

Beach Watch Annual Report:

1998

by

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ABSTRACT

In 1993, the Gulf of the Farallones National Marine Sanctuary began Beach Watch, a long term shoreline monitoring program. The objectives of the program are to: 1) provide a baseline of information on the average presence of live and beachcast marine organisms; 2) assist Sanctuary management in the early detection of natural and human-caused environmental perturbations such as initial phases of an epizootic, El Niño-Southern Oscillation events and oil spills; 3) develop a network of expert shoreline surveyors who can respond during an oil spill; 4) educate the public about the coastal environment; 5) encourage the public that they can help protect their beaches. Beach Watch systematically surveys designated beaches once every two to four weeks, to generate encounter rates for beached marine animals, which account for the level of effort in searching for marine animals. Encounter rates can then be compared from year to year and from beach to beach. Surveyors document numbers of live and beached (dead) marine mammals and birds, oil and tarball deposition, and human activities along coastal beaches including natural resource violations.

During 1998, of the 86 beach segments (total of 241 km) between Bodega Head and southern San Mateo County 25 beach segments (total of 48.7 km) were monitored every four weeks and 30 beach segments (70.8 km) were monitored every two weeks. During 1998 volunteer staff increased from 98 to 114 and retention rate rose from 87% during 1997 to 93%. Volunteer hours decreased from 11,337 hours in 1997 to 10,288 hours in 1998, due to canceled surveys during the El Niño winter storms. We analyzed data from 13 randomly selected beaches on all dead marine mammals, birds and tarball deposition patterns as well as encounter rates for live birds, from October 1993 through September 1998. Each beach selected had a minimum of 12 surveys completed each year. A total of 1,044 surveys were included in the analyses representing 2,173.4 km of shoreline surveyed. Data collected during oil spill response and boat grounding surveys were not included in this data set. Beached (dead) birds included waterfowl, shorebirds, seabirds and passerine birds: a total of 74 species were documented. A total of 3,066 beached birds were found (1.411/km) and Common Murres were most frequently reported ($n = 1,034$ murres, 0.476/km). Alcids in general were the most commonly encountered beached birds at a rate of 0.573 birds per km surveyed. The group Alcids include all alcids identified to species and all birds that could be identified to the higher taxa in the Family Alcidae. Beached gulls (all gull species and birds identified to the Family Laridae) were encountered at a rate of 0.202 gulls per km surveyed ($n = 440$). Western Gulls were the most common beached gull species (0.094/km). Western and Clark's Grebe species, combined, were encountered at a rate of 0.110 grebes per km surveyed ($n = 240$). Cormorants, all species combined, were encountered at a rate of 0.081 birds per km ($n = 176$). Beached birds were most frequently encountered on the smaller beaches, Muir

Beach and Rodeo Beach; 2.309 birds/km and 3.101 birds/km, respectively. Mammals were most frequently encountered at beaches near major pinniped rookeries, such as Cove Beach in Año Nuevo State Reserve and Gazos Creek, 0.508 mammals/km and 0.473 mammals/km, respectively. Oiled birds were most frequently encountered at two small beaches, Muir Beach and Kirby Cove; 0.260 oiled birds/km and 0.159 oiled birds/km, respectively. There was no correlation between beaches which had higher rates of tarballs on them and beaches that had higher rates of oiled beached birds. Tarballs were found most frequently at Limantour Beach West, near the mouth of Drakes Estero; 162.225 tarballs/km.

During 1998, three major red tides occurred off the coast of central California from 17 May through 2 June. Each of the red tides consisted of dinoflagellates from one or more of the following species, *Pseudo-nitzschia australis*, *P. delicatissima* and *P. multiseris*. During the red tide event, strandings of dead Common Murres and otariids greatly increased above the rate previously documented for this region, during the months of May and June. The encounter rate for dead Common Murres during May and June 1994-1997 was 0.001 birds per km surveyed. During 1998 this rate increased dramatically to 1.928/km. A similar increase was seen in otariids; during May and June 1994-1997 otariid encounter rate was 0.079/km and increased to 0.264/km during May and June 1998.

From October 1993 through September 1998 a total of 178 live avian species were noted within the survey area. Sanderlings, Western Gulls and Brown Pelicans were the most commonly documented species at the 13 selected beaches; encounter rates were 23 birds/km, 12 birds/km, and 17 birds/km surveyed, respectively. Abundant species found in the Gulf of the Farallones, such as Common Murres and Northern Fulmars, are infrequently seen near the shoreline and have low encounter rates.

Care must be taken when viewing the live data, understanding that the survey area is narrow (the width of the beach plus 90 m on either side) and common, offshore, seabird species may not be frequently documented, because they do not always use the beach.

Live animal counts are useful to resource managers to determine resources at risk during coastal oil spills. Volunteers who regularly conduct baseline surveys are able to efficiently respond during an oil spill and collect data to aid in response efforts and damage assessment. Volunteers who conduct baseline surveys have current knowledge of wildlife response procedures, data collection protocols, and are familiar with response and damage assessment personnel. Volunteers who collect baseline data are continuously trained and their skill level is continuously assessed. Therefore, resource managers can depend on the data being accurate and complete. By using volunteer surveyors, the GFNMS saves approximately \$290,000, annually.

INTRODUCTION

The Beach Watch program is a long term, baseline monitoring project implemented by volunteers and administered through the Gulf of the Farallones National Marine Sanctuary (GFNMS). Our area of operation is from Bodega Head to the San Mateo-Santa Cruz County border and includes the northern portion of the Monterey Bay National Marine Sanctuary. The objectives of the program are to: 1) provide a baseline of information on the average presence of live and beachcast marine organisms; 2) assist Sanctuary management in the early detection of natural and human-caused environmental perturbations such as initial phases of an epizootic, El Niño-Southern Oscillation (ENSO) events and oil spills; 3) develop a network of expert shoreline surveyors who can respond during an oil spill; 4) educate the public about the coastal environment; 5) encourage the

public that they can help protect their beaches. The GFNMS has monitored the coastal beaches since 1993 and has developed a database of information on the activities and use of the beaches by natural resources and humans. Data collected, are compatible with pre and post-spill assessment programs implemented by federal and state resource trustees.

Shoreline surveys for beached birds have been conducted since the middle of this century (Bull and Boeson 1961, Veitch 1976, Page et al. 1982, Stenzel et al. 1988, Powlesland and Imber 1988, Carter and Page 1989, and Bayer 1991) but few directed efforts for a systematic and periodic patrol for beached (dead) birds and marine mammals have been conducted (Fay et al. 1977 and Roletto et al. 1997, 1998a and 1998b). Attempts have been made to search for live, injured, moribund and dead marine mammals by the various regional Marine Mammal Stranding Networks, MMSN, (Brown 1975, Sheldrick 1976, Geraci and St. Aubin 1979, Reynolds and Odell 1991, Wilkinson 1991, Gerber et al. 1993), coordinated through National Marine Fisheries Service, but the Networks neither schedule regular shoreline searches for these animals nor do they account for a level of search effort, as in the beached bird surveys. The Beach Watch surveys are structured to produce data and information on trends and indices of beached birds and mammals, eliminating the biases of increased survey effort which may occur during oil spill response efforts, die-offs, and the increased search effort for debilitated marine mammals in areas of high human-use.

The GFNMS has experienced several major to moderate sized oil spills since its designation in 1981. On 31 October 1984, two explosions aboard the tanker vessel *PUERTO RICAN* resulted in sinking of the stern section. This released an estimated 1,400,000 gallons of refined and crude petroleum products into the Sanctuary. The stern sank with approximately 8,500 gallons of vessel fuel on board. At least 3,000 birds were killed. In 1986 the barge *APEX HOUSTON* spilled an unknown amount of oil along the central California coast. It is estimated that over 10,000 birds were killed.

After each spill researchers from Point Reyes Bird Observatory undertook damage assessment for marine birds. They established a damage assessment procedure for seabirds in central California and were contracted by the GFNMS to write a post-spill assessment plan for birds within the GFNMS (Carter and Page 1989). The Beach Watch monitoring plan is a pre-spill assessment plan for marine birds and mammals and human-use. Beach Watch establishes baseline beached and live animal levels then documents the changes during oil spills. Beach Watch compliments and improves the Carter and Page (1989) post-spill plan.

The Beach Watch monitoring plan was used in evaluating the three most recent spills in the Sanctuaries. On 28 October, 1996 the *CAPE MOHICAN* released an estimated 2,660 barrels of oil into the San Francisco Drydock Company drydock facility (SFDD). A portion of the oil (estimated 42,000-50,000 gallons) released into the San Francisco Bay had reached the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries by 30 October 1996. During the fall and winter of 1997 and 1998, another oil spill incident unfolded, designated as the Point Reyes Tarball Incident (PBTBI). During this period numerous tarballs washed up on the shores of the Sanctuaries and over 2,000 oiled birds were found. Damage assessment for this spill is still underway. On 27 September 1998, an oil slick, approximately ten miles long was reported off of Half Moon Bay; this spill was named the Southern Traffic Lane Oil Spill. This case is still under investigation and damage assessment has begun. The federal grand jury has indicted the Pearl Shipping Company, ANAX, the vessel operating company, and the ship's master and chief engineer for the allegedly illegally discharge, conspiracy and failure to report the spill. During each of these incidents the GFNMS was able to quickly survey local beaches, collect oil and

oiled wildlife, aid in the direction of response and clean-up efforts and assess the change in use of the beaches by many taxa of marine organisms and humans.

This Annual Report is intended to provide readers, resource managers, researchers, and educators, a summary of the health and variation of coastal birds and marine mammals. The reader is also encouraged to review the selected data presented in this report and inquire with the Sanctuary about the availability and use of the data that is presented in this document as well data that has been collected but not presented in this report. Data collected through the Beach Watch program but not presented in this document include bird and mammal counts from other beaches, distribution and encounter rate of oyster rack separator tubes, human activities, presence of dogs, violations, qualitative photo-documentation of beach erosion and deposition, relative abundance of vegetation wrack, and band and tag resightings for birds and mammals.

DESIGN AND CONTENTS OF THE MONITORING PLAN

The monitoring plan covers the outer coast of central California between Bodega Head, Sonoma County, and the San Mateo-Santa Cruz County border. Estuaries included in the plan are Tomales Bay and Bolinas Lagoon. Most of the shoreline is accessible by road or a trail less than 1 km from vehicular access. Beach monitors survey one or a series of pre-defined beach segments within seven regions of the coast. Altogether, 86 beach segments have been designated to be monitored within this program. Surveys are conducted once every two to four weeks. A total of 55 beaches (119.5 km in length) were monitored during 1998. Currently, 25 beach segments are monitored once every four weeks and 30 beach segments are monitored every two weeks (Figure 1).

The GFNMS provides survey volunteers with 82 hours of mandatory training and a manual which reviews the procedures on how to survey and document a beach for live and dead marine organisms including seabirds, shorebirds, marine mammals, humans, and large wracks of invertebrates and marine plants. The manual describes methods for proper sampling of oil or oiled organisms and notification procedure in the event of a violation. An additional 103 hours of optional training was provided to the volunteers in 1998.

The beach monitor must possess skills in identifying live and dead aquatic birds, marine mammals, common invertebrates and marine plants. Many dead birds and mammals are decomposed, heavily scavenged, and/or covered with oil. Consequently, identification of dead animals is often more difficult. Volunteers in the Beach Watch program are required to attend classes on identification of marine organisms. In addition, the Sanctuary funded the revision of a beached bird and marine mammal identification book (Ainley et al. 1994) and issues this book to each surveyor. Other helpful books used to identify marine mammal parts are Kasper (1980) and Jefferson et al. (1993).

