Marine Mammal Research and Monitoring in the Monterey Bay National Marine Sanctuary

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Introduction

Designated in 1992, the Monterey Bay National Marine Sanctuary (MBNMS) encompasses over 5,000 square miles off of Central California. Marine mammal habitats within the MBNMS include estuaries, rocky shores, sandy beaches, kelp forests, continental shelf, canyons, and deep water. The MBNMS has one of the most diverse and abundant assemblages of marine mammals in the world, including six species of pinnipeds, one species of fissiped, and 21 species of cetaceans (see the MBNMS Site Characterization at http://bonita.mbnms.nos.noaa.gov/sitechar/). Many of these marine mammals migrate north to the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries, and south to the Channel Islands National Marine Sanctuary. There are also more than 20 active marine research institutions in the broader MBNMS, making this a recognized center for excellence in marine science. This wealth of habitats, species, scientists, and resource managers allows for successful collaborations and opportunities to enhance scientific understanding to manage natural resources. In this brief paper, we will give an overview of ongoing marine mammal studies in the MBNMS, successful collaborative projects, critical resource management questions to be addressed, and requests by scientists to the MBNMS to enhance research.

Marine Mammal Monitoring and Research

From a survey we conducted with marine mammal scientists in the MBNMS region, an extensive list of research projects was compiled (see Appendix 1-- Jan and Sarah: if there is no room for the Appendix, please put "see DeVogelaere and Benson, http://bonita.mbnms.nos.noaa.gov/Research/techreports/techreps.html). In 1999, we gathered information from 64 scientists at 17 marine research institutions that were working on 34 different marine mammal studies. Monitoring projects ranged from monthly surveys of beachcast and pelagic organisms to disease prevalence and pathogenesis. Research studies ranged widely, including diverse topics such as diving behavior of wild and rehabilitated seals and analyses of spatio-temporal patterns in the distribution and abundance of zooplankton, fish and mammals in relation to coastal upwelling. Marine mammal research in the MBNMS is extensive and of high quality.

Resource Management and Science Collaborations

In 1999, the MBNMS research staff consisted of two people, so collaboration with regional scientists was essential for addressing resource management issues. Fortunately, there have been numerous successful collaborations between the MBNMS and regional scientists. The MBNMS has an active Research Activity Panel (RAP), with representatives from all the major regional research institutions, that meets 8 times per year. This group advises the MBNMS on science issues and played a critical role in completing the MBNMS Site Characterization, through reviews and authoring chapters. This continually updated document is available on the world wide web at http://bonita.mbnms.nos.noaa.gov/sitechar/, and is a collaborative project continually used by resource managers, educators and scientists. The MBNMS, largely through the RAP, also facilitates cross disciplinary collaboration on projects such as sharing oceanographic data needed for marine mammal distribution studies.

The MBNMS is able to provide time aboard the 175 ft. R/V McArthur and smaller vessels, has access to NOAA planes, and supplies modest funds to address resource management issues. These resources have successfully been used to study critical marine mammal habitat questions, sea otter rehabilitation, pelagic and coastal surveys, and sound propagation from whales. The MBNMS also provides office space for National Marine Fishery Service staff, graduate students and interns.

The MBNMS Beach COMBERS (Coastal Ocean Mammal and Bird Education and Research Surveys) is a collaborative beachcast monitoring effort spearheaded by MBNMS, Moss Landing Marine Laboratories and over 40 volunteers; numerous other government organizations participate in volunteer training, necropsies, facilitating beach access, and use the data. Information from this program has been used to assess impacts of oil spills, to determine species distribution patterns, and to detect by-catch impacts from a gill net fishery. This project was also involved in a comprehensive assessment, from oceanographic conditions to death of sea lions, of a harmful algal bloom in Monterey Bay (Scholin et al.; Nature 403:80-84).

Questions to be Addressed

In addition to the ongoing marine mammal research, there are issues the MBNMS would like to address in a more comprehensive manner. Though each issue is complex, the following simple list is provided to encourage scientists to contact MBNMS staff if they are interested in participating in related efforts: developing a comprehensive marine mammal monitoring program; understanding the links between climate variability, nearshore productivity and marine mammal populations; determining if there is a link between coastal nitrate loading and harmful algal blooms; developing methods to minimize by-catch from the set gillnet fishery; developing ecosystem health indices; determining the causes of the current sea otter population decline; and assessing the effects of vessel traffic on marine mammals.

