33	0.33	0.33	0.33	0	0.00					0	0.00	
SEADRIFT	16	0.23	0.26	0.26	0.26	0.26	0.26	0.26	0.26	2	0.04	0.26	0.26	0.26	0.26	0	0.00	
SHARP PARK	1	0.06	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0	0.00					0	0.00	
STINSON	0	0.00								1	0.13	0.71	0.71	0.71	0.71	0	0.00	
THORNTON	3	0.13	0.63	1.32	1.32	1.32	1.32	1.32	1.32	1	0.03	0.30	0.30	0.30	0.30	0	0.00	

REGION-MONTEREY BAY

BEACH	FALL			WINTER			75%			SPRING			75%			MAX		
	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN	N	P	MEDIAN
DAYENPORT, EAST	0	0.00								0	0.00					0	0.00	
DAYENPORT, WEST	0	0.00								0	0.00					0	0.00	
DEL MONTE	3	0.07	1.23	1.00	1.00	1.00	1.00	1.00	1.00	3	0.11	0.63	0.63	0.63	0.63	1	0.04	0.21
JETTY	7	0.16	0.63	0.63	0.63	0.63	0.63	0.63	0.63	4	0.14	0.63	0.63	0.63	0.63	0	0.00	
LAGUNA CREEK	1	0.02	1.43	1.43	1.43	1.43	1.43	1.43	1.43	0	0.00					0	0.00	
MAJORS CREEK	0	0.00								1	0.04	0.63	0.63	0.63	0.63	0	0.00	
MARINA	10	0.30	0.23	0.32	0.32	0.32	0.32	0.32	0.32	4	0.16	0.16	0.36	0.42	0.42	0	0.00	
PAJARO DUNES	6	0.09	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1	0.02	0.50	0.50	0.50	0.50	0	0.00	
RIO DEL MAR	1	0.03	0.30	0.30	0.30	0.30	0.30	0.30	0.30	1	0.04	0.50	0.50	0.50	0.50	0	0.00	
SALINAS RIVER	0	0.00								0	0.00					0	0.00	
SCOTT CREEK	2	0.06	1.23	1.67	1.67	1.67	1.67	1.67	1.67	1	0.04	0.83	0.83	0.83	0.83	0	0.00	
SEASCAPE-APTOS	3	0.14	1.00	1.23	1.23	1.23	1.23	1.23	1.23	0	0.00					0	0.00	
SEASIDE	2	0.04	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0	0.00					0	0.00	
SUMSET	1	0.04	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0	0.00					0	0.00	
WILLOW	0	0.00								0	0.00					0	0.00	
YELLOW BANK CREEK	3	0.23	0.56	2.70	2.70	2.70	2.70	2.70	2.70	0	0.00					0	0.00	
ZNUDDYSKI	0	0.00								0	0.00					0	0.00	