Figure 2 illustrates the forms and data taken on each survey. Basic survey data include beach name, location, date, approximate tide height, the name of the person(s) making the observations, wind speed and visibility, and a photograph of the beach profile for erosion and deposition information. Live birds and marine mammals censused during each survey are tallied on the Live Animal Count form. Surveyors also note on this form if any of the animals were oiled. Surveyors document marine plants (wrack) and beachcast invertebrates using abundance codes as relative estimate of numbers along the entire beach segment. The presence and abundance of oil, typically found as tarballs, are documented on the Live Animal Count form. The presence and activity of humans and dogs are recorded in the Visitor Use section. Dead birds and mammals are photographed and the following information is recorded: species, age, sex (when possible), presence of bands or

tags, evidence for cause of death, the presence of oil, stage of decomposition, and evidence of scavenging. The beaches are surveyed in a zig-zag fashion and the upper dune areas are checked for any hidden carcasses. Live birds and mammals seen on the beach and 90 m on either side of the beach are counted and identified to the best possible taxon. Any unusual conditions encountered are to be noted on the reverse side of the forms (e.g. oil on beach and location, a heavy cover of debris on the beach that may possibly hide carcasses, possible intervention by people burying or piling up carcasses, violations, the status of lagoons and streams which seasonally flow across the beach, etc.).

If a live, stranded marine mammal or seabird is encountered, the volunteers notify the proper authorities and rehabilitation facility for the animal. Each beach has a designated Area Manager, who is associated with the county, state or federal agency managing a particular beach, such as the Point Reyes National Seashore and the Golden Gate National Recreation Area. When violations and oil spills are witnessed, the volunteers will photo document the event, record their observations, and notify the designated Area and Sanctuary Managers.

Collection of oil samples, tarballs and oil from dead marine organisms is an important responsibility of the surveyors. Properly collected and stored samples can later be used to determine the origin and type(s) of oil, as well as evidence during litigation against an alleged spiller. The surveyors do not sample free flowing oil due to the hazardous nature of oil. But in most circumstances the oil encountered is weathered tarballs, patties or tar, or is on a bird or other marine organism. The Sanctuary works with the State Office of Spill Prevention and Response (OSPR) in collecting oil samples. OSPR has provided the Sanctuary with oil sampling equipment, instruction and training of the surveyors on quality assurance/quality control procedures so that nothing will interfere or mask the analysis and "fingerprinting" of the oil. In 1994 we increased the number of tarball samples to be collected during a given survey from two to three per beach segment, when present. Sanctuary staff has received HazWHOPPER training and will collect whole, oiled birds during an oil spill or tarball event.

Raw survey data is reviewed for completeness and accuracy. Each dead vertebrate is photographed and assigned a specimen number. The species identification, age and sex are later checked against the photographs for accuracy and precision (identification to family or group when species identification is not possible due to scavenging). Data are then entered into a relational data base, FileMaker Pro®. Encounter rates (i.e. sighting rates) are calculated as number of animals sighted per kilometer surveyed. This accounts for the varying level of survey effort which occurs between past and current beached bird programs (e.g. the 14-year beached bird program conducted by PRBO and the current Beach COMBERS program conducted by MBNMS). Seasonal and annual trends and indices can later be statistically calculated.

CURRENT STATUS

Of the 86 beach segments (total of 241 km) between Bodega Head and southern San Mateo County, 25 beach segments (total of 48.7 km) were monitored every four weeks and 30 beach segments (70.8 km) were monitored every two weeks. See Figure 1 for location of currently monitored beaches (asterisk denotes beaches monitored every two weeks). Beaches monitored within the Point Reyes National Seashore include: McClure's Beach, Point Reyes (A*, B*, C and D), Chimney Rock to Drakes Beach, Drakes Beach West* and East*, Limantour Beach West* and East*, Coast Camp to Point Resistance, Palomarin (was inaccessible for most of 1998 due to storm damage), and RCA Beach. Beaches monitored within the Golden Gate National Recreation Area include: Bolinas

Lagoon along the CalTrans mitigation area, Muir Beach*, Tennessee Cove, Rodeo Beach*, Kirby Cove, Baker Beach*, China Beach, Lands End, Ocean Beach North*, Central* and South*, Thornton Beach North* and South* segments. Researchers and resource managers may access data from these beaches after written request to the Sanctuary Research Coordinator, Jan Roletto.

During 1998 we increased our volunteer staff from 98 to 114 (Table 1) and our retention rate rose from 87% during 1997 to 93%. Volunteer hours decreased from 11,337 hours in 1997 to 10,288 hours in 1998. Volunteer hours include the survey hours, survey preparation time, data entry and training. The drop in the number of volunteer survey hours was due to canceled surveys during the ENSO storm events. The number of volunteer hours decreased in each National Park. The Golden Gate National Recreation Area (GGNRA) decreased from 1,331 hours in 1997 to 930 hours worked in 1998; Point Reyes National Seashore (PRNS) decreased from 2,203 hours to 1,752 hours in 1998.

RESULTS

Representative Analyses of Survey Data from Thirteen Selected Beaches, October 1993 Through September 1998

We analyzed data from 13 randomly selected beaches for all dead marine mammals, birds and tarball deposition patterns and encounter rates for live birds, from October 1993 through September 1998. Each beach selected had a minimum of 12 surveys completed each year (Figure 3). A total of 1,044 surveys were included in the analyses representing a total of 2,173.4 km of shoreline surveyed. Data collected during oil spill response and boat grounding surveys have not been included in this data set. Some results of these analyses have appeared in a report on an unusual mortality event of birds and sea lions last fall (Gulland et al. 1999). These analyses also served as the basis of a report on Snowy Plover populations and distribution of oyster rack separator tubes, requested by the Point Reyes National Seashore (Appendices I, II and III) and sea otter sightings along the central California coast, requested by US Fish and Wildlife Service (Appendix IV).

The following analyses provide an overview of the resource use of the central California beaches. Examples of analyses of bird and mammal encounter rates for individual beaches, seasonal variations in encountered rates, and annual trends are presented in this report. This report indicates data available from the Beach Watch program. Further data may be available to researchers who can provide funding to support data entry and analyses.

Beached Bird and Mammal Encounter Rates

Beached (dead) birds included waterfowl, shorebirds, seabirds and passerine birds: a total of 74 species were documented (Table 2). A total of 3,066 beached birds were documented (1.411/km) and Common Murres were most frequently reported, 1,034 murres (0.476/km). Alcids in general were the most common group of beached birds found at a rate of 0.573 birds per km surveyed. The group alcids include all alcids identified to species and all specimens that could only be identified to the higher taxa within the Family Alcidae. Beached gulls (all gull species and birds identified to the Family Laridae) were encountered at a rate of 0.202 gulls per km surveyed (n = 440). Western Gulls were the most common beached gull species (0.094/km). Western and Clark's Grebe species, combined, Genus *Aechmophorus* were encountered at a rate of 0.110 grebes per km surveyed (n = 240). Cormorants, all species combined, were encountered at a rate of 0.081 birds per km (n = 176).

Beached marine mammal species at the selected beaches include minke whale, harbor porpoise and all six pinniped species found along central California. Other marine mammal species were encountered at other beaches, but the data for those beaches were not entered and analyzed for this report. For a complete list of beached mammals encountered for all shoreline surveys conducted since 1993, see Table 3. California sea lions were the most frequently encountered marine mammal species; 191 sea lions were found at a rate of 0.088 per km. Marine mammals are occasionally removed prior to a beach survey by members of the Marine Mammal Stranding Network, in particular small cetaceans and uncommonly found small pinnipeds such as northern fur seals, but the numbers are negligible. For further information see Roletto et al. 1998a.

Beached animal data collected during the shoreline surveys include information on the level of oiling found on each specimen. Table 4 lists all species that had oil on the plumage, documented from the 13 selected beaches. No oiled marine mammals were encountered. A total of 184 oiled birds were found, at a rate of 0.085 birds per km surveyed. Common Murres, the most frequently encountered beached bird species (0.476/km), was also the species most frequently found with oil on them (0.063/km; 74% of oiled birds were murres). This data does not include data collected during oil spill response efforts, nor does it include data from the November-February 97/98 Point Reyes Tarball Incident. Oil spill response data is analyzed separately and will later be incorporated in this data set.

Deposition rates of beached birds, mammals, oiled birds and tarballs are listed in Table 5, for each of the 13 selected beach segments. Beached birds were most frequently encountered on the smaller beaches, Muir Beach and Rodeo Beach; 2.309 birds/km and 3.101 birds/km, respectively. Mammals were most frequently encountered at beaches near major pinniped rookeries, such as Cove Beach in Año Nuevo State Reserve and Gazos Creek, 0.508 mammals/km and 0.473 mammals/km, respectively. Pinnipeds, cetaceans and deer were also frequently encountered at Pescadero (0.225 mammals/km), a relatively moderately long beach (1.2 km).

Tarballs were found most frequently at Limantour Beach West, near the mouth of Drakes Estero; 162 tarballs/km. The majority of the tarballs were old, weathered tarballs found after storm events had uncovered them. Volunteers are instructed to remove old weathered tarballs, so they are not counted in future surveys. We recorded a high occurrence of tarballs during the winter of 1996-97 at the small beaches near the Golden Gate Bridge and entrance to the San Francisco Bay. During this time residual tarballs from the *CAPE MOHICAN*-SFDD oil spill, were deposited on those nearby, small beaches. Because of the short-term, high deposition of tarballs, we had an elevated rate of tarball deposition at Rodeo Beach, Kirby Cove and Land's End (Table 5). Oiled birds were most frequently encountered at two small beaches, Muir Beach and Kirby Cove; 0.260 oiled birds/km and 0.159 oiled birds/km, respectively. There was no correlation between beaches which had higher rates of tarballs on them and beaches that had higher rates of oiled beached birds. From October 1993 through September 1998, we did not observe any tarballs at Pescadero and Cove Beach. Most interesting is that in three years of surveys (1993-96) prior to the *CAPE MOHICAN* oil spill, we never observed any tarballs or oiled birds at Land's End, which has each year 800 to 1,100 oil tankers pass within 2 km of this beach. During the *CAPE MOHICAN*-SFDD oil spill (October 1996) Land's End was observed with oil and oiled birds on the beach. Throughout 1997 and 1998, each of the small beaches near the Golden Gate Bridge, Rodeo Beach, Kirby Cove and Land's End, continued to concentrate tarballs originating from the *CAPE MOHICAN* (Unpub. data, CDFG-OSPR, 1997).

Oil Pollution Events, 1998

On 27 September 1998 an oil slick approximately ten miles long, was reported to be 15 miles west of Half Moon Bay. This spill was designated as the Southern Traffic Lane oil spill. Approximately 170 oiled birds were collected, both dead and alive. The majority of the birds (77%) were Common Murres. One oiled harbor seal was seen at the Farallon Islands; 80% of the seal's body was covered in oil. This case is still under investigation and damage assessment has begun. The federal grand jury has indicted the Pearl Shipping Company, ANAX, the vessel operating company, and the ship's master and chief engineer for the allegedly illegal discharge, conspiracy and failure to report the spill.