Requests from the Scientific Community

As we surveyed the scientific community about ongoing marine mammal research, we asked for input on how the MBNMS could facilitate their research; comments fell into general

categories of resource support, coordination assistance, and program development and expansion. Many scientists appreciated support for their projects in terms of using MBNMS research platforms and research funds. For marine mammal studies, time available on the R/V McArthur has decreased and there is a great need for increased funding beyond occasional contracts on the order of $ 2,000 - 20,000. It was suggested that the MBNMS could develop a equipment/supply pool for multidisciplinary use, including cameras, geographic information system technology, CTDs and fuel. One successful way of supporting research, that the MBNMS funded in the past, is graduate student fellowships for specific topics of interest.

Scientists suggested administrative ways of coordinating and enhancing marine mammal research in the MBNMS. These included developing online directories for potential funding sources, and serving as a central location for databases on environmental conditions, maps, and marine mammal distribution and abundance to facilitate effective monitoring and information sharing. There were requests to maintain lists of ongoing marine mammal research, as developed for this workshop. Finally, several scientists felt strongly that a more streamlined permit process, within Sanctuaries and across different resource management agencies, would greatly facilitate research.

Expanding existing programs was suggested as strategy to improve research results for understanding of Sanctuary ecosystem function. The MBNMS Beach COMBERS program and pelagic surveys should be expanded to cover the entire geographic range of the Sanctuary. Moreover, many marine mammals easily transit between Sanctuaries, and cross-Sanctuary projects should be supported to effectively address population assessments. The MBNMS RAP and Sanctuary Currents Symposium were mentioned as effective ways of facilitating dialogue between scientists, environmental groups, user groups, and resource managers. This is not often effectively accomplished, and the MBNMS could therefore expand on their opportunities to fill this niche.

Summary

The MBNMS region is active with marine mammal research, and the information is being transferred between scientists and resource managers. Important recent successes include the discovery of significant by-catch from a gill net fishery, a comprehensive assessment of the marine mammal impacts by a harmful algal bloom, and ongoing monitoring data from the Beach COMBERS and pelagic surveys. However, there are many critical resource management issues that still need to be addressed. Marine mammal research could significantly be enhanced in the MBNMS by increasing availability of monetary and research platform resources, collaboration across Sanctuaries to study migrating populations, and some moderate administration/coordination support to regional scientists.

Appendix 1. A list of marine mammal research and monitoring projects in the Monterey Bay National Marine Sanctuary

Research Projects

Project Title:

Dispersal and food habits of juvenile pacific harbor seals (*Phoca vitulina richardsi*) in Central California.

Investigators: Stori C. Oates, and Jim Harvey.

Agencies / Institutions: Moss Landing Marine Laboratories.

Synopsis of research:

- Despite numerous studies conducted on the behavior and population dynamics of the Pacific harbor seal (*Phoca vitulina richardsi*), little is known about the impacts of juvenile dispersal, haulout site fidelity, or food habits on populations especially along the central California coast.
- The objectives of this study are to: 1) determine where weaned pups haul-out and what factors contribute to their dispersal; 2) identify and determine the relative importance of prey species consumed by weaned pups; and 3) determine if resource partitioning occurs between age classes.
- To determine the direction and distance traveled by weaned pups from their natal beaches, weaned pups will be captured, tagged, and tracked using radio telemetry. To determine types of prey consumed by recently weaned harbor seals, all captured pups will be lavaged. Otoliths and cephalopod beaks will be identified, measured, and enumerated to determine the length, weights, and the number of the species consumed.
- Determining dispersal, site fidelity and foraging habits exhibited by weaned seal pups are important for a better understanding of the population dynamics of harbor seals in California and have important implications for management and conservation of this species and closely related species that are threatened.

Project Title:

Pregnancy and parturition rates of harbor seals in Central California.

Investigators: Denise Greig, Jim Harvey, and Jenn Burns.

