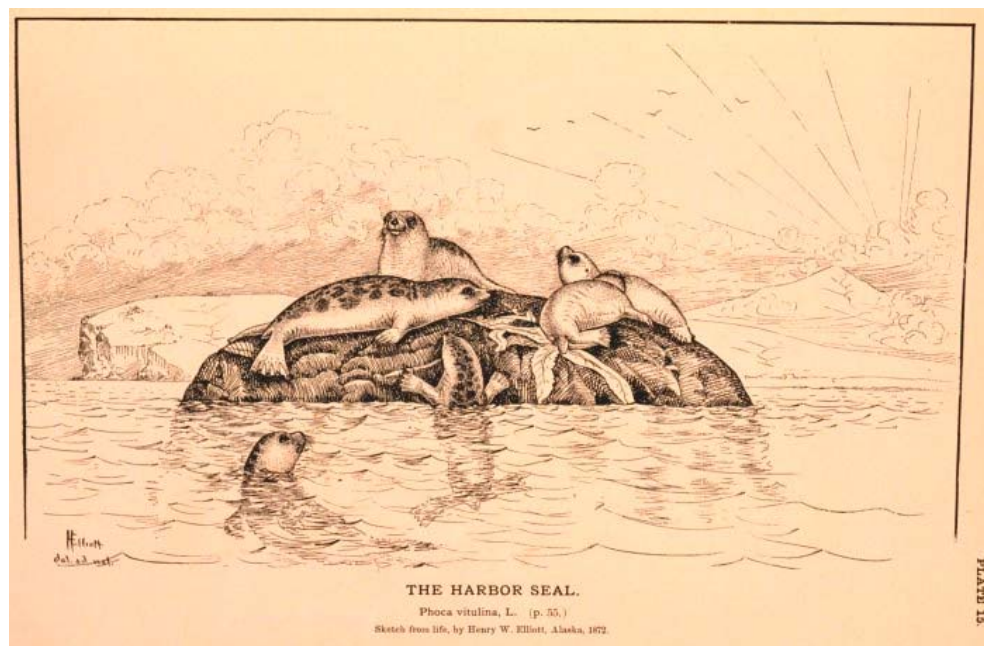


DRAFT

PINNIPED LONG-TERM MONITORING PROGRAM

San Francisco Area Network of Parks



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SUMMARY

The purpose of this document is to describe the National Park Service's monitoring program for pinniped (see Appendix 4 for definition) populations that occur within the San Francisco Bay Area Network (SFAN) of parks in central California. Protocols document standardized objectives, methods, and data management to enable high quality evaluation of pinniped population status in the region. Oakley et al. (2003) provided guidance in the development of this protocol. The main purpose of the program is to monitor pinniped population status and trends and to adaptively guide management actions.

The numerically dominant pinniped species that breed, haul-out, and molt in the region include the Pacific harbor seal (*Phoca vitulina richardii*), northern elephant seal (*Mirounga angustirostris*), California sea lion (*Zalophus californianus*), and Steller sea lion (*Eumetopias jubatus*). On occasion, northern fur seal (*Callorhinus ursinus*) and Guadalupe fur seal (*Arctocephalus townsendi*) are reported at Point Reyes sites, although they do not occur regularly.

Survey effort focuses on species that breed in the parks because this information contributes significantly to the regional and stock-wide understanding of these species required under the Marine Mammal Protection Act (1972). Other species are monitored at lower levels, although efforts may shift depending on changes in habitat use.

Specific objectives of the long-term monitoring program are to:

1. Determine the population size, distribution, reproductive success, and population ecology of pinniped populations that depend on resources within the SFAN of parks;
2. Provide an early warning of abnormal conditions and impairment of the marine ecosystem and of pinniped populations;
3. Provide better data to understand the dynamic nature of the marine ecosystem;
4. Provide information in various formats on status and trends to the public, National Park Service resource managers, other resource agencies and academic institutions.
5. Provide a means for measuring progress towards performance goals and objectives.

Coordination with other agencies is necessary to protect these species because their movements during migration, foraging, and molting range outside park boundaries. Protocols will be integrated with other resource agencies for compatible population analysis. The SFAN monitoring program contributes to California State and U.S. National efforts to assess pinniped population status and trends.