Oiled Samples Collected 1998

Tarballs and feathers from oiled birds were collected during 1998 from the beaches listed in Table 7. This list indicates areas of tarball and dead bird deposition and where tarballs may be retained on the beaches through the process of sand deposition, later to be found after the winter storm erosion. Data from 1998 is similar to deposition patterns from 13 selected beaches, October 1993 through September 1998. Samples of hardened oil from potential natural seeps were collected by OSPR for comparison to the tarballs that are collected by Beach Watch. Samples were collected from Bolinas and Agate Beaches, and the beach at Coast Camp in the Point Reyes National Seashore. Currently no tarball samples have matched with the samples collected from the potential seeps.

Red Tide Event, 1998

During 1998, three major red tides occurred off the coast of central California from 17 May through 2 June. Each of the red tides consisted of dinoflagellates from one or more of the following species, *Pseudo-nitzschia australis*, *P. delicatissima* and *P. multiseris*. Each of these species of dinoflagellates have been known to produce life threatening levels of domoic acid. Through the work of National Marine Fisheries Service, The Marine Mammal Center, UC Davis Veterinary Health Services, UC Santa Cruz, CA Department of Health Services, Monterey Bay Aquarium Research Institute and the National Marine Sanctuary Program, the red tides and the affected birds and mammals were detected and tracked. *P. australis* and high levels of domoic acid was detected in anchovies collected off of Santa Cruz and Monterey. Dying California sea lions were found and collected by The Marine Mammal Center from San Mateo County south through San Luis Obispo County. The sea lions presented with seizures and death. Urinalysis revealed high levels of domoic acid in the urine of some sea lions. Histopathology revealed lesions in the brain consistent with domoic acid poisoning. For further details on the red tide event see the report by Gulland et al. 1999.

During the red tide event strandings of dead Common Murres and otariids greatly increased above the rate previously document for this region, during the months of May and June (Table 7). The encounter rate for dead Common Murres during May and June 1994-1997 was 0.001 birds per km surveyed. During 1998 this rate increased dramatically to 1.928/km. A similar increase was seen for otariids; during May and June 1994-1997 otariid encounter rate was 0.079/km and increased to 0.264/km during May and June 1998. Figure 4 illustrates the distribution of the beached birds and mammals. In previous years Common Murres were not typically found along San Mateo County beaches. Yet during the red tide event in 1998, murres were found along the southern beaches, closest to the red tides and a dramatic increase in the number of murres found along the Point Reyes National Seashore beaches, closest to the dense murre colonies at Point Reyes Headlands (estimated population is 20,000-30,000, pers. comm. M. Parker, 1999).

El Niño-Southern Oscillation Event, July 1997-June 1998

From July 1997 to June 1998, the west coast of North America experienced a strong El Niño-Southern Oscillation (ENSO) event (PFEL, 1999). The upwelling data from Pacific Fisheries Environmental Laboratory (Figures 5 and 6) show a drop in the upwelling index and Beach Watch data show a sustained increase in the rate of dead birds and marine mammals found along the central California coast. Figure 6 illustrates the encounter rate for dead Common Murres. The sustained die-off of murres from August 1997 through October 1998 coincided with the ENSO event, the red tide event, and the Southern Traffic Lane oil spill. This sustained die-off may affect the recovery of the local murre population and the murre restoration project for the *APEX-HOUSTON* oil spill.

Uncommon Strandings and Sightings of Interest

Live and beached seabirds are by far the most abundant group of animals encountered during any beach survey, but during the warm water, El Niño fall of 1998 many surveyors sighted sea hares, *Aplysia californica*, especially at beach segments near and along Tomales Bay. Sea hares were noted at Doran Beach on 13 and 17 November, Drakes Beach West on 31 October, and along Tomales Bay from Sand Point to Tom's Point on 15 and 29 November. During the spring and summer of 1998 many dead harbor porpoises were recorded. Records include a cow-calf pair at Point Reyes B on 18 July and another pair at Limantour West on 31 May. Harbor porpoise calves were documented at Limantour West on 19 May, Point Reyes D on 6 June, and at Thornton Beach South on 21 June. Adult and juvenile porpoises were also documented at Muir beach on 31 August, 2 porpoises at Sharp Park on 5 July.

Other unusual marine mammal findings include a live female elephant seal at Doran Beach on 10 July; a dead adult female short-beaked dolphin at Drakes Beach West on 27 January; on a dead Steller sea lion at Limantour West on 4 April, one at Rodeo Beach on 23 October, and one at So. Montara Beach on 17 July.

Interesting bird sightings include a dead Sabine's Gull at Point Reyes A on 1 June; a dead Virginia Rail at Point Reyes B on 22 June; a dead Black-footed Albatross on 27 June; a dead Thick-billed Murre at Kirby Cove on 28 June; and a live Stejneger's Petrel was seen off of Point Reyes A on 25 September. A dead Pomarine Jaeger was found at Point Reyes B on 9 October and a dead Ross' (Snow) Goose was found at Limantour West on 22 January. Raptor records include a dead Red-tailed Hawk at Coast Camp to Pt. Resistance on 29 March and a dead Cooper's Hawk at Muir Beach on 24 November.

Other sightings of note include a dead female white shark at Limantour West on 1 May; a dead leatherback sea turtle at Ocean Beach North on 19 October; and a dead ocean sunfish at San Gregorio to Pomponio on 24 June.

Live Bird Sightings and Encounter Rates

A total of 178 live species were noted within the survey area (Table 9). The survey area is a narrow band along the shoreline, 90 meters on either side of the beach. Because of the edge effect, avian biodiversity in the Sanctuaries is maximal on the shoreline. However, beach surveys do not sample offshore species that are abundant in the Sanctuaries. Therefore, abundant species in the Gulf of the Farallones, such as Common Murres and Northern Fulmars, are infrequently seen near the shoreline and have a low encounter rate for live sightings. Sanderlings, Western Gulls and Brown Pelicans were the most commonly documented species at the 13 selected beaches; encounter rates were 23 birds/km, 12 birds/km, and 17 birds/km surveyed, respectively (Table 9).

SUMMARY

The Beach Watch program along central California coast quantifies rates by determining the number of animals per kilometer surveyed. Beach Watch surveys are undertaken at regular intervals, permitting a temporal analysis of mortality events. Unusual mortality events can thus be seen against a seasonal baseline of strandings. This more informative method should be adopted by the marine mammal stranding networks, even if done at only a few selected beaches. Selected beaches should be small (≤ 1 km), sandy cove beaches, which face prevailing winds or sandy beaches near rookeries and haul-outs (Carter and Page 1989, Roletto et al. 1997 and 1998b).

Often during environmental events such as ENSO events and die-offs due to red tides, pathogens or oil spills, the general public is informed of the increased number of sick animals coming into rehabilitation centers. The public not only is made aware of who to contact if they find a sick animal on the beach, but may intensify the typical effort to search for stranded animals. Geraci and St. Aubin 1979 and Roletto 1988 found that the number of stranded marine mammals were higher on beaches near human population centers, which have higher concentration of pollutants in the water, and high public-use beaches. Public reports of distress animals increase on weekends and summer holidays. All of this suggests that the general public, on an ad hoc basis, are finding many dead or moribund marine mammals on selected beaches near high public-use areas. However, since their search effort is intense, local, and unquantified, it is difficult for resource managers to interpret their findings, since little is known about ordinary stranding rates for marine mammals. By accounting for search effort, thus assessing the stranding rate instead of counts of stranded or beached animals, resource managers can better understand the natural variability of stranded and beached animals, over seasons and years. Rates most likely will be different for different species, age classes and sex.

Seasonal trends and geographical trends can be analyzed from Beach Watch data for both live and dead animals. Care must be taken to view the live count data, understanding that the survey area is narrow (the width of the beach plus 90 m on either side) and common, offshore, seabird species may not be frequently documented, because they do not always use the beach. Live animal counts are useful to resource managers to determine resources at risk during coastal oil spills.

Surveys can be accomplished through the training and use of volunteers. Volunteers who are from the local constituency are concerned citizens and often want to be involved in the protection and monitoring of our natural resources. Organized surveys can involve concerned citizens as well as control for search effort, resulting in a stranding rate for target species. There are other benefits to using volunteers as citizen-scientists and surveyors. Volunteers who regularly conduct baseline surveys are able to efficiently respond during an oil spill and collect data to aid in response efforts and damage assessment. Volunteers who conduct baseline surveys have current knowledge of wildlife response procedures, data collection protocols, and are familiar with response and damage assessment personnel. Volunteers who collect baseline data are continuously trained and their skill level is continuously assessed. Therefore, resource managers can depend on the data being accurate and complete. By using volunteer surveyors, the GFNMS saves approximately \$290,000, annually.

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Table 1. Volunteer hours, 1998.

Total number of volunteers	114
Total number recruited	27
Number of Volunteers Lost	7
Retention rate	93%
Total volunteer mileage	43,074 miles
Total volunteer survey hours	5,566 (includes survey, prep & drive time)
Volunteer hours in PRNS	(1,752)
Volunteer hours in GGNRA	(930)
Total volunteer training hours	4,626
Total data entry hours	<u>96</u>
Total volunteer hours	10,288
(includes survey, training & travel)	

Table 2. Beached birds and mammals encountered on 13 selected beaches, October 1993 - September 1998. Table does not include survey data collected during oil spill response efforts.

Taxon	Number Encountered	Number Per Km Surveyed
Family Diomedidae: Albatross		
Black-footed Albatross	3	0.001
Family Procellariidae: Petrels, Shearwaters		
Northern Fulmar	319	0.147
Pink-footed Shearwater	4	0.002
Black-vented Shearwater	1	0.001
Buller's Shearwater	1	0.001
Sooty Shearwater	66	0.030
Short-tailed Shearwater	9	0.004
Shearwater Species Unknown	9	0.004
Family Hydrobatidae: Storm-petrels		
Leach's Storm-petrel	3	0.001
Ashy Storm-petrel	5	0.002
Fork-tailed Storm-petrel	4	0.002
Family Gaviidae: Loons		
Red-throated Loon	26	0.012
Pacific Loon	74	0.034
Common Loon	31	0.014
Loon Species Unknown	7	0.003
All Loons	138	0.064
Family Podicipedidae: Grebes		
Eared Grebe	10	0.005
Eared/Horned Grebe	7	0.003
Red-necked Grebe	3	0.001
Horned Grebe	15	0.007
Western Grebe	128	0.059
Clark's Grebe	22	0.010
Western/Clark's Grebe	90	0.041
Grebe Species Unknown	15	0.007
All Western and Clark's Grebes	240	0.110
Family Pelecanidae: Pelicans		
Brown Pelican	35	0.016
Family Phalacrocoracidae: Cormorants		
Double-crested Cormorant	3	0.001
Brandt's Cormorant	130	0.060
Pelagic Cormorant	36	0.017
Cormorant Species Unknown	7	0.003
All Cormorants	176	0.081
Family Ardeidae: Egrets & Herons		
Black-crowned Night-Heron	1	0.001
Snowy Egret	1	0.001
Family Anatidae: Ducks		
Greater White-fronted Goose	1	0.001
Gadwall	1	0.001