Agencies / Institutions: Moss Landing Marine Laboratories, University of California at Santa Cruz.

Synopsis of research:

- Pregnancy and birth rates are useful for monitoring reproductive health and predicting population growth.
- We are measuring circulating hormone levels in wild harbor seals during gestation to detect pregnancy and comparing pregnancy rates with observed birth rates.

Project Title:

Diving behaviors of wild and rehabilitated harbor seal (*Phoca vitulina richardsi*) pups.

Investigators: Michelle Lander and Jim Harvey.

Agencies / Institutions: The Marine Mammal Center, Moss Landing Marine Laboratories.

Synopsis of research:

- The objective of this study was to examine the diving behaviors of wild and rehabilitated pups in greater detail using time depth recorders (TDRs), which have never been deployed on Pacific harbor seal pups.
- To measure depths and durations of dives, surface intervals, time at depth, and average rates of descent and ascent for dives, TDRs (Mk5 and Mk7 models) with a remote release mechanism (RRM) were attached to the dorsum of 12 wild pups captured at Pebble Beach, California and nine rehabilitated pups released from The Marine Mammal Center, Sausalito, from 1997 to 1999.
- Diving behaviors of wild pups and rehabilitated pups were similar. Maximum dives of wild pups ranged from 24 to 105 m, whereas maximum dives of rehabilitated pups ranged from 21 to 96 m.
- Mean depth, duration, and bottom time of dives generally increased over time for most pups and presumable foraging bouts became more prominent.

Project Title:

Protozoal encephalitis in sea otters and harbor seals.

Investigators: Melissa A. Chechowitz, Patricia A. Conrad, Linda J. Lowenstine, Ian A. Gardner, Frances Gulland, and David Jessup.

Agencies / Institutions: University of California at Davis, The Marine Mammal Center, and California Department of Fish and Game.

Synopsis of research:

- The work is being completed in several ongoing phases involving thorough, detailed necropsies of otters and seals, with protozoal parasite isolation in cell culture.
- Isolated parasites are characterized via molecular and antigenic techniques, and fully characterized parasites will be utilized for diagnostic test development and epidemiologic studies.

Project Title:

Predator/prey interactions between white sharks and elephant seals.

Investigators: Burney J. Le Boeuf, A. Peter Klimley, Dan P Costa, Dan Crocker, and Barbara Block.

Agencies / Institutions: University of California at Santa Cruz, and Bodega Marine Laboratory.

Synopsis of research:

- The aim is to determine how white sharks hunt their prey, the elephant seals, and how the prey evade the predator.

Project Title:

Elephant Seals as platforms for collection of oceanographic data.

Investigators: Burney J. Le Boeuf, A. Peter Klimley, Dan P. Costa, Dan Crocker, and Barbara Block.

Agencies / Institutions: University of California at Santa Cruz, Bodega Marine Laboratory.

Synopsis of research:

- The aim is to use elephant seals, rather than conventional ships and CTDs, to collect temperature/depth data and acoustical data in the water column in the northeastern Pacific that is of use to oceanographers

Project Title:

Diving and foraging behavior of northern elephant seals.

Investigators: Burney J. Le Boeuf, A. Peter Klimley, Dan P. Costa, Dan Crocker, and Barbara Block.

Agencies / Institutions: University of California at Santa Cruz, Bodega Marine Laboratory.

Synopsis of research:

- The aim is to determine how and where elephant seals forage and to document habitat separation between the sexes.

Project Title:

Determining the percentage of salmon taken by pinnipeds in commercial and recreational fisheries.

Investigators: Michael Weise and Jim Harvey.

Agencies / Institutions: Moss Landing Marine Laboratories.