REGION=GULF OF THE FALALONES

BEACH	FALL			WINTER			SPRING			
	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX
AMO NUEVO	6	1.00	0.14	0.23	0.28	2	1.00	0.12	0.14	0.14
BOLINAS	7	0.21	0.37	0.74	1.11	8	0.23	0.37	0.37	1.11
CROMKHITE	21	0.36	1.11	2.22	3.33	16	0.08	1.11	1.11	1.11
OLLON	16	0.64	0.43	0.91	1.36	14	0.47	0.68	0.91	1.02
ODRAN	8	0.29	0.44	0.59	0.59	6	0.22	0.59	0.59	0.59
ODUBLE POINT	8	0.32	0.29	0.29	1.43	8	0.32	0.29	0.29	0.06
ORAKES	2	0.50	0.42	0.63	0.63	5	0.43	0.21	0.42	0.42
EDGEHAR	6	0.55	1.54	2.69	3.85	3	0.00			
FORT POINT	2	0.07	0.63	0.63	0.63	3	0.15	1.25	2.50	2.50
HALF MOON BAY, NORTH	17	0.65	0.65	1.56	2.19	14	0.54	0.39	1.64	2.50
HALF MOON BAY, SOUTH	8	0.57	0.50	1.17	1.33	4	0.36	0.34	0.91	1.08
LIMANTOUR	22	0.48	0.18	0.35	0.53	15	0.38	0.18	0.35	0.35
LINDA HAR	1	0.17	1.54	1.54	1.54	1	0.25	1.54	1.54	1.54
MONTARA	1	0.17	1.88	1.88	1.88	1	0.17	0.31	0.31	0.31
MUIR	21	0.34	2.00	2.00	3.00	5	0.09	1.00	1.50	2.00
OCEAN	37	0.65	0.63	0.94	2.19	17	0.33	0.31	0.63	0.94
PESCAERO	12	0.50	0.56	0.97	2.22	0	0.00			
POINT REYES, A	23	0.96	0.48	0.48	2.14	10	0.38	0.30	0.54	0.71
POINT REYES, B	1	1.00	0.16	0.16	0.16	1	0.14	0.05	0.05	0.05
POINT REYES, C	1	0.50	0.67	0.67	0.67	1	0.14	0.67	0.67	0.67
POINT REYES, D	1	1.00	1.09	1.09	1.09	4	0.57	0.22	0.71	0.87
RCA	35	0.64	0.20	0.83	2.50	16	0.54	0.28	0.31	1.39
SALMON CREEK	13	0.54	0.38	0.77	1.03	7	0.47	0.26	0.26	0.38
SCADRIFF	38	0.59	0.26	0.51	2.51	31	0.60	0.26	0.51	1.54
SHARP PARK	13	0.76	1.33	2.00	3.33	5	0.30	0.67	1.33	1.33
STINSON	1	0.25	0.71	0.71	0.71	2	0.25	0.71	0.71	0.71
THORNTON	28	0.70	1.15	1.47	3.75	10	0.31	0.63	0.77	1.00

REGION-INDIG38

BEACH	FALL			WINTER			SPRING					
	N	P	75%	MAX	M	P	75%	MAX	M	P	75%	MAX
DAVENPORT, EAST	2	0.06	2.00	2.00	1	0.03	1.00	1.00	1	0.03	2.00	2.00
DAVENPORT, WEST	0	0.00			0	0.00			0	0.00		
OEL MONTE	26	0.37	1.23	3.13	29	0.64	1.23	1.88	16	0.72	1.23	2.50
JETTY	13	0.30	0.63	1.23	7	0.24	0.63	1.23	1	0.30	0.63	0.63
LAGUNA CREEK	11	0.27	1.43	2.06	9	0.28	0.71	1.43	3	0.14	1.43	1.43
MAJORS CREEK	12	0.36	1.23	2.50	3	0.19	1.23	2.81	4	0.19	1.23	3.08
MARINA	16	0.80	0.40	0.56	7	0.20	0.19	0.56	7	0.50	0.14	0.19
PAJARO DUNES	30	0.45	0.50	1.50	18	0.18	0.50	0.50	2	0.17	0.50	0.50
RIO DEL MAR	3	0.09	0.50	0.50	2	0.07	0.50	0.50	7	0.08	0.50	0.50
SALINAS RIVER					2	0.50	1.00	1.50				
SCOTT CREEK	2	0.40	0.42	0.63	1	0.20	0.31	0.31	0	0.00		
SEASCAPE-APTOS	1	0.03	0.03	0.03	2	0.08	0.93	0.93	1	0.03	0.93	0.93
SEASIOE	12	0.33	1.13	2.00	3	0.29	1.00	1.44	3	0.45	1.00	1.23
SUNSET	10	0.40	0.21	0.42	6	0.26	0.21	0.36	2	0.13	0.17	0.21
WILCOX	6	0.24	1.23	1.41	3	0.25	0.63	2.50	4	0.23	0.73	1.23
YELLOW BANK CREEK	3	0.08	0.71	0.71	3	0.10	1.43	1.43	1	0.04	1.43	1.43
ZMUODWSKI	6	0.46	0.83	1.67	7	0.70	0.56	0.56	1	0.13	0.56	0.56