Mallard	1	0.001
Green-winged Teal	4	0.002
Greater Scaup	3	0.001
Lesser Scaup	1	0.001
Scaup	1	0.001
Bufflehead	11	0.005
Black Scoter	4	0.002
Surf Scoter	126	0.058
White-winged Scoter	27	0.012
Scoter Species Unknown	6	0.003
All Scoters	163	0.075
Family Cathartidae: Vultures		
Turkey Vulture	1	0.001
Family Falconidae: Falcons		
Peregrine Falcon	1	0.001
Family Rallidae: Rails		
Virginia Rail	2	0.001
American Coot	7	0.003
Family Scolopacidae: Sandpipers		
Willet	5	0.002
Sanderling	1	0.001
Marbled Godwit	6	0.003
Black Turnstone	1	0.001
Surfbird	1	0.001
Red Phalarope	13	0.006
Red-necked Phalarope	3	0.001
Shorebird Species Unknown	4	0.002
Family Laridae: Jaegers, Gulls & Terns		
Pomarine Jaeger	1	0.001
Caspian Tern	1	0.001
Elegant Tern	1	0.001
Sabine's Gull	1	0.001
Bonaparte's Gull	3	0.001
Heermann's Gull	28	0.013
Mew Gull	3	0.001
Ring-billed Gull	10	0.005
California Gull	29	0.013
Herring Gull	11	0.005
Western Gull	204	0.094
Glaucous-winged Gull	48	0.022
Glaucous Gull	2	0.001
Western-Glaucous-winged Gull Hybrid	14	0.006
Black-legged Kittiwake	16	0.007
Gull Species Unknown	68	0.031
All Gulls	440	0.202
Family Alcidae: Auks, Murres & Puffins		
Common Murre	1034	0.476
Pigeon Guillemot	59	0.027
Ancient Murrelet	4	0.002
Marbled Murrelet	6	0.003
Xantus' Murrelet	1	0.001
Craveri's Murrelet	1	0.001
Marbled/Xantus' Murrelet	1	0.001
Murrelet Species Unknown	2	0.001

Cassin's Auklet	85	0.040
Parakeet Auklet	2	0.001
Rhinoceros Auklet	23	0.011
Horned Puffin	3	0.001
Tufted Puffin	1	0.001
Alcid Species Unknown	23	0.011
All Alcids	1245	0.573
Family Columbidae: Pigeons & Doves		
Rock Dove	12	0.006
Band-tailed Pigeon	1	0.001
Family Corvidae: Jays & Crows		
Common Raven	3	0.001
Class Aves: Birds		
Seabird Species Unknown	8	0.004
Bird Species Unknown	36	0.017
All Birds	3066	1.411
Suborder Mysticeti: Baleen Whales		
Gray Whale	1	0.001
Minke Whale	1	0.001
Baleen Whale Species Unknown	3	0.001
Suborder Odontoceti: Toothed Whales		
Harbor Porpoise	7	0.003
Dall's Porpoise	1	0.001
Dolphin/Porpoise Species Unknown	1	0.001
Order Cetacea		
Cetacean Species Unknown	3	0.001
All Cetaceans	17	0.008
Family Otariidae: Sea Lions & Fur Seals		
California Sea Lion	191	0.088
Steller Sea Lion	8	0.004
Northern Fur Seal	2	0.001
Otariid Species Unknown	20	0.009
All Otariids	221	0.102
Family Phocidae: Seals		
Northern Elephant Seal	41	0.019
Harbor Seal	79	0.036
Phocid Species Unknown	2	0.001
All Phocids	122	0.056
Pinniped Species Unknown	12	0.006
All Pinnipeds	355	0.163
Family Mustelidae		
California Sea Otter	1	0.001
All Marine Mammal Species	373	0.172
Class Mammalia		
Raccoon	1	0.001
Skunk	1	0.001
Muskrat	1	0.001
Horse	1	0.001
Rabbit	1	0.001
Mouse	1	0.001

Cow	1	0.001
Deer	3	0.001
Black-tailed deer	2	0.001
Terrestrial Mammal Species Unknown	8	0.004

Table 3. Dead mammal species encountered during all shoreline surveys, October 1993 - September 1998. Not all survey data is available.

<u>Pinnipeds</u>	<u>Cetaceans</u>	<u>Marine Fissipeds</u>	<u>Terrestrial Mammals</u>
California Sea Lion	Beaked Whale	Southern Sea Otter	Ringtail Cat
Northern Fur Seal	Cuvier's Beaked Whale		Cow (domestic)
Steller's Sea Lion	Harbor Porpoise		Black-tailed Mule Deer
Harbor Seal	Gray Whale		Dog (domestic)
Northern Elephant Seal	Humpback Whale		Botta's Pocket Gopher
Guadalupe Fur Seal	Killer Whale		Horse (domestic)
	Minke Whale		Field Mouse
	Short-beaked Common		Muskrat
	Dolphin		Opossum
			Pig (domestic)
			Brush-tailed Rabbit
			Raccoon
			Sheep
			Striped Skunk
			Woodrat
			Tule Elk
			Cat (domestic)

Table 4. Oiled beached bird species found on 13 selected beaches, October 1993 - September 1998. No dead oiled mammals were documented on these selected beaches. Table does not include survey data collected during oil spill response efforts.

	<u>Total Found Oiled</u>	<u>% of Total # Found</u>	<u># / km Surveyed for Each Species</u>
Common Loon	1	3.2	<0.001
Pacific Loon	4	5.4	0.002
Red-throated Loon	1	3.8	<0.001
Eared Grebe	3	30.0	0.001
Western Grebe	9	7.0	0.004
Western/Clark's Grebe	1	1.2	<0.001
Grebe Species Unknown	1	6.7	<0.001
Northern Fulmar	11	3.4	0.005
Pink-Footed Shearwater	1	25.0	<0.001
Pelagic Cormorant	1	2.8	<0.001
Red Phalarope	1	7.7	<0.001
Black Kittiwake	3	18.8	0.001
Western Gull	3	1.5	0.001
Common Murre	136	13.2	0.063
Ancient Murrelet	1	33.3	<0.001
Cassin's Auklet	1	1.2	<0.001
Pigeon Guillemot	1	1.7	<0.001
Shorebird Species	1	25.0	<0.001
Seabird Species Unknown	1	12.5	<0.001
Bird Species Unknown	2	5.6	0.001
All Birds	184	6	0.085

Table 5. Encounter rates of beached birds, mammals and tarballs at 13 selected beaches, October 1993 - September 1998. No dead oiled mammals were documented on these selected beaches. Table does not include survey data collected during oil spill response efforts.

Beach Name & Segment No.	Length (km)	Total Birds	Birds/km	Total Mammals	Mammals/km	Total Oiled Birds	Oiled Birds/km	Tarballs/km
Doran Beach, 1-06	3.2	514	2.033	39	0.154	18	0.071	0.775
Pt. Reyes Beach A, 1-14	5.0	398	1.305	29	0.095	18	0.059	2.552
Pt. Reyes Beach B, 1-15	4.3	633	1.732	53	0.145	42	0.115	4.744
Drakes Beach East, 2-04	2.5	219	1.288	30	0.176	17	0.100	12.890
Limantour West, 2-05	4.6	317	0.718	38	0.086	36	0.082	162.225
Muir Beach, 2-19	0.6	133	2.309	7	0.122	15	0.260	0.050
Rodeo Beach, 2-23	0.9	307	3.101	23	0.232	1	0.010	1.248
Kirby Cove, 2-30	0.2	25	1.984	2	0.159	2	0.159	26.447
Land's End, 3-06	0.1	1	0.161	1	0.161	1	0.162	7.895
Pescadero, 4-17	1.2	178	1.216	33	0.225	3	0.021	0
Pebble Beach, 4-20	2.1	60	0.501	22	0.184	10	0.084	8.611
Gazos Creek, 5-03	1.8	240	1.646	69	0.473	16	0.110	7.531
Cove Beach, 5-09	0.8	41	0.801	26	0.508	5	0.098	0

Table 6. All beaches where tarballs, oiled birds and other oil samples were collected during 1998. List does not include samples collected during the Southern Traffic Lane oil spill response effort, September through October 1998. Data does not reflect results from OSPR lab analyses.

Beach Name	Beach No.	Sample Type and Number Collected	
Doran*	1-06	NOFU 1, WEGR 2, PALO 1, COLO 1	WEGR = W. Grebe
Dillon Beach*	1-10	COMU 1	COMU = Common murre
Pt Reyes A*	1-14	tarball 5, COMU 10, NOFU 1, WEGR 1, WE/CLGR 1, CAAU 1, GWGU 1, alcid 1	EAGRE = Eared grebe
Pt Reyes B*	1-15	tarball 5, COMU 16, WEGR 1, WE/CLGR 1, PALO 1, EAGR 2	CAAU = Cassin's Auklet
Drakes E*	2-04	tarball 6, COMU 2	PIGU = Pigeon Guillemot
Limantour W*	2-05	tarball 5, COMU 9, NOFU 1, BLKI 1, shearwater 1	BLKI = black leg Kittiwake
Limantour E*	2-06	tarball 17, COMU 1,	PALA = Pacific Loon
RCA	2-12	tarball 3	CLGR = Clark's grebe
Bolinas	2-13	WEGR 1	NOFU = northern fulmar
Muir*	2-19	COMU 2	SUSC = surf scoter
Rodeo*	2-23	tarball 5, PIGU 1	
Baker Beach*	3-02	COMU 1	
Ocean No.*	3-08	tarball 8, COMU 1	
Ocean Central*	3-09	tarball 5, COMU 5, PALO 1, SUSC 1	
Ocean Beach So.*	3-10	tarball 1	
Thornton So.*	3-12	tarball 5, COMU 1	
Sharp Park*	3-15	tarball 5	
Linda Mar	3-19	tarball 2	
So. Montara*	3-27	COMU 2, BLKI 1	
Fitzgerald Mar. Res.	3-31	tarball 2	
Pillar Point Harbor	n/a	tarball 1	
Half Moon Bay No.	4-03	tarball 1	
Tunitas Creek*	4-10	tarball 1	
Pomponio	4-14	COMU 1	
Pescadero*	4-17	tarball 3, COMU 1, NOFU 1	
Pebble Beach	4-20	tarball 6, COMU 2	
Pigeon Point*	4-24	tarball 3, COMU 1	
Gazos Creek*	5-03	tarball 5, COMU 6, WEGR 1	
North Pt.*	5-06	COMU 1	
Cove Beach	5-09	COMU 1, WEGR 1	
Bradley Beach	5-10	COMU 1, WEGR 1	

*Beaches that are surveyed every two weeks.

Table 7. Encounter rates of beached murre and otariids for May and June 1994-1997 and May and June 1998, during the red tide event.

Beach	Common Murre '94-'97 (#/km)	Common Murre '98 (#/km)	Otariid '94-'97 (#/km)	Otariid '98 (#/km)
Doran Beach	0.078	1.250	0.052	0.156
Pt. Reyes Beach A	0.120	4.333	0.000	0.000
Pt. Reyes Beach B	0.078	1.977	0.103	0.116
Drakes Beach East	0.000	1.200	0.040	DNA
Limantour West	0.047	DNA	0.031	DNA
Muir Beach	0.139	DNA	0.000	0.000
Rodeo Beach	0.417	1.389	0.208	0.833
Kirby Cove	0.000	2.500	0.625	0.000
Land's End	0.000	0.000	0.000	3.333
Pescadero	0.042	0.208	0.083	0.417
Gazos Creek	0.202	0.476	0.253	0.952
Cove Beach	0.000	1.667	0.375	0.972
Regional Rate	0.001	1.928	0.079	0.264

Table 8. Encounter rates of live bird species documented within 90 m of the shoreline, from all beaches surveyed, October 1993 - September 1998. Encounter rates are from 13 selected beaches. Encounter rates of family and group-type identifications, e.g. gull, scoter, peep, etc. are not included. DNA = data not available.