Synopsis of research:

- In the ocean commercial troll and recreational salmon fishery in Monterey Bay California, California sea lions (*Zalophus californianus*) will swim near or follow fishing boats and will depredate fish once hooked.
- The objectives of the study were to determine the percentage of salmon taken by pinnipeds in commercial and recreational fisheries, identify relative importance of prey items seasonally consumed by sea lions, and determine the proportion of salmonids in the sea lion diet on a seasonal basis.
- From April 1997 through September 1998, 1041 hours of onboard and dockside surveys of the commercial and recreational salmon fisheries were conducted at the three ports in Monterey Bay, California.
- Sea lions depreadated 7.9 % of the fish hooked in the commercial fishery in 1997 and 28.6 % in 1998, 8.4 % (1997) and 18.3 % (1998) of the CPFV fishery, and 15.6 % (1997) and 17.5 % (1998) of the private skiff fishery. Increased depredation rates in both the commercial and recreational salmon fisheries in 1998 were most likely the result of the large El Niño Southern Oscillation event that occurred in 1997-1998 during which a greater number of sea lions were present in central California.
- Prey hardparts identified in sea lion fecal samples collected in Monterey Bay indicated that schooling fishes were the predominant prey fish species, such as market squid (*Loligo opalescens*), Pacific sardine (*Sardinops caeruleus*), northern anchovy (*Engraulis mordax*), and rockfish (*Sebastes* sp).

Project Title:

Assessment of the level of pinniped-caused mortality on adult winter-run steelhead (*Oncorhynchus mykiss*) at the mouth of the San Lorenzo River.

Investigators: Michael Weise, and Jim Harvey.

Agencies / Institutions: Moss Landing Marine Laboratories.

Synopsis of research:

- Increasing numbers of Pacific harbor seal (*Phoca vitulina richardsi*) and California sea lion (*Zalophus californianus*) have caused concern that predation on salmonids by pinnipeds could increase and possibly affect the recovery of listed salmonid populations.
- The purpose of this study was to assess the level of pinniped-caused mortality on adult winter-run steelhead (*Oncorhynchus mykiss*) at the mouth of the San Lorenzo River.
- Harbor seal foraging behavior was monitored during daylight hours at the mouth of the San Lorenzo River for 792.5 hours in 1997 and 1998.
- No fish were taken in 1998, six predation events were observed in 1999, one involved salmonids, most likely a steelhead.
- Prey hard parts identified in harbor seal fecal samples collected in 1998 near the San Lorenzo River indicated that bottom fishes and schooling fishes were the most commonly occurring fish species, such as speckled sanddab (*Citharichthys stigmaeus*; 28.8%), white croaker (*Genyonemus lineatus*; 23.1%), plainfin midshipman (*Porichthys notatus*; 20.5%), northern anchovy (*Engraulis mordax;* 12.4%), and capelin (*Mallotus villosus*; 5.6%).
- This report does not intend to imply that salmonids are not a prey species for pinnipeds in the San Lorenzo River, but highlights the difficulties encountered in establishing the role of salmonids in the pinniped diet.

Project Title:

Using trained sea lions to record and sample ocean communities and organisms.

Investigators: Jenifer Hurley, and Stephanie Wurts.

Agencies / Institutions: Moss Landing Marine Laboratories.

Synopsis of research:

- This program attempts to develop trained sea lions, wearing various monitoring equipment, as a new, affordable technique to rapidly and repetitively sample ocean phenomena.
- We intend to use the sea lions wearing video cameras and time-depth recorders to record the underwater behavior of a variety of marine animals (particularly whales and dolphins), to sample population dynamics of various benthic and pelagic communities and species (e.g. running simple transect lines), and to recover and place monitoring instruments either on large animals or on the sea floor.

Project Title:

Research experience for undergraduates working in marine science with trained sea lions.

Investigators: Jenifer Hurley, Dan Costa, William Head, Dave Casper, Jim Harvey, and Stephanie Wurts.

Agencies / Institutions: Moss Landing Marine Labs, University of California at Santa Cruz, and California State University at Monterey Bay.

Synopsis of research:

- We are developing a Research Experience for Undergraduates (REU) site at Moss Landing Marine Laboratories, California providing internships for undergraduates to study marine science with trained California sea lions.
- Students may be provided stipends to work part time for a full semester to conduct individual research projects with sea lions.
- Research topics may include swimming and diving physiology, developmental energetics, veterinary medicine, and education.
- This project's philosophy is that early professional experience enables students to be substantially better prepared to compete in the job market and gain admission into graduate school.
- Students are directly responsible and actively involved in all aspects of the research laboratory.