BLACK-LEGGED KITTIWAKE: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1983

REGION-GULF OF THE FARALLONES

BEACH	FALL		73%		MAX	WINTER		73%		MAX	SPRING		73%		MAX
	M	P	MECIAM			M	P	MECIAM			M	P	MECIAM		
AMO NUEVO	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	0.74	0.93	0.93
BOLINAS	0	0.00	.	.	.	0	0.00	.	.	.	3	0.13	1.11	1.11	1.11
CHONKITE	1	0.02	1.11	1.11	1.11	0	0.00	.	.	.	1	0.02	0.34	0.43	0.43
CLLON	0	0.00	.	.	.	5	0.13	0.43	1.14	1.36	2	0.08	0.29	0.01	1.47
COHAM	0	0.00	.	.	.	0	0.00	.	.	.	4	0.30	0.29	0.29	0.29
DOUBLE POINT	0	0.00	.	.	.	0	0.00	.	.	.	1	0.05	0.42	0.42	0.42
ORAKES	0	0.00	.	.	.	0	0.00	.	.	.	1	0.13	0.42	0.42	0.42
COGEMAR	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
FORT POINT	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
HALF MOON BAY, NORTH	1	0.04	0.31	0.31	0.31	0	0.00	.	.	.	3	0.14	0.63	1.00	1.00
HALF MOON BAY, SOUTH	1	0.07	0.27	0.27	0.27	0	0.00	.	.	.	0	0.00	.	.	.
LINAMOUR	2	0.04	0.26	0.35	0.35	1	0.03	0.10	0.10	0.10	9	0.26	0.10	0.44	2.90
LINDA MAR	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
MONTARA	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
MUIR	1	0.02	1.00	1.00	1.00	1	0.02	2.00	2.00	2.00	2	0.03	1.00	1.00	1.00
OCEAN	2	0.04	0.31	0.31	0.31	1	0.02	0.31	0.31	0.31	7	0.17	0.31	1.23	2.19
PESCAERO	1	0.04	1.11	1.11	1.11	1	0.07	0.20	0.20	0.20	4	0.33	0.03	1.33	1.67
POINT REYES, A	0	0.00	.	.	.	3	0.12	0.71	1.07	1.07	3	0.36	0.36	3.33	4.76
POINT REYES, B	0	0.00	.	.	.	1	0.14	0.16	0.16	0.16	0	0.00	.	.	.
POINT REYES, C	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
POINT REYES, D	0	0.00	.	.	.	0	0.00	.	.	.	1	0.23	0.22	0.22	0.22
RCA	1	0.02	0.14	0.14	0.14	2	0.04	0.21	0.20	0.20	9	0.27	0.20	0.43	1.59
SALMON CREEK	2	0.08	0.26	0.26	0.26	3	0.20	0.26	0.30	0.30	4	0.24	0.26	2.56	2.56
SEABRIFT	0	0.00	.	.	.	3	0.06	0.26	0.31	0.31	4	0.11	0.26	0.64	0.17
SHARP PARK	2	0.12	1.00	1.33	1.33	0	0.00	.	.	.	4	0.40	3.00	3.33	3.33
STIMSON	0	0.00	.	.	.	2	0.23	0.71	0.71	0.71	0	0.00	.	.	.
THORNTON	0	0.00	.	.	.	1	0.03	0.63	0.63	0.63	2	0.00	0.09	1.13	1.13