I. INTRODUCTION

Monitoring Justification

The San Francisco Bay Area Network (SFAN) is one of eight networks in the Pacific West Region (PWR) of the National Park Service (NPS). The NPS National Inventory and Monitoring Program (I&M) in 1998 created “networks” or groupings of parks in order to develop common methodologies for data comparability, to reduce the level of effort, and to share resources. The units in the SFBAN that encompass resources utilized by pinnipeds (seals and sea lions) include Golden Gate National Recreation Area (GOGA) and Point Reyes National Seashore (PORE). One other park unit in the PWR has a pinniped monitoring protocol, the Channel Islands NP (CHIS; DeMaster et al. 1988).

In 1992, the NPS I&M Program developed a national policy “to better understand their dynamic nature and condition” of natural resources, to detect or predict changes that may require intervention, and to serve as reference points for more altered parts of the environment. By integrating this information into NPS planning, management and decision-making, scientific knowledge of natural resources will improve NPS stewardship of our heritage lands (NPS 75: Natural Resources Inventory and Monitoring Guideline 1992).

Marine mammals, particularly pinnipeds, were selected by the SFAN to monitor and ranked the pinniped guild as number 10 on the vital signs indicator list. The ecosystem conceptual models developed for the SFAN include pinnipeds as an indicator of the marine ecosystem (SFAN Phase II Report of the Monitoring Plan, Figure 2.3). Pinnipeds are one of the few species that inhabit both marine and terrestrial ecosystems; they forage and travel in the coastal waters of the parks but come onshore to rest, breed and molt. They reside in estuaries such as Drakes Estero, in rocky intertidal zones such as Point Bonita, along pocket beaches in wilderness areas such as Tomales Point, in research natural areas such as Point Reyes Headland and on islands such as Alcatraz. Pinnipeds are sensitive to changes in the marine ecosystem and respond quickly to changes in prey abundance and distribution.

General conservation concerns of pinniped populations (SFAN Phase II Report of the Monitoring Plan, 2003) include: 1) protect marine mammals, threatened and endangered species, and other sensitive natural resources and 2) provide an early warning of ecosystem condition based on exposure of marine mammals to climate change, human disturbance, oil spills, or fishing activities (operational and biological). Additionally, other important concerns include natural and anthropogenically enhanced toxic blooms, preservation of haul-out habitats, biomagnified contaminants, and disease.

The pinniped guild was specifically selected for monitoring because:

1. Pinnipeds come under the legal mandates related to the Endangered Species Act (1973) and Marine Mammal Protection Act (1972; MMPA),

2. Marine mammals are specifically identified in the enabling legislation of and management objectives of PORE (SFAN Phase II Vital Signs Monitoring Plan 2003),
3. Pinnipeds are good indicators of the condition of the marine ecosystem because they respond quickly to oceanic conditions, and
4. There is a long history of monitoring pinnipeds at PORE and GOGA in collaboration with other agencies and organizations.

Seals are also heroic species that are of great interest to the public. Tens of thousands of visitors come to the parks every year just to observe marine mammals, including seals.

Legal mandates

The NPS shares a mandate with National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) to protect marine mammal populations. Several federal laws and executive orders provide legal direction and support for expending funds to determine the condition of pinniped populations in parks:

- Coastal Zone Management Act (1972)
- Endangered Species Act (16 USCA 1531 et. seq., 1973, amended in 1982)
- Executive Order 11900 (Protection of Wetlands)
- Fish and Wildlife Act (16 USCA 742a et.seq., 1956)
- Fish and Wildlife Coordination Acts (16 USCA 661 et.seq., 1958, 1980)
- Magnuson Fishery Conservation and Management Act (16 USCA 1801 et.seq., 1977)
- Marine Mammal Protection Act (16 USCA 1361 et.seq.; amended 1972 and 1994)
- Marine Protection, Research and Sanctuaries Act (33 USCA 1401 et.seq., 16 USCA 1431 and 1431 et.seq., 1972)
- Natural Resource Protection Act (1990)
- National Environmental Policy Act (PL 91-190 as amended) 1969)

The National Parks Omnibus Act of 1998 includes congressional mandate for Parks to provide information on the long-term trends in the condition of their natural resources.