Project Title:

Documenting the effects of instrumentation on freely swimming and diving sea lions.

Investigators: Jenifer Hurley, Skrovan, and Stephanie Wurts.

Agencies / Institutions: Moss Landing Marine Laboratories

Synopsis of research:

- This study examines the effects of instrumentation on the swimming and diving abilities of differently sized sea lions.
- Most field research on marine mammals is conducted by gluing or affixing various types of data-logging instrumentation to the study animal (Costa 1993).
- A wide variety of data on diving behavior and physiology has been obtained using these techniques. However, very little is understood about the effects of this instrumentation and how it might confound the interpretation of these results.
- It is hypothesized that instrumentation will increase the frequency of propulsive movements and respiratory rate of the study animal, which may be correlated with the characteristics of the instrumentation.

Project Title:

Marine mammal sightings in association with upwelling off Central California, 1986-1997.

Investigators: Carol A. Keiper, David G. Ainley, and Sarah G. Allen.

Agencies / Institutions: Moss Landing Marine Laboratories; National Park Service, Point Reyes National Seashore; H.T.Harvey & Associates.

Synopsis of research:

- Relationships between marine mammals and hydrographic features off central California from Bodega Bay to Monterey Bay 1986 - 1997 (except 1995-96) were investigated using the Geographical Information System (GIS) Arc/View Spatial Analyst.
- Data were collected using standard strip transect methodology. Marine mammal sightings and sea surface isotherms derived from shipboard data were mapped; AVHRR images for 1993 and 1994 were overlayed with isotherm data to validate the location of upwelling regions.
- Preliminary analysis indicates that the spatial and temporal distribution of marine mammals changed relative to surface hydrographic features associated with coastal upwelling. Regions of maximum upwelling and coincident cold-water plumes were identified near Pt. Reyes and Año Nuevo Point.

Monitoring Projects

Project Title:
Monitoring the success of rehabilitated sea otters returned to the wild.

Investigators: Michelle Staedler, Twyla Anderson, Krista Hanni, and Andrew Johnson.

Agencies / Institutions: Monterey Bay Aquarium, and University of California at Davis.

Synopsis of research:
- Using radio telemetry, we carefully monitor rehabilitated sea otters returned to the wild.

Project Title:
Development and implementation of a subcutaneous radio transmitter for sea otters.

Investigators: Jack Ames, Mike Murray, Andrew Johnson, Dave Jessup, and Michelle Staedler.

Agencies / Institutions: California Department of Fish and Game, The Marine Mammal Center, and Monterey Bay Aquarium.

Synopsis of research:
- We are currently waiting for permit approval to test a newly developed smaller radio transmitter that would be implanted subcutaneously in sea otters rather than the currently used abdominal implant.

Project Title:
Sea Otter Ecology Project (SOEP).

Investigators: Thomas R. Kieckhefer, Barbara Voss, and Sue Lynn Reif.

Agencies / Institutions: Pacific Cetacean Group.

Synopsis of research:
- Long-term monitoring project recording sea otter distribution and abundance in Elkhorn Slough, based on initial work done by Sue Lynn Reif & Daniela Feinholz (1994-1995).
- The current phase of this research is a 3-year study from 1998-2000. Otter locations are recorded with GPS and interfaced with a portable laptop computer along with behavior states and environmental data.
- Identification of prey, size, and depth along with dive durations will be recorded.
- Otter distribution and behavior will be inter-related to episodic and annual variations in air & water temperature, tidal heights & states (ebb vs. flood) using GIS.

Project Title:

Long-term monitoring of underwater vocalizations of harbor seals (*Phoca vitulina richardsii*) in Monterey Bay, California.

Investigators: David K. Mellinger and Teri Nicholson.

Agencies / Institutions: Monterey Bay Aquarium Research Institute, Moss Landing Marine Laboratories.

Synopsis of research:

- Underwater vocalizations of harbor seals were recorded from an array of eight hydrophones at Hopkins Marine Station, Pacific Grove, CA. Seals were also visually observed, and behaviors were correlated with call types and characteristics.

Project Title:

Disease prevalence and pathogenesis in stranded pinnipeds.