REGION-MONTEREY BAY

BEACH	FALL		73%		MAX	WINTER		73%		MAX	SPRING		73%		MAX
	M	P	MECIAM			M	P	MECIAM			M	P	MECIAM		
DAVENPORT, EAST	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
DAVENPORT, WEST	0	0.00	.	.	.	1	0.23	1.00	1.00	1.00	0	0.00	.	.	.
OEL MONIC	2	0.04	0.63	0.63	0.63	3	0.11	0.63	0.94	1.23	7	0.20	0.03	1.23	6.04
JETTY	0	0.00	.	.	.	1	0.03	0.31	0.31	0.31	5	0.17	0.63	0.94	1.23
LAGUNA CREEK	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
MAJORS CREEK	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
MARINA	0	0.00	.	.	.	3	0.12	0.14	0.97	0.97	3	0.21	0.37	1.11	1.11
PAJARO DUMES	1	0.02	0.25	0.25	0.25	2	0.04	0.25	0.25	0.25	4	0.10	0.30	1.63	2.00
RIO DEL MAR	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
SALINAS RIVER	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
SCOTT CREEK	0	0.00	.	.	.	0	0.00	.	.	.	1	0.03	0.03	0.03	0.03
SEASCAPL-APTOS	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
SEASIDE	0	0.00	.	.	.	0	0.00	.	.	.	1	0.06	0.42	0.42	0.42
SUNSET	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
WILDER	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
YELLOW BANK CREEK	0	0.00	.	.	.	0	0.00	.	.	.	0	0.00	.	.	.
ZHUODWSK	1	0.08	0.56	0.56	0.56	1	0.10	1.11	1.11	1.11	2	0.23	0.03	1.11	1.11

REGION-GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING		
	N	P	MAX	N	P	MAX	N	P	MAX
AMO NUEVO	2	0.33	0.03	0	0.00	0.74	0	0.00	0.74
BOLINAS	9	0.26	0.37	1	0.03	0.74	0	0.00	0.74
CROWNITE	7	0.12	3.33	0	0.00	0.34	0	0.00	0.43
OILLOM	4	0.16	2.93	2	0.06	0.15	0	0.00	0.15
OGARAN	6	0.21	0.00	1	0.04	0.15	0	0.00	0.15
DOUBLE POINT	4	0.16	0.21	0	0.00	0.15	0	0.00	0.15
ORAKES	2	0.50	1.04	0	0.00	0.15	0	0.00	0.15
COGENAR	7	0.64	2.31	0	0.00	0.15	0	0.00	0.15
FORT POINT	0	0.00	0.00	0	0.00	0.15	0	0.00	0.15
HALF MOON BAY, NORTH	14	0.52	2.19	1	0.04	0.63	0	0.00	0.63
HALF MOON BAY, SOUTH	4	0.29	1.04	0	0.00	0.63	0	0.00	0.63
LEIMANTOUR	12	0.26	0.33	1	0.03	0.09	0	0.00	0.09
LINDA MAR	0	0.00	0.00	0	0.00	0.09	0	0.00	0.09
MONTANA	1	0.17	10.00	0	0.00	0.31	0	0.00	0.31
MUIA	23	0.37	4.00	2	0.04	1.00	0	0.00	1.00
OCEAN	7	0.12	0.94	0	0.00	1.00	0	0.00	1.00
PESCADERO	10	0.42	0.56	0	0.00	0.24	0	0.00	0.24
POINT REYES, A	13	0.54	1.43	1	0.04	0.24	0	0.00	0.24
POINT REYES, B	1	1.00	0.16	0	0.00	0.43	0	0.00	0.43
POINT REYES, C	2	1.00	0.67	0	0.00	0.43	0	0.00	0.43
POINT REYES, D	1	1.00	0.22	0	0.00	0.43	0	0.00	0.43
ACA	27	0.51	0.69	1	0.14	0.20	0	0.00	0.20
SALMON CREEK	15	0.63	1.03	4	0.27	0.26	0	0.00	0.26
SEADRIFT	36	0.56	1.03	4	0.08	0.19	0	0.00	0.19
SHARP PARK	1	0.06	0.67	0	0.00	0.19	0	0.00	0.19
STINSON	3	0.75	10.00	0	0.00	0.19	0	0.00	0.19
THORNTON	14	0.55	1.00	0	0.00	0.19	2	0.00	0.19