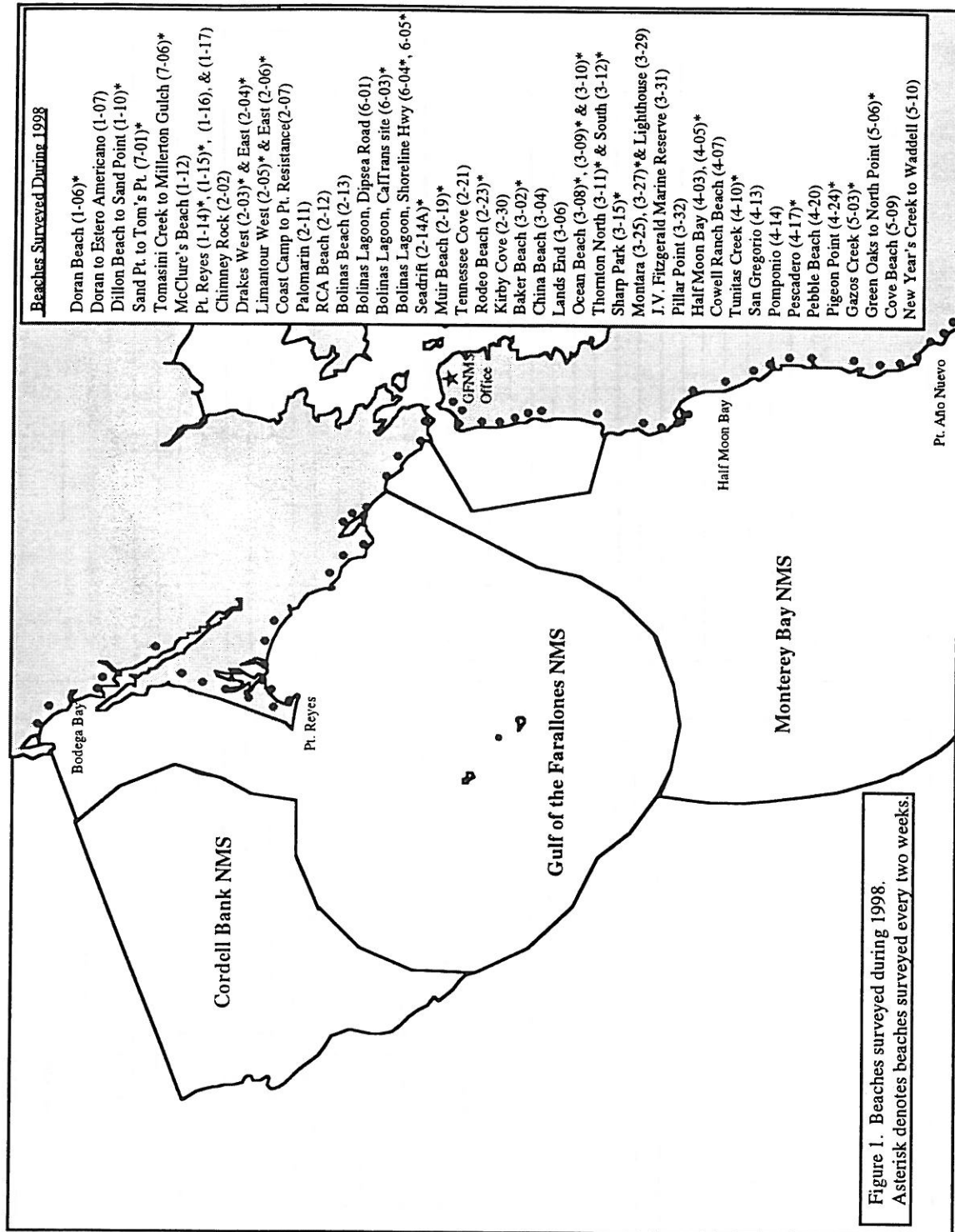
Order	Family	Species	Encounter Rate
Gaviiformes			
	Gaviidae		
		Loon, Red-throated	0.160
		Loon, Pacific	0.189
		Loon, Common	0.342
		Loon, Yellow-billed	DNA
Podicipediformes			
	Podicedidae		
		Grebe, Pied-billed	DNA
		Grebe, Horned	0.070
		Grebe, Red-necked	0.009
		Grebe, Eared	0.021
		Grebe, Western	0.625
		Grebe, Clark's	0.030
Procellariiformes			
	Procellariidae		
		Fulmar, Northern	0.001
		Shearwater, Sooty	0.150
		Shearwater, Black-vented	0.002
Pelicaniformes			
	Pelecanidae		
		Pelican, American White	0.285
		Pelican, Brown	16.876
	Phalacrocoracidae		
		Cormorant, Double-crested	0.583
		Cormorant, Brandt's	3.376
		Cormorant, Pelagic	0.447
Ciconiiformes			
	Ardeidae		
		Heron, Great Blue	0.024
		Egret, Great	0.046
		Egret, Snowy	0.074
		Heron, Green-backed	0.001
		Night-heron, Black-crowned	0.001
	Cathartidae		
		Vulture, Turkey	0.608
Anseriformes			
	Anatidae		
		Goose, Canada	0.003
		Brant	1.057
		Teal, Green-winged	0.002
		Mallard	0.324

		Pintail, Northern	0.031
		Teal, Cinnamon	DNA
		Shoveler, Northern	0.001
		Gadwall	0.002
		Wigeon, Eurasian	<0.001
		Wigeon, American	0.001
		Duck, Ring-necked	DNA
		Scaup, Greater	0.001
		Scaup, Lesser	0.001
		Duck, Harlequin	DNA
		Eider, King	DNA
		Scoter, Surf	10.240
		Scoter, Black	0.007
		Scoter, White-winged	0.334
		Goldeneye, Common	0.002
		Bufflehead	0.102
		Merganser, Hooded	0.001
		Merganser, Common	0.009
		Merganser, Red-breasted	0.051
		Duck, Ruddy	DNA
Falconiformes			
	Accipitridae		
		Osprey	0.059
		Kite, White-tailed	0.003
		Harrier, Northern	0.019
		Hawk, Sharp-shinned	DNA
		Hawk, Cooper's	0.001
		Hawk, Red-shouldered	DNA
		Hawk, Red-tailed	0.043
		Eagle, Golden	DNA
	Falconidae		
		Kestrel, American	0.004
		Merlin	0.001
		Falcon, Peregrine	0.006
Galliformes			
	Phasianidae		
		Quail, California	DNA
Gruiformes			
	Rallidae		
		Rail, Virginia	DNA
		Coot, American	0.034
Charadriiformes			
	Charadriidae		
		Plover, Black-bellied	1.720
		Plover, American Golden	0.001
		Plover, Snowy	2.183
		Plover, Semipalmated	0.826
		Killdeer	0.169
	Haematopodidae		

	Oystercatcher, Black	0.239
Recurvirostridae		
	Avocet, American	0.001
Scolopacidae		
	Yellowlegs, Greater	0.010
	Yellowlegs, Lesser	0.001
	Willet	6.389
	Tattler, Wandering	0.013
	Sandpiper, Spotted	0.002
	Whimbrel	1.533
	Curlew, Long-billed	0.001
	Godwit, Marbled	3.066
	Turnstone, Ruddy	0.007
	Turnstone, Black	0.968
	Surfbird	0.240
	Knot, Red	0.009
	Sanderling	23.368
	Sandpiper, Western	10.400
	Sandpiper, Least	5.947
	Sandpiper, Baird's	0.006
	Sandpiper, Pectoral	0.001
	Dunlin	4.332
	Dowitcher, Short-billed	0.028
	Dowitcher, Long-billed	0.001
	Phalarope, Red-necked	0.044
	Phalarope, Red	0.014
	Phalarope, Wilson's	0.003
Stercorariidae		
	Jaeger, Parasitic	DNA
Laridae		
	Gull, Bonaparte's	0.155
	Gull, Heermann's	10.210
	Gull, Mew	0.971
	Gull, Ringed-billed	2.411
	Gull, California	4.148
	Gull, Herring	0.140
	Gull, Thayer's	0.009
	Gull, Western	11.762
	Gull, Glaucous-winged	0.677
	Gull, Glaucous	0.005
	Gull, Franklin's	0.001
	Kittiwake, Black-legged	0.001
	Tern, Caspian	0.818
	Tern, Elegant	0.624
	Tern, Forster's	0.125
	Tern, Royal	0.002
Alcidae		
	Murre, Common	0.672
	Guillemot, Pigeon	0.094

		Murrelet, Marbled	DNA
		Auklet, Cassin's	DNA
		Auklet, Rhinoceros	0.001
		Puffin, Horned	DNA
Columbiformes	Columbidae		
		Dove, Rock	0.018
		Dove, Mourning	0.004
Strigiformes	Strigidae		
		Owl, Great-horned	DNA
		Owl, Short-eared	DNA
Apodiformes	Trochilidae		
		Hummingbird, Anna's	0.001
		Hummingbird, Allen's	0.001
	Apodidae		
		Swift, Vaux's	0.001
		Swift, White-throated	0.001
Coraciiformes	Alcedinidae		
		Kingfisher, Belted	0.010
Piciformes	Picidae		
		Flicker, Northern	0.001
Passeriformes	Tyrannidae		
		Phoebe, Black	0.091
		Phoebe, Say's	0.013
	Laniidae		
		Shrike, Loggerhead	DNA
		Shrike, Northern	0.001
	Vireonidae		
		Vireo, Hutton's	0.001
	Alaudidae		
		Lark, Horned	0.032
	Hirundinidae		
		Swallow, Tree	0.004
		Swallow, Violet-green	0.001
		Swallow, Northern Rough-winged	0.004
		Swallow, Bank	0.030
		Swallow, Cliff	0.333
		Swallow, Barn	0.283
	Corvidae		
		Jay, Steller's	0.004
		Jay, Scrub	0.002
		Crow, American	0.043
		Raven, Common	0.666
	Paridae		

	Chickadee, Chestnut-backed	DNA
Aegithalidae		
	Bushtit	DNA
Troglodytidae		
	Wren, Bewick's	0.001
Muscicapidae		
	Kinglet, Ruby-crowned	DNA
Turdidae		
	Robin	0.001
	Thrush, Hermit	0.001
	Thrush, Swainson's	DNA
Motacillidae		
	Wrentit	0.007
	Pipet, American	0.133
Sturnidae		
	Starling, European	0.105
Emberizidae		
	Warbler, Audubon's	0.001
	Warbler, Yellow	0.001
	Warbler, Yellow-throated	DNA
	Warbler, Yellow-rumped	0.002
Icteridae		
	Blackbird, Red-winged	0.430
	Blackbird, Tricolored	0.001
	Meadowlark, Western	DNA
	Blackbird, Brewer's	1.408
	Cowbird, Brown-headed	0.002
	Oriole, Northern	DNA
	Oriole, Bullock's	DNA
Fringillidae		
	Towhee, Spotted	0.160
	Towhee, California	0.001
	Sparrow, Savannah	0.011
	Sparrow, Fox	<0.001
	Sparrow, Song	0.043
	Sparrow, White-crowned	0.026
	Sparrow, Golden -crowned	0.007
	Junco, Dark-eyed	DNA
	Finch, Cassin's	DNA
	Finch, Purple	0.007
	Finch, House	0.134
	Siskin, Pine	DNA
	Goldfinch, Lesser	DNA
	Goldfinch, American	0.003
	Goldfinch, American	0.002
Passeridae		
	Sparrow, House	0.041