Investigators: Frances Gulland, Linda Lowenstine, Jeff Stott, and Jim Harvey.

Agencies / Institutions: The Marine Mammal Center, University of California at Davis, and Moss Landing Marine Laboratories.

Synopsis of research:

- We are working on Herpesviruses in pinnipeds, skin disease in northern elephant seals, domoic acid toxicity.
- Sea lion herpes: Determining the relationship between herpesviral infection and contaminants in the etiology of carcinoma in California sea lions.
- Leptospirosis: Determining mode of transmission and epidemiology in California sea lions.

Project Title:

Abundance and distribution of California sea lions in Central and Northern California ('98, '99, '00 anticipated).

Investigators: Mark Lowry, Jay Barlow, and Karin Forney.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Synopsis of research:

- The objective of the study is to determine seasonal abundance and distribution of California sea lions in central and northern California from Point Conception to the CA/OR border and out to approximately 60 nautical miles offshore.
- Three surveys occur when salmonids are running in or out of rivers; the fourth survey is held when the US stock of sea lions are in California.
- There are two parts to the surveys: 1) Aerial photographic census of California sea lions that are hauled out, and 2) offshore strip-transect surveys to estimate the number of animals at sea.
- The sum of animals hauled out and of those estimated to be at sea provide a total abundance estimate of California sea lions for the region. Also, cetaceans and other pinniped species are recorded during offshore-strip transect surveys.

Project Title:

Steller sea lion pup production, Año Nuevo.

Investigators: Wayne L. Perryman, Morgan Lynn, and Jim Gilpatrick.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Project Title:

Gray whale calf production survey.

Investigators: Wayne L. Perryman, Morgan Lynn, Jim Gilpatrick, and Richard Rowlett.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Project Title:

Gray whale photogrammetry study.

Investigators: Wayne L. Perryman, Morgan Lynn, and Jim Gilpatrick.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Project Title:

California cetacean abundance surveys ('91, '93, '96, '02 anticipated).

Investigators: Jay Barlow and Grant Cameron.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Synopsis of research:

- Our primary mission is to assess the human impacts on cetacean and pinniped populations in this region and to monitor the recovery of endangered species.
- The major human impact within the MBNMS is entanglement in set gillnets which affects many species, but most significantly harbor porpoises.
- MBNMS includes important feeding areas for endangered blue, humpback and fin whales.

Project Title:

Distribution, movements, abundance, and population trends of humpback and blue whales off California ('91 - '00).

Investigators: John Calambokidis, Gretchen Steiger, Kristin Rasmussen, Todd Chandler, Lisa Schlender, and Jay Barlow.

Agencies / Institutions: Cascadia Research, and NOAA / NMFS Southwest Fisheries Science Center.

Synopsis of research:

- Cascadia Research and collaborators have conducted a long-term research effort on humpback and blue whales off the west coast of the United States with the support of a number of government agencies, primarily Southwest Fisheries Science Center and the marine sanctuary program of NOAA.
- Intensive research of humpback and blue whales off California using photographic identification has been conducted annually since 1986.
- Major long-term objectives have been to: 1) Determine the abundance of humpback and blue whales found in coastal waters of California, Oregon, and Washington. 2) Determine if populations are increasing or decreasing and, if so, at what rate. 3) Examine reproductive and mortality rates of humpback whales. 4) Examine movements, migratory destinations, and define the stock structure of the populations that use these waters. 5) Examine other aspects of their biology including food habits and behavior. 6) Evaluate the impact of human and environmental factors on these populations.

Project Title:

Humpback whale feeding ecology project.

Investigators: Thomas R. Kieckhefer, and Barbara Voss.

Agencies / Institutions: Pacific Cetacean Group.

Synopsis of research:

- Feeding behavior of humpback whales in the Monterey Bay National Marine Sanctuary will be observed during 2000 to 2003 (presently conducting a pilot study).
- Combined with concurrent studies of whale distribution, movements, and population size, this study proposes to accurately describe the importance of the Monterey Bay habitats in providing food resources for these whales.
- Six objectives will be pursued: 1) assess percentage of time spent feeding compared with other behavioral states of rest, slow travel, fast travel, and mill/search; 2) quantify respirations and surface behaviors associated with feeding (surface and sub-surface) and non-feeding; 3) characterize feeding behavior for different types of prey (e.g., euphausiids vs. fish, shallow vs. deep prey); 4) identify prey species and determine their depth in the water column; 5) relate the distribution of prey to topographic features and annual variations of environmental factors; and 6) determine relative resident times whales inhabit Monterey Bay using photo-identification methods.