AVO A3031MON=MO1238

BEACH	FALL			WINTER			SPRING								
	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX	N	P	MEDIAN	75%	MAX
DAVENPORT, EAST	3	0.08	2.00	6.00	6.00	0	0.00	.	.	.	0	0.00	.	.	.
DAVENPORT, WEST	1	0.25	2.00	2.00	2.00	0	0.00	.	.	.	0	0.00	.	.	.
DOEL MONTE	0	0.00				0	0.00	.	.	.	0	0.00	.	.	.
JETTIE	7	0.16	2.50	0.75	15.15	0	0.00	.	.	.	0	0.00	.	.	.
LAGUNA CREEK	6	0.15	3.21	6.07	7.14	0	0.00	.	.	.	0	0.00	.	.	.
MAJORS CREEK	7	0.21	2.50	3.15	3.15	1	0.04	1.25	1.25	1.25	0	0.00	.	.	.
MARINA	13	0.65	0.20	3.12	4.72	1	0.04	0.42	0.42	0.42	0	0.00	.	.	.
PAJARO GUMES	3	0.08	1.00	2.25	3.00	1	0.02	0.50	0.50	0.50	0	0.00	.	.	.
RIO DEL MAR	0	0.23	0.75	1.50	5.50	0	0.00	.	.	.	0	0.00	.	.	.
SALINAS RIVER	.					0	0.00	.	.	.	.		.	.	.
SCOTT CREEK	1	0.20	1.56	1.56	1.56	0	0.00	.	.	.	0	0.00	.	.	.
SEASCAPE-APTOS	3	0.14	0.83	2.50	4.17	1	0.04	0.03	0.03	0.03	1	0.05	0.03	0.03	0.03
SEASIDE	1	0.05	1.00	1.00	1.00	0	0.00	.	.	.	0	0.00	.	.	.
SUNSET	0	0.32	0.52	0.83	1.01	0	0.00	.	.	.	0	0.00	.	.	.
WILDER	1	0.04	0.65	0.65	0.65	0	0.00	.	.	.	0	0.00	.	.	.
YELLOW BANK CREEK	4	0.11	1.45	5.71	7.14	0	0.00	.	.	.	0	0.00	.	.	.
ZHUOWSKI	6	0.46	3.35	5.00	6.67	0	0.00	.	.	.	0	0.00	.	.	.

**PIGEON GUILLENOT: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985**

----- REGION-GULF OF THE PARALLONES -----

BEACH	N	P	FALL MEDIAN	75%	MAX	N	P	WINTER MEDIAN	75%	MAX	N	P	SPRING MEDIAN	75%	MAX
AMO NUEVO	1	0.17	0.14	0.14	0.14	0	0.00				0	0.00			
BOLINAS	3	0.09	0.37	0.74	0.74	0	0.00				0	0.00			
CROMWITE	6	0.10	1.11	2.22	2.22	0	0.00				0	0.00			
DILLON	10	0.40	0.68	1.02	1.36	2	0.06	0.43	0.43	0.43	2	0.06	0.34	0.43	0.43
DOORAM	7	0.23	0.39	1.10	2.65	1	0.04	0.29	0.29	0.29	6	0.30	0.74	1.69	2.33
DOUBLE POINT	1	0.04	0.29	0.29	0.29	0	0.00				2	0.10	0.21	0.29	0.29
DRAKES	3	0.75	0.83	0.83	0.83	0	0.00				1	0.13	0.83	0.83	0.83
EDGEWATER	1	0.09	0.77	0.77	0.77	0	0.00				0	0.00			
FORT POINT	0	0.00				0	0.00				0	0.00			
HALF MOON BAY, NORTH	7	0.26	0.31	0.63	0.94	0	0.00				1	0.05	0.31	0.31	0.31
HALF MOON BAY, SOUTH	3	0.21	0.27	0.31	0.31	0	0.00				0	0.00			
LIMANTOUR	14	0.30	0.16	0.33	0.88	2	0.03	0.13	0.13	0.13	3	0.09	0.16	0.16	0.16
LINCOLN MAR	0	0.00				0	0.00				0	0.00			
MONTARA	1	0.17	0.31	0.31	0.31	0	0.00				1	0.23	0.21	0.21	0.21
MUIR	3	0.05	2.00	3.00	3.00	0	0.00				1	0.02	1.00	1.00	1.00
OCEAN	6	0.11	0.31	0.70	0.94	0	0.00				0	0.00			
PESCAUERO	3	0.13	0.36	0.56	0.56	0	0.00				0	0.00			
POINT REYES, A	7	0.29	0.24	0.48	1.19	1	0.04	0.24	0.24	0.24	3	0.21	0.24	0.40	0.40
POINT REYES, B	2	1.00	0.16	0.16	0.16	1	0.14	0.05	0.05	0.05	0	0.00			
POINT REYES, C	1	0.30	0.33	0.33	0.33	0	0.00				0	0.00			
POINT REYES, D	0	0.00				0	0.00				0	0.00			
RCA	13	0.20	0.20	0.83	0.94	1	0.02	0.14	0.14	0.14	2	0.06	0.19	0.20	0.20
SALMON CREEK	10	0.42	0.64	1.33	2.03	1	0.07	0.26	0.26	0.26	2	0.12	0.30	0.31	0.31
SEADRIFT	11	0.17	0.26	0.51	1.03	2	0.04	0.14	0.14	0.14	0	0.00			
SHARP PARK	6	0.35	0.67	0.83	1.33	0	0.00				0	0.00			
STIMSON	1	0.25	0.71	0.71	0.71	0	0.00				1	0.17	0.71	0.71	0.71
THOANTON	13	0.32	0.63	1.36	1.92	0	0.00				0	0.00			