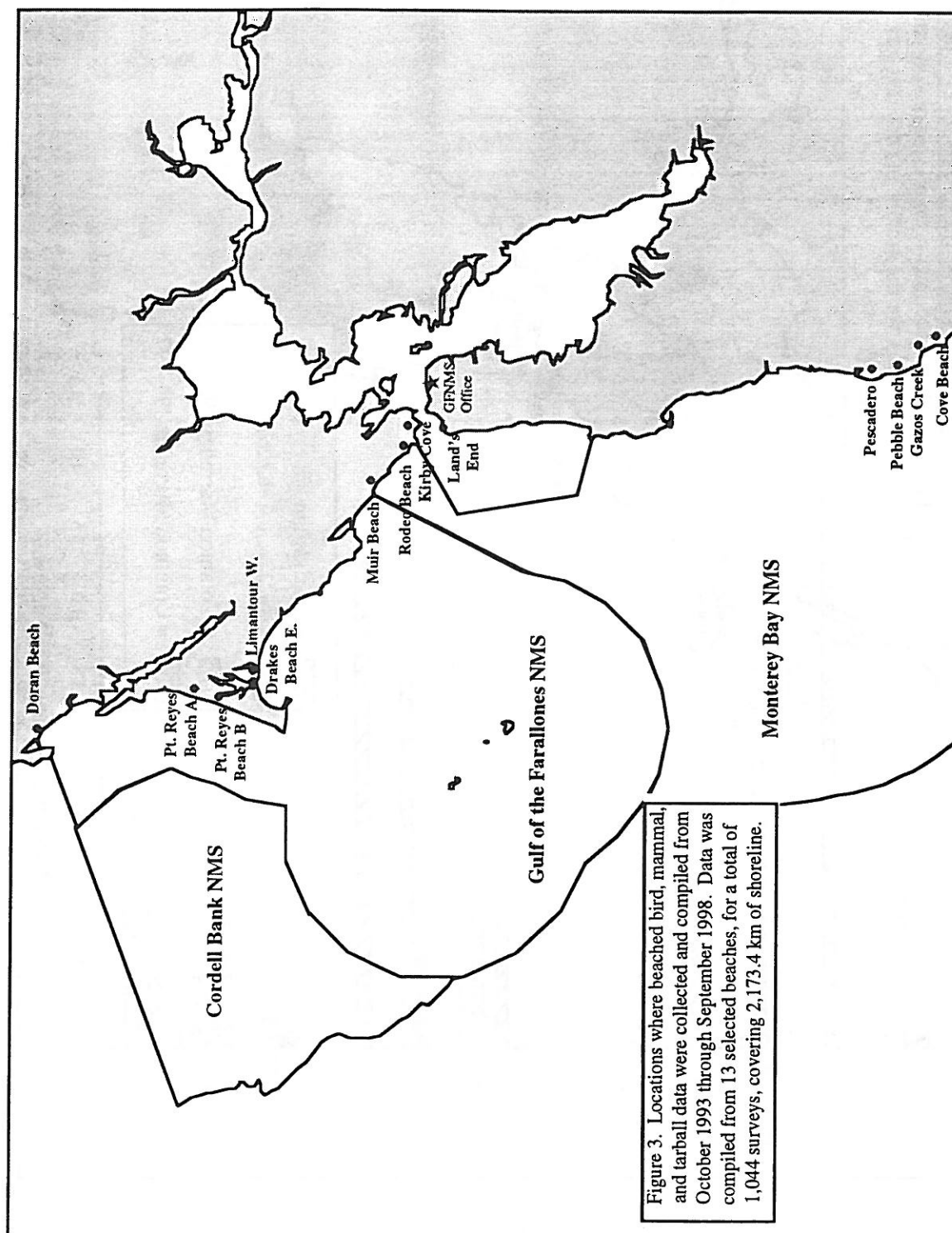
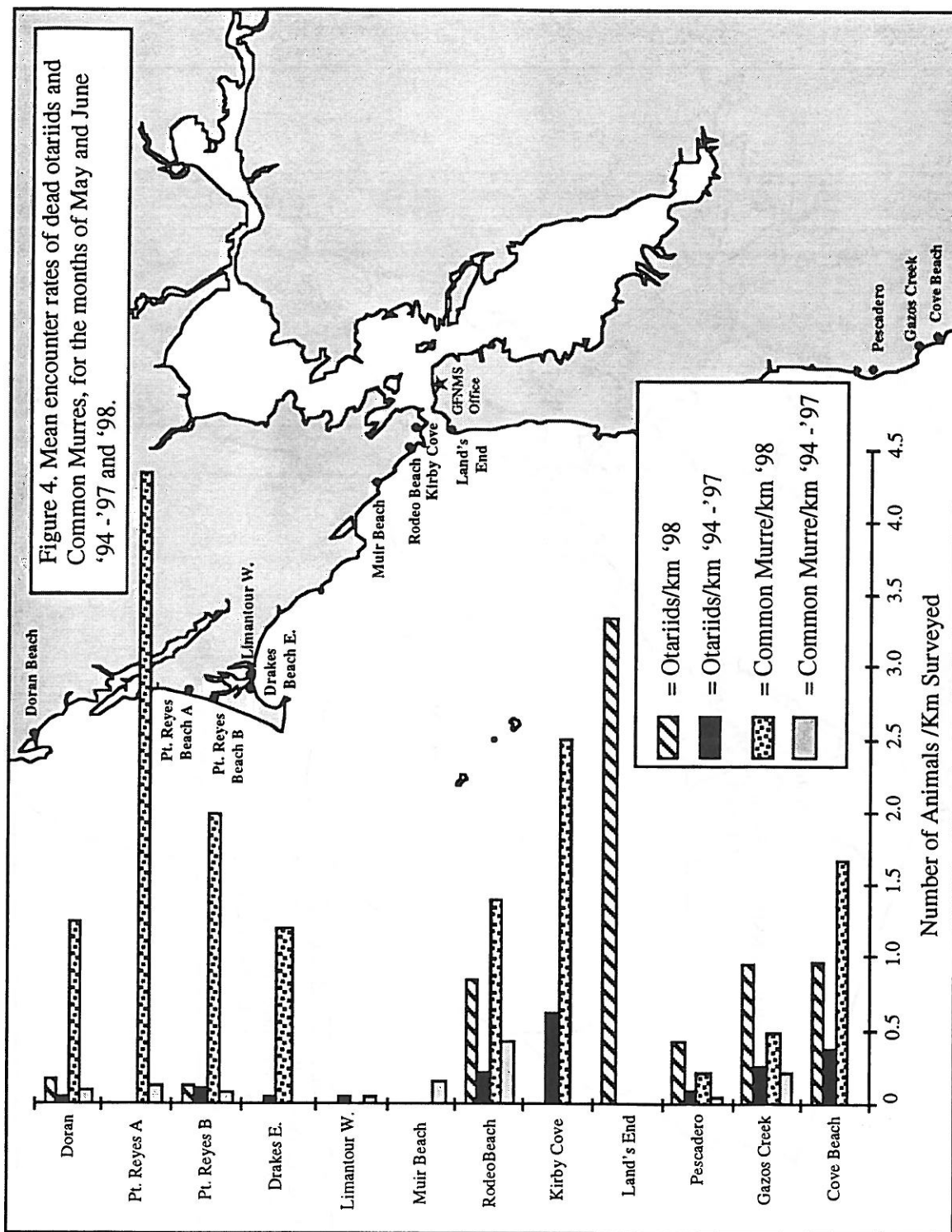


Figure 3. Locations where beached bird, mammal, and tarball data were collected and compiled from October 1993 through September 1998. Data was compiled from 13 selected beaches, for a total of 1,044 surveys, covering 2,173.4 km of shoreline.



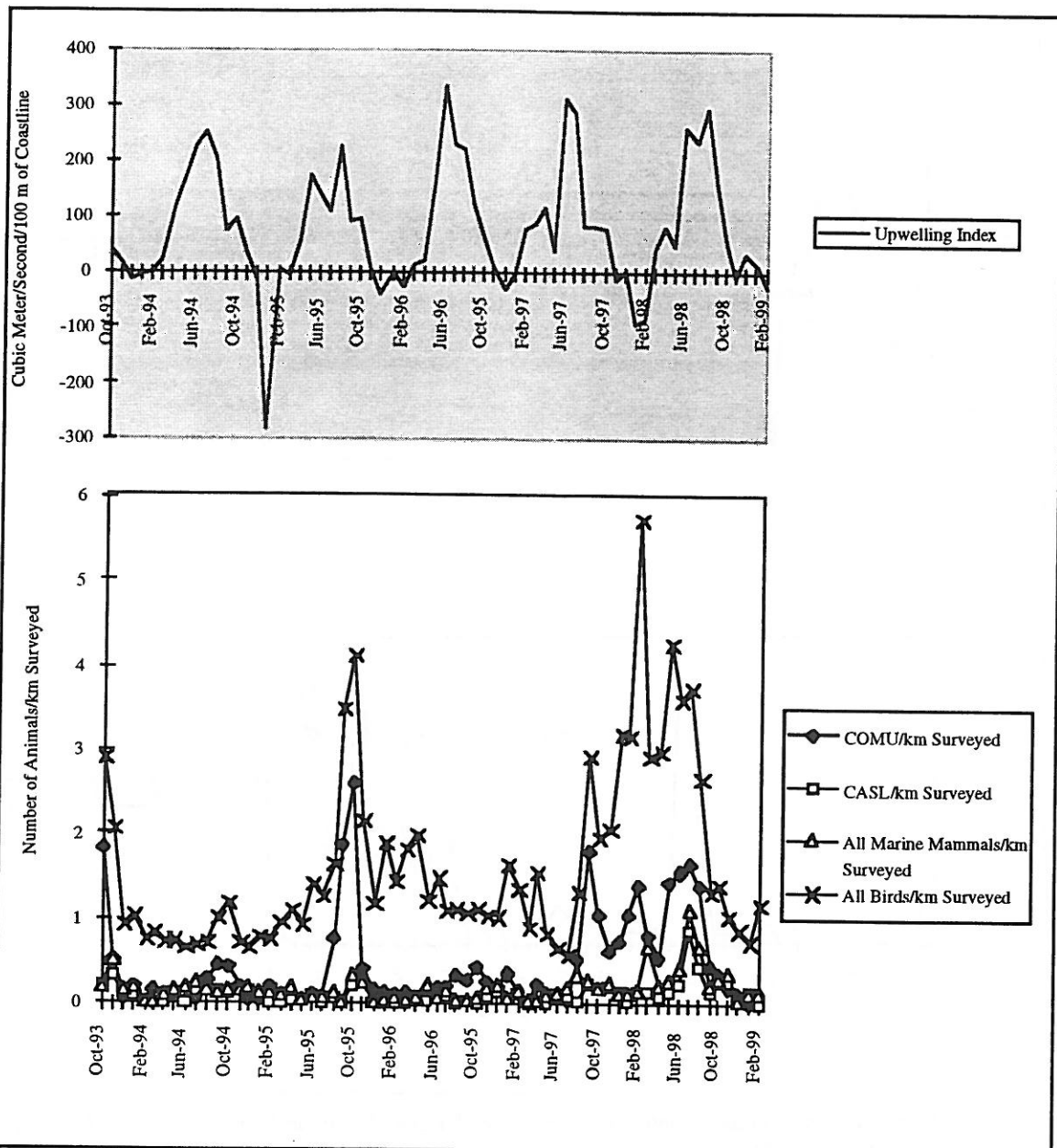


Figure 5. Upwelling indices and monthly encounter rates for dead Common Murres (COMU), California sea lions (CASL), all marine mammal species and all bird species, October 1993 through February 1999. Upwelling index data from Pacific Fisheries Environmental Laboratory, Monterey CA. Graph does not include survey data collected during oil spill response efforts.