Project Title:

Monterey Bay ecosystem monitoring: Wind to Whales.

Investigators: Don Croll, Scott Benson, Baldo Marinovic, and Jim Harvey.

Agencies / Institutions: University of California at Santa Cruz, and Moss Landing Marine Laboratories.

Synopsis of research:

- In this study we are identifying critical marine mammal and seabird foraging habitats, and establish the nature and magnitude of the link between coastal upwelling processes in Monterey Bay, primary production, euphausiid (krill) production, fish productivity and top marine predators (marine mammals and seabirds).
- This information will allow models of various scenarios of climate variability on nearshore productivity and marine mammal and seabird populations.

Project Title:

Seabird and marine mammal distribution and abundance in the Gulf of the Farallones from Monterey Bay to Point Arena.

Investigators: Sarah Allen and D.G. Ainley.

Agencies / Institutions: National Park Service, Point Reyes National Seashore, and H.T.Harvey & Associates.

Synopsis of research:

- Started in 1985 and continue up to the present.
- Separate from MBNMS area: Long-term monitoring studies of pinnipeds at Point Reyes - some of which travel to MBNMS - elephant seals marked at Pt Reyes have shown up at San Simeon and Año Nuevo, harbor seals radio-tagged at Pt Reyes have gone to Elkhorn slough and vice a versa.

Project Title:

Monterey Bay Dolphin Project.

Investigators: Lisa L. Giesick, Thomas R. Kieckhefer, Susan Shane, and Daniela Fienholz.

Agencies / Institutions: Pacific Cetacean Group.

Synopsis of research:

- Estimate the number of Bottlenose Dolphins (*Tursiops truncatus*) that inhabit Monterey Bay.
- Determine what parts of the Bay are utilized the most and is there any seasonality, changes in environmental conditions, or time of day that relates to their movement patterns.
- Determine what are the group characteristics and associations.
- Determine if the groups are stable or fluid in nature.
- Collaborate with Southern California studies to determine if this is an "open" population with mixing and interchange between north and south.

Project Title:

Coastal bottlenose dolphin tandem aerial surveys ('94, '99, '00 anticipated).

Investigators: James V. Carretta, Karin A. Forney, and Jay Barlow.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Synopsis of research:

- Aerial surveys are conducted using tandem aircraft between the U.S. Mexico border and approximately Santa Cruz to estimate the abundance of coastal bottlenose dolphins.

Project Title:

Harbor porpoise aerial surveys ('95, '97, '99, '01 anticipated).

Investigators: Karin A. Forney, James V. Carretta, and Jay Barlow.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Synopsis of research:

- Bi-annual aerial surveys are conducted in central and northern California to monitor trends in abundance of harbor porpoise.

Project Title:

Mortality estimation for Monterey Bay area set gillnet fishery ('99, '00 anticipated).

Investigators: Karin A. Forney, Grant Cameron, and Jay Barlow.

Agencies / Institutions: NOAA / NMFS / Southwest Fisheries Science Center.

Synopsis of research:

- Fishery observer data are used to estimate bycatch of marine mammals and seabirds in the Monterey Bay area setnet fishery.

Project Title:

A beach monitoring program to assess natural and anthropogenic changes in populations of birds, mammals, and turtles in the Monterey Bay National Marine Sanctuary.

Investigators: Scott R. Benson, Andrew P. De Vogelaere, and James T. Harvey.

Agencies / Institutions: Moss Landing Marine Laboratories and Monterey Bay National Marine Sanctuary.