----- REGION-MONTEREY BAY -----

BEACH	N	P	FALL MEDIAN	75%	MAX	N	P	WINTER MEDIAN	75%	MAX	N	P	SPRING MEDIAN	75%	MAX
OAYEMPORT, EAST	0	0.00				0	0.00				0	0.00			
OAYEMPORT, WEST	0	0.00				0	0.00				0	0.00			
DEL MONTE	21	0.46	0.63	0.94	3.63	2	0.04	0.47	0.63	0.63	14	0.36	0.63	1.00	6.00
JETTY	2	0.03	0.63	0.63	0.63	0	0.00				2	0.07	0.63	0.63	0.63
LAGUNA CREEK	3	0.13	0.93	2.14	2.86	0	0.00				0	0.00			
MAJORS CREEK	3	0.13	1.23	1.56	1.88	0	0.00				1	0.03	0.63	0.63	0.63
MARIWA	6	0.30	0.19	0.52	0.83	0	0.00				0	0.00			
PAJARO DUNES	3	0.08	0.50	0.50	0.50	0	0.00				0	0.00			
RIO DEL MAR	0	0.00				0	0.00				0	0.00			
SALINAS RIVER						0	0.00								
SCOTT CREEK	1	0.20	0.31	0.31	0.31	0	0.00				0	0.00			
SEASCAPE-APTOS	3	0.09	0.83	2.50	2.50	0	0.00				0	0.00			
SEASIDE	9	0.41	2.00	4.00	8.75	0	0.00				3	0.43	3.13	6.80	10.00
SUNSET	1	0.04	0.42	0.42	0.42	0	0.00				0	0.00			
WILDER	2	0.08	0.52	0.63	0.63	0	0.00				0	0.00			
YELLOW BANK CREEK	1	0.03	0.71	0.71	0.71	0	0.00				1	0.04	1.43	1.43	1.43
ZNUOWSKI	3	0.23	0.56	0.56	0.56	0	0.00				0	0.00			