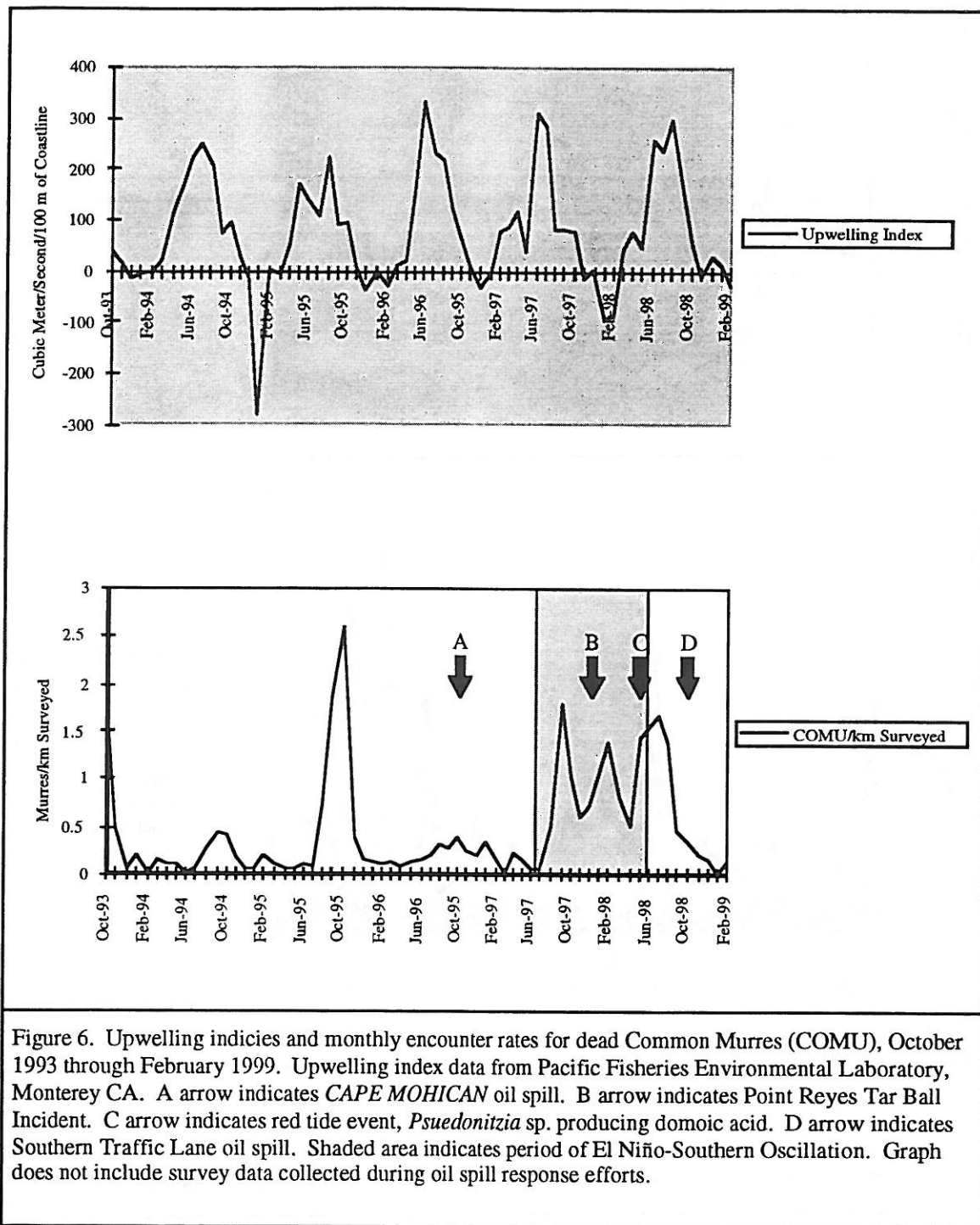


Figure 6. Upwelling indices and monthly encounter rates for dead Common Murres (COMU), October 1993 through February 1999. Upwelling index data from Pacific Fisheries Environmental Laboratory, Monterey CA. A arrow indicates *CAPE MOHICAN* oil spill. B arrow indicates Point Reyes Tar Ball Incident. C arrow indicates red tide event, *Psuedonitzia* sp. producing domoic acid. D arrow indicates Southern Traffic Lane oil spill. Shaded area indicates period of El Niño-Southern Oscillation. Graph does not include survey data collected during oil spill response efforts.

Appendix I. Available Snowy Plover counts conducted within the Point Reyes National Seashore. Not all survey data is available. See Figure 1 for beaches surveyed within the Seashore.

Beach	Date	Snowy Plover Count		3/9/97	0
Point Reyes A, 1 -14	10/24/93	0		4/9/97	0
	11/20/93	6		5/4/97	4
	12/18/93	8		6/1/97	0
	1/16/94	3		6/29/97	0
	2/12/94	14		8/22/97	8
	3/13/94	6		9/21/97	27
	4/9/94	19		10/17/97	25
	5/9/94	3		12/13/97	17
	6/5/94	0		1/8/98	3
	7/2/94	0		4/4/98	22
	7/28/94	0		5/2/98	2
	8/27/94	7		6/1/98	2
	9/25/94	25		6/27/98	0
	10/22/94	29		7/24/98	4
	11/19/94	38		8/21/98	0
	12/17/94	16		9/18/98	21
	1/22/95	0	Point Reyes B, 1-15	10/2/93	28
	2/20/95	0		10/31/93	54
	3/12/95	10		11/27/93	22
	4/9/95	0		12/26/93	10
	5/6/95	2		1/23/94	17
	6/3/95	0		2/20/94	74
	7/4/95	0		3/20/94	0
	7/29/95	3		4/16/94	0
	8/26/95	0		5/15/94	8
	9/24/95	11		6/12/94	0
	10/22/95	7		7/9/94	25
	11/25/95	2		8/7/94	15
	1/13/96	0		10/1/94	1
	2/11/96	0		10/29/94	0
	3/9/96	0		12/4/94	188
	4/6/96	0		12/31/94	71
	5/5/96	0		1/29/95	0
	6/1/96	0		2/26/95	2
	6/29/96	0		3/26/95	0
	7/27/96	0		4/22/95	2
	8/26/96	0		5/21/95	0
	9/22/96	18		6/18/95	1
10/19/96	0	7/16/95		0	
11/16/96	0	8/12/95		15	
12/15/96	4	9/10/95		11	
1/19/97	7	10/14/95		0	
2/8/97	0	11/5/95		0	
		12/3/95		0	

12/30/95	2		7/16/98	22
1/28/96	0		8/14/98	15
2/25/96	0		9/11/98	33
3/24/96	0	Point Reyes C, 1-16	10/17/93	0
4/21/96	8		11/20/93	0
5/19/96	1		12/19/93	0
6/15/96	0		1/16/94	0
7/21/96	16		2/20/94	0
8/10/96	2		3/20/94	1
9/2/96	0		4/16/94	0
9/29/96	10		5/15/94	1
11/3/96	0		6/9/94	1
11/24/96	0		7/16/94	0
12/8/96	0		8/21/94	1
12/29/96	19		9/18/94	0
1/4/97	0		10/27/96	0
1/18/97	4		11/23/96	0
2/1/97	0		12/22/96	0
2/16/97	0		1/19/97	0
3/1/97	0		2/15/97	0
3/23/97	5		3/16/97	0
3/29/97	4		4/12/97	0
4/12/97	7		5/11/97	0
4/27/97	8	Point Reyes D, 1-17	11/20/94	0
5/11/97	10		12/17/94	0
5/26/97	3		1/16/95	0
6/8/97	11		2/12/95	0
6/22/97	8		3/12/95	0
7/5/97	11		4/9/95	0
7/19/97	28		5/7/95	0
8/7/97	10		6/4/95	0
8/17/97	6		7/2/95	0
8/30/97	6		7/30/95	0
9/13/97	31		8/26/95	0
9/21/97	5		10/22/95	0
10/25/97	2		12/17/95	0
11/8/97	1		1/14/96	0
11/23/97	0		2/11/96	0
12/8/97	10		3/11/96	0
12/20/97	2		4/6/96	0
1/3/98	18		5/5/96	0
2/1/98	1		6/1/96	0
2/15/98	0		7/1/96	0
3/1/98	11		7/27/96	0
3/15/98	5		8/25/96	0
3/29/98	10		9/28/96	0
4/24/98	14		10/27/96	0
5/21/98	6		11/24/96	0
6/23/98	8		12/23/96	0

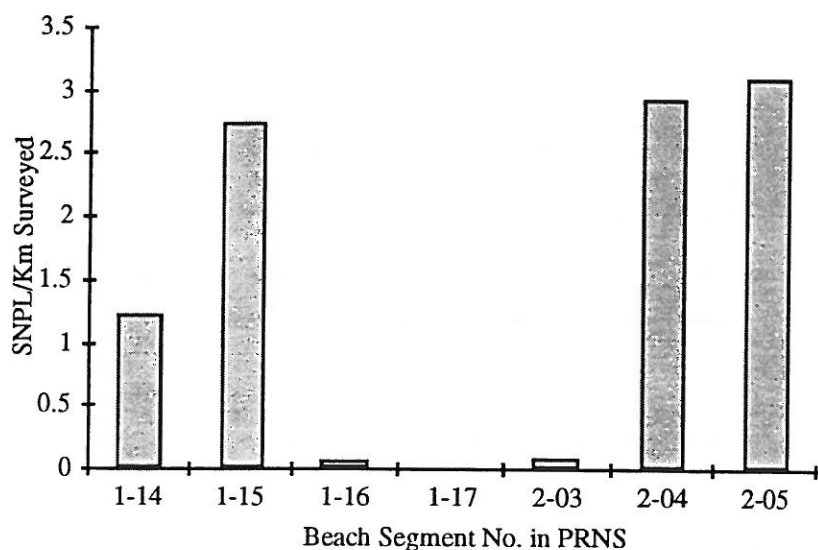
	3/17/97	0		5/3/97	0
	5/15/97	0		6/1/97	0
	9/27/97	0		6/29/97	0
Drakes West, 2-03	10/17/93	0		7/26/97	0
	11/13/93	0		8/24/97	0
	12/12/93	0		9/19/97	0
	1/9/94	0		10/21/97	0
	2/5/94	0		12/14/97	0
	3/5/94	0		12/27/97	0
	4/2/94	0		1/11/98	0
	4/30/94	0		1/27/98	0
	5/28/94	0		2/28/98	0
	6/25/94	0		3/10/98	0
	7/26/94	0		3/22/98	0
	8/20/94	0		4/5/98	0
	9/17/94	0		4/19/98	0
	11/13/94	0		5/10/98	0
	12/10/94	0		5/16/98	0
	4/8/95	0	Drakes East, 2-04	10/16/93	4
	5/6/95	0		11/12/93	0
	6/3/95	0		12/12/93	38
	7/3/95	0		1/9/94	54
	7/30/95	0		2/5/94	0
	8/27/95	0		3/5/94	23
	10/1/95	0		4/3/94	7
	10/15/95	0		5/1/94	9
	11/12/95	0		5/28/94	0
	11/26/95	0		6/25/94	0
	1/14/96	0		7/23/94	0
	1/20/96	0		8/21/94	0
	2/11/96	0		9/19/94	25
	2/17/96	0		10/16/94	45
	3/16/96	0		11/12/94	35
	3/17/96	0		12/10/94	0
	4/14/96	0		1/6/95	0
	5/18/96	0		1/16/95	72
	6/24/96	0		3/3/95	10
	7/21/96	0		4/3/95	0
	8/18/96	0		5/1/95	0
	9/15/96	0		5/27/95	0
	10/13/96	3		6/22/95	0
	10/28/96	0		7/23/95	0
	11/9/96	0		8/20/95	5
	12/15/96	18		9/14/95	0
	1/12/97	0		10/14/95	30
	2/10/97	0		11/10/95	35
	3/9/97	0		12/8/95	0
	4/6/97	0		1/8/96	7
	4/19/97	0		2/6/96	4