Synopsis of research:

- A beach monitoring study, utilizing volunteers to sample selected sections of beach for dead marine birds and mammals, was established within the MBNMS in February 1997.
- The primary goal of the program, designated Beach COMBERS (Coastal Ocean Mammal / Bird Education and Research Surveys), is to obtain information on rates of stranding of all species of birds and mammals in the greater Monterey Bay region. The geographic range of this study is expanding.
- A separate weekly survey was conducted to investigate the effects of time of day and tidal cycle on deposition rates and to provide weekly information on persistence times of carcasses.
- The latest report, summarizing data through 1998, is available at **Error! Reference source not found.**

Project Title:

Beach Watch Program.

Investigators: Jan Roletto, Leslie Grella, and Tom Ryan.

Agencies / Institutions: Gulf of the Farallones National Marine Sanctuary.

Synopsis of research:

- The Beach Watch program (since 1993) is a long term, baseline monitoring project implemented by volunteers and administered through the Gulf of the Farallones National Marine Sanctuary.
- The area of operation is from Bodega Head to the San Mateo-Santa Cruz County line, and includes a portion of the Monterey Bay National Marine Sanctuary.
- The program goals are to: 1) educate the public about the coastal environment; 2) encourage the public that they can make a difference in protecting their beaches; 3) assist the Sanctuary in the early detection of natural and human-caused environmental pertubations such as cold water events and oil spills; 4) provide a baseline of information on the average presence of live and beachcast marine organisms; and 5) develop a network of local experts who can document and discuss the natural changes a beach will undergo over a period of several years.

Project Title:

Marine mammal stranding network.

Investigators: Jim Harvey and Dave Casper.

Agencies / Institutions: Moss Landing Marine Laboratories and Long Marine Laboratory.

Synopsis of research:

- Document and investigate marine mammal strandings in Monterey and Santa Cruz counties as part of national marine mammal stranding network program.
- Collect life history data and perform necropsies on stranded marine mammals.

Successful collaborations with the Monterey Bay National Marine Sanctuary

This is a partial list of collaborations that regional scientists found useful in working with the Monterey Bay National Marine Sanctuary. Additional comments are welcome.

- Completing a MBNMS Site Characterization (http://bonita.mbnms.nos.noaa.gov/sitechar/index.html).
- Use of NOAA ships for critical marine mammal habitat assessments and sea otter studies.
- Funding for ship and plane surveys to enhance pelagic and coastal surveys.
- Developing a MBNMS Beach COMBERS monitoring program.
- Science and management of set gillnet by-catch.
- MBNMS Beach COMBERS & CDFG: Necropsies of beachcast seabirds and seabirds caught incidentally in set gillnet fishery.
- 1998 HAB assessment: from plankton to sea lions.
- Facilitating collaboration across disciplines with the Sanctuary Currents Symposium and MBNMS Research Activity Panel.
- Providing office space and equipment.
- Writing letters of support to funding agencies.

Critical Questions to address

(in addition to existing work!)

This is a partial list of critical resource management questions suggested to MBNMS by regional scientists. Of course, all ongoing work in this document is considered important. Additional comments are welcome.

- Complete a comprehensive monitoring program for marine mammals.
- Understand links between climate variability, nearshore productivity and marine mammal populations.
- Understand links between regional nitrate loading and harmful algal blooms.
- Assess/find ways to minimize by-catch from the set gill-net fishery.
- Determine cause of the southern sea otter population decline.
- Development of ecosystem health indices, complete a retrospective study.
- Assess the effect of vessel traffic on marine mammals.

Future Research Needs and Requests

This is a partial list of research needs and requests made by scientists working in the Monterey Bay National Marine Sanctuary. Additional comments are welcome.

- Continue/more ship and plane time.
- Develop an equipment/supply pool for multi-institutional use (e.g., cameras, CTD, GIS, fuel, film).
- Develop graduate student fellowships.
- Develop directories of potential funding groups.
- Streamline permit processes with other agencies.
- Serve as a central location for databases on environmental conditions, maps, and marine mammal distribution and abundance monitoring data - facilitate sharing information.
- Increase broad based dialog between scientists, environmental groups, user groups and resource managers.
- Develop cross-Sanctuary plans in California for species that range between them (e.g., whales and krill at upwelling centers).
- Expand geographic range of the Beach COMBERS program and pelagic surveys.
- Minimize ecotourism impacts in Elkhorn Slough.

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