RHINOCEROS AUKLET: RATES FOR BEACHES IN CENTRAL CALIFORNIA
USING ALL DATA FROM 1971 TO 1985

REGION=GULF OF THE FARALLONES

BEACH	FALL			WINTER			SPRING			
	N	P	MEAN	75%	MAX	N	P	MEAN	75%	MAX
AND NUEVO	0	0.00	.	.	.	0	0.00	.	.	.
BOLINAS	0	0.00	.	.	.	0	0.00	.	.	.
CROCKWITE	2	0.03	1.11	1.11	1.11	0	0.00	.	.	.
OILION	1	0.04	0.45	0.45	0.45	1	0.03	0.45	0.45	0.45
OORAN	0	0.00	.	.	.	4	0.15	0.29	0.29	0.59
DOUBLE POINT	0	0.00	.	.	.	1	0.04	0.29	0.29	.
ORAKES	0	0.00	.	.	.	0	0.00	.	.	.
COGEMAR	0	0.00	.	.	.	0	0.00	.	.	.
FORT POINT	0	0.00	.	.	.	1	0.03	0.63	0.63	0.63
HALF MOON BAY, NORTH	0	0.00	.	.	.	1	0.04	0.31	0.31	.
HALF MOON BAY, SOUTH	0	0.00	.	.	.	1	0.09	0.27	0.27	.
LIMANTOUR	0	0.00	0.18	0.18	0.18	7	0.18	0.18	0.18	0.18
LIMOA MAR	1	0.02	.	.	.	0	0.00	.	.	.
MONTARA	0	0.00	.	.	.	0	0.00	.	.	.
MUIR	0	0.00	.	.	.	1	0.02	1.00	1.00	.
OCEAN	1	0.02	0.16	0.16	0.16	1	0.02	0.31	0.31	.
PESCADERO	1	0.04	0.56	0.56	0.56	0	0.00	.	.	.
POINT REYES, A	4	0.17	0.24	0.24	0.24	6	0.23	0.36	0.36	0.12
POINT REYES, B	0	0.00	.	.	.	2	0.29	0.19	0.33	0.16
POINT REYES, C	0	0.00	.	.	.	2	0.29	0.23	0.33	1.00
POINT REYES, D	0	0.00	.	.	.	3	0.43	0.22	0.43	1.00
RCA	0	0.00	.	.	.	2	0.04	0.21	0.28	0.28
SALMON CREEK	1	0.02	0.28	0.28	0.28	2	0.07	0.51	0.51	0.26
SEARIFT	0	0.00	.	.	.	1	0.04	0.31	0.31	.
SHARP PARK	0	0.00	.	.	.	4	0.08	0.26	0.45	.
STINSON	0	0.00	.	.	.	1	0.08	0.67	0.67	.
THORNTON	1	0.02	0.16	0.16	0.16	0	0.00	.	.	0.16

REGION=MONTEREY BAY

BEACH	FALL			WINTER			SPRING			
	N	P	MEAN	75%	MAX	N	P	MEAN	75%	MAX
DAVENPORT, EAST	0	0.00	.	.	.	1	0.03	1.00	1.00	1.00
DAVENPORT, WEST	0	0.00	.	.	.	0	0.00	.	.	.
OEL MONTE	1	0.02	0.63	0.63	0.63	14	0.31	0.63	1.25	1.25
JETTY	4	0.09	0.63	0.63	0.63	6	0.21	0.94	0.63	0.63
LAGUNA CREEK	0	0.00	.	.	.	1	0.03	0.48	0.48	0.71
MAJORS CREEK	0	0.00	.	.	.	0	0.00	.	.	.
MARINA	4	0.20	0.14	0.24	0.28	8	0.32	0.28	1.14	1.39
PAJARO GUNES	1	0.02	0.50	0.50	0.50	7	0.13	0.50	1.00	1.00
RIO DEL MAR	0	0.00	.	.	.	0	0.00	.	.	.
SALINAS RIVER	0	0.00	.	.	.	0	0.00	.	.	.
SCOTT CREEK	0	0.00	.	.	.	0	0.00	.	.	.
SEASCAPE-APTOS	0	0.00	.	.	.	0	0.00	.	.	.
SEASIOE	0	0.00	.	.	.	3	0.18	2.00	0.93	0.93
SUNSET	0	0.00	.	.	.	5	0.22	0.28	1.00	1.00
WILDER	1	0.04	0.63	0.63	0.63	2	0.10	0.52	0.63	0.63
YELLOW BANK CREEK	0	0.00	.	.	.	0	0.00	.	.	.
ZHUOWSKI	0	0.00	.	.	.	0	0.00	.	.	.