3/1/96	0	2/11/95	0
3/28/96	0	3/12/95	0
4/25/96	0	4/9/95	0
5/27/96	0	5/7/95	1
6/23/96	0	6/3/95	0
7/19/96	0	7/3/95	0
7/26/96	4	7/28/95	8
8/17/96	5	8/25/95	17
10/14/96	2	9/25/95	11
11/9/96	13	10/21/95	1
12/6/96	48	11/5/95	37
1/6/97	0	11/24/95	25
1/31/97	0	12/4/95	0
3/1/97	0	1/1/96	41
3/29/97	0	1/20/96	41
4/24/97	0	1/28/96	0
5/22/97	0	2/11/96	0
6/22/97	0	2/26/96	0
6/28/97	0	3/9/96	46
7/26/97	4	3/24/96	20
8/16/97	0	4/6/96	9
9/12/97	0	4/22/96	5
10/11/97	3	5/4/96	15
11/7/97	0	5/19/96	4
12/6/97	0	6/1/96	0
1/5/98	0	6/17/96	0
2/4/98	0	6/29/96	0
2/27/98	0	7/15/96	0
3/26/98	0	7/27/96	22
4/25/98	4	8/12/96	6
5/22/98	0	8/23/96	16
6/22/98	0	9/7/96	40
7/20/98	0	9/21/96	40
8/14/98	0	10/6/96	2
9/11/98	0	10/18/96	3
Limantour West, 2- 1/14/94	0	11/2/96	0
05		11/15/96	48
2/22/94	0	12/6/96	2
3/10/94	0	12/14/96	112
4/8/94	22	12/30/96	4
5/8/94	1	1/10/97	16
6/4/94	0	1/26/97	10
7/1/94	0	2/8/97	52
7/29/94	0	2/26/97	6
8/26/94	13	3/7/97	5
9/23/94	0	3/23/97	17
10/21/94	2	4/6/97	9
11/19/94	76	4/20/97	1
12/16/94	8	5/4/97	2
1/16/95	0		

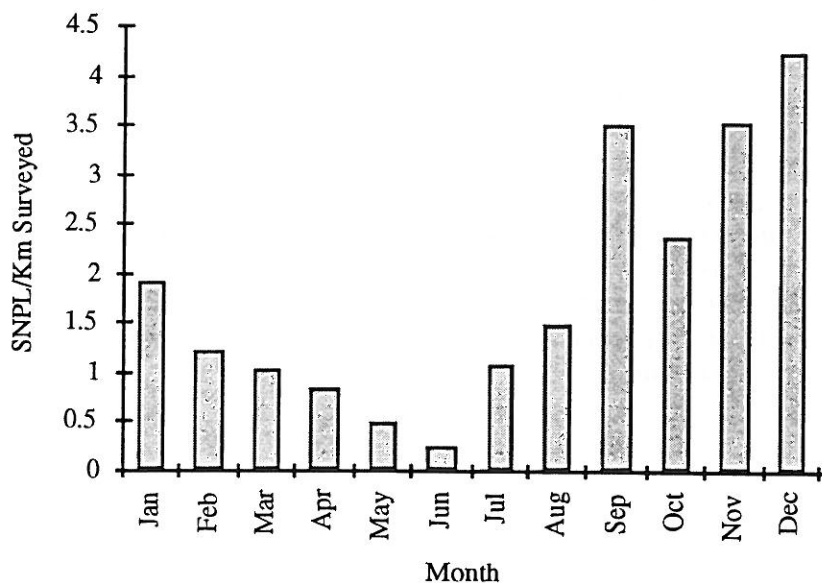
5/17/97	4	1/25/98	20
5/30/97	5	2/23/98	12
6/15/97	2	3/6/98	1
6/27/97	4	3/30/98	0
7/14/97	11	4/4/98	0
7/25/97	10	4/22/98	0
8/10/97	14	5/1/98	0
8/21/97	16	5/18/98	1
9/7/97	39	5/31/98	0
9/20/97	53	6/15/98	0
10/5/97	45	6/26/98	0
10/17/97	40	7/14/98	1
11/2/97	83	7/25/98	17
11/16/97	37	8/8/98	9
12/1/97	70	8/22/98	26
12/13/97	32	9/3/98	19
12/28/97	0	9/18/98	10
1/8/98	0		

Appendix II. Available Snowy Plover mean encounter rates for all beaches. Not all survey data is available. See Figure 1 for beaches surveyed.

Beach	Start Date	End Date	# of Surveys	Plovers/km
106	10/19/93	11/13/98	79	1.52
110	2/5/94	5/29/95	16	5.082
114	10/24/93	9/18/98	61	1.223
115	10/2/93	9/11/98	80	2.666
116	10/17/93	5/11/97	20	0.048
117	11/20/94	9/27/97	29	0.000
203	10/17/93	5/16/98	85	0.059
204	10/16/93	9/11/98	67	2.925
205	1/14/94	9/18/98	98	3.099
212	8/29/96	10/10/98	26	0.000
214.5	10/21/96	5/8/97	7	0.000
219	10/29/93	9/30/98	90	0.000
223	7/8/89	9/28/98	107	0.000
230	10/16/93	9/20/98	64	0.000
301	9/29/98	9/29/98	1	0.000
306	9/15/93	10/20/98	64	0.000
309	9/29/98	9/29/98	1	6.250
310	11/16/94	11/2/98	48	0.000
311	12/13/94	9/29/98	41	0.101
312	12/10/94	4/27/97	32	0.000
315	6/25/98	9/29/98	2	0.000
319	6/25/98	6/25/98	1	0.000
321	6/25/98	6/25/98	1	0.000
327	7/14/95	6/25/98	24	0.000
403	10/16/93	12/15/96	43	0.000
405	10/31/93	6/25/98	46	8.362
410	11/14/93	10/27/98	44	8.649
413	6/13/94	6/16/98	36	0.000
414	10/31/93	7/23/97	43	0.000
417	9/26/93	9/29/98	82	5.457
420	10/30/93	9/4/98	56	0.000
503	12/31/93	9/30/98	80	3.361
509	10/9/93	9/27/98	62	0.000
601	12/8/95	3/28/98	18	0.000
604	8/17/94	11/24/96	15	0.000
706	12/10/94	10/20/97	38	0.000



Snowy Plover encounter rate for beaches surveyed within the Point Reyes National Seashore. See Figure 1 for location and names of beach segments. Not all survey data has been entered in to the data base and may not appear in the graph.



Mean monthly encounter rate for Snowy Plovers within the Point Reyes National Seashore. Not all survey data has been entered in to the data base and may not appear in the graph.

Appendix III. Summary of oyster rack separator tubes found along the central California coast. Not all survey data is available. See Figure 1 for beaches surveyed.

The following table does not include survey data not entered into the data base due to lack of available staff. Each tubes is counted and removed during a beach survey. The majority of the tubes (8,867 out of 8,794) are found within the Point Reyes National Seashore, primarily at beaches along Drakes Bay and Point Reyes Beach. Oyster rack separator tubes were found as far north as Doran Beach, Sonoma County, the northern extent of our surveys, and as far south as Pomponio State Beach, San Mateo County. Surveyors continue to find new tubes and old tubes recently uncovered by erosion.

Beach Number	Start	End	No. of Visits	Total No. Tubes	Oyster Tubes per km
106	10/19/93	7/26/97	60	77	0.40
110	2/5/94	5/29/95	16	0	0.00
114	10/24/93	6/29/97	50	603	2.41
115	10/2/93	6/22/97	56	618	2.57
116	10/17/93	5/11/97	20	233	2.77
117	11/20/94	9/27/97	30	54	0.31
203	10/17/93	12/15/96	43	28	0.16
204	10/16/93	5/22/97	50	2672	21.38
205	1/14/94	6/27/97	65	4459	14.91
214.5	10/21/96	5/8/97	7	2	0.00
219	10/29/93	6/22/97	66	3	0.08
223	3/18/94	8/1/97	79	7	0.10
230	10/16/93	7/18/97	50	0	0.00
306	9/15/93	6/5/97	48	0	0.00
310	11/16/94	6/20/97	23	1	0.04
311	12/13/94	3/29/97	40	7	0.06
312	12/10/94	4/27/97	32	8	0.07
327	7/14/95	5/13/97	23	0	0.00
403	10/16/93	12/15/96	43	0	0.00
405	10/31/93	10/30/97	45	1	0.01
414	10/31/93	6/25/97	42	11	0.12
414.5	12/16/96	12/16/96	1	0	0.00
417	9/26/93	6/29/97	56	0	0.00
420	10/30/93	6/15/97	42	0	0.00
503	12/31/93	7/23/97	58	9	0.09
509	10/9/93	6/29/97	45	0	0.00
604	8/17/94	11/24/96	15	0	0.00
706	12/10/94	10/20/97	38	1	0.01

Appendix IV. Available mean encounter rate for live sea otter sightings for all available beaches. Not all survey data is available; data from some key beaches, e.g. Fitzgerald Marine Reserve, Princeton Harbor and Sharp Park are not available. See Figure 1 for beaches surveyed.

Beach	Start Date	Last Date	Visits	Otter/km
106	10/19/93	11/13/98	79	0.000
110	2/5/94	5/29/95	16	0.000
114	10/24/93	9/18/98	61	0.000
115	10/2/93	9/11/98	80	0.003
116	10/17/93	5/11/97	20	0.000
117	11/20/94	9/27/97	29	0.000
203	10/17/93	5/16/98	85	0.000
204	10/16/93	9/11/98	67	0.000
205	1/14/94	9/18/98	98	0.002
212	8/29/96	10/10/98	26	0.010
214.5	10/21/96	5/8/97	7	0.000
219	10/29/93	9/30/98	90	0.000
223	7/8/89	9/28/98	107	0.000
230	10/16/93	9/20/98	64	0.000
301	9/29/98	9/29/98	1	0.000
306	9/15/93	10/20/98	64	0.000
309	9/29/98	9/29/98	1	0.000
310	11/16/94	11/2/98	48	0.000
311	12/13/94	9/29/98	41	0.000
312	12/10/94	4/27/97	32	0.000
315	6/25/98	9/29/98	2	0.000
319	6/25/98	6/25/98	1	0.000
321	6/25/98	6/25/98	1	0.000
327	7/14/95	6/25/98	24	0.000
403	10/16/93	12/15/96	43	0.000
405	10/31/93	6/25/98	46	0.000
410	11/14/93	10/27/98	44	0.000
413	6/13/94	6/16/98	36	0.000
414	10/31/93	7/23/97	43	0.000
417	9/26/93	9/29/98	82	0.020
420	10/30/93	9/4/98	56	0.077
503	12/31/93	9/30/98	80	0.035
509	10/9/93	9/27/98	62	0.040
601	12/8/95	3/28/98	18	0.000
604	8/17/94	11/24/96	15	0.000
706	12/10/94	10/20/97	38	0.000