The Endangered Species Act (ESA; P.L. 93-205) mandates the protection of all threatened, endangered, or candidate species as well as their critical habitats within park boundaries. The Marine Mammal Protection Act of 1972 (MMPA; P.L. 92-522 as amended by P.L. 93-205, 94-265, 95-136, and 97-58) and reauthorized on April 30, 1994 (P.L. 103-238) supplements ESA, providing special protection for all marine mammals of the Seashore. MMPA states that it is unlawful to "harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill". The law places much emphasis on protecting species and population stocks in danger of extinction or depletion above a level (to be determined) at which they cease to be a significant functioning element of the ecosystem. Particular

emphasis was placed on protecting rookeries, mating grounds and areas of similar significance. In 1994, the NMFS proposed guidelines on distances of approach to marine mammals so that their behavior would not be altered (Fed. Reg. vol. 57:149, pp. 34121-22).

Enabling legislation

The Golden Gate NRA (GOGA) was authorized by Congress as a unit of the National Park Service in 1972 (Public Law 92-589). The enabling legislation of the park stated that the new park's purpose was, "to preserve for public use and enjoyment certain areas on Marin and San Francisco Counties, California, possessing outstanding natural, historic, scenic, and recreational values..."

The Point Reyes National Seashore (PORE) was authorized by Congress as a unit of the National Park Service in the Act of September 1962 (Public Law 87-657), and was officially established in October 1972 (P.L. 92-589). The statement of purpose for the park in this law calls for the preservation and protection of the diminishing seashore of the United States for "public recreation, benefit and inspiration."

The Wilderness Act of 1976 (P.L. 95-544) established 25,370 acres of wilderness and 8,003 acres of potential wilderness in the Point Reyes National Seashore, thereby adding special protection. The Wilderness Act also amended the Seashore enabling legislation (P.L. 87-657) to include:

"...without impairment of natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area."

A primary objective of resource management stated in the General Management Plan of the Seashore (1980) is "to protect marine mammals...and other sensitive resources found within the Seashore." The revised Statement of Management (1993) specified several natural resources management objectives including, but not limited to:

"To identify, protect and perpetuate the diversity of existing ecosystems which are found at Point Reyes National Seashore and are representative of the California seacoast.

"To enhance knowledge and expertise of ecosystem management through research and experimentation programs relating to wildlife,... regulation and control of resource use, and pollution control.

As noted in the 1993 Statement for Management of PORE, the enabling legislation "affects seashore management in the ocean shore areas by: 1) requiring personnel and funding to monitor populations and activities within the Seashore; 2) generating meetings and discussions and action plan coordination between different agencies and organizations; 3) suggesting the inclusion of information in interpretive programs and

handouts; and 4) requiring the fabrication and installation of regulatory and informational signs."

Indicator of ecosystem condition

Pinnipeds are apex predators of the marine ecosystem and numerous dynamic processes interacting together have the potential to affect their abundance, species composition and distribution. Changes in pinniped abundance, species composition and distribution may be influenced by changes in food supply, disease, disturbance by park visitors (commercial and recreational users), interspecies interactions, or environmental factors on multiple scales (from localized storm events to decadal shifts in climate; Figure 1).

The collective knowledge gained about the recovery of pinnipeds since passage of MMPA has been possible due to long-term monitoring programs that provide information at temporal and spatial scales and that allow accurate interpretation of measured trends and responses to environmental change. Information gained at PORE and GOGA contributes to predicting how recovered or disappearing populations will influence the ecosystem structure and productivity of this region. The targeted monitoring scale includes annual investigations into the health and habitat use by pinnipeds to detect immediate effects of environmental changes and to manage adaptively to reduce negative interactions.

Long-term investigations are necessary to understand population-level responses to such events as EL Nino Southern Oscillation (ENSO), regime shifts, Pacific Aleutian Low events, introduced, sporadic or chronic disease, localized storms affecting habitat, and climatic change. Researchers have recently identified changes in oceanic conditions termed "regime shifts" that are characterized by shifts in prey distributions that will affect pinnipeds (Francis and Hare 1994). Long-term investigations include: 1) the survivorship of pups to breeding age (depending upon the species and sex), 2) the life span of reproductive females (15-20 yrs, depending upon species), and 3) the life span of reproductive females through generations (20+ yrs).

At a regional scale, long-term studies can help interpret potential population responses to management strategies. Bolinas Lagoon is rapidly changing in shape due to siltation, which alters haul-out space and prey availability. Fisheries management by state and federal agencies has altered activities in the region with preliminary designation of Marine Protected Areas (MPA) by the California Department of Fish and Game (CDFG), and with restrictions on gillnetting, trawling and take of certain species of rockfish. New studies in Tomales Bay are illuminating concerns of contamination from the Gambonini mercury mine and land use changes (US Environmental Protection Agency, administrative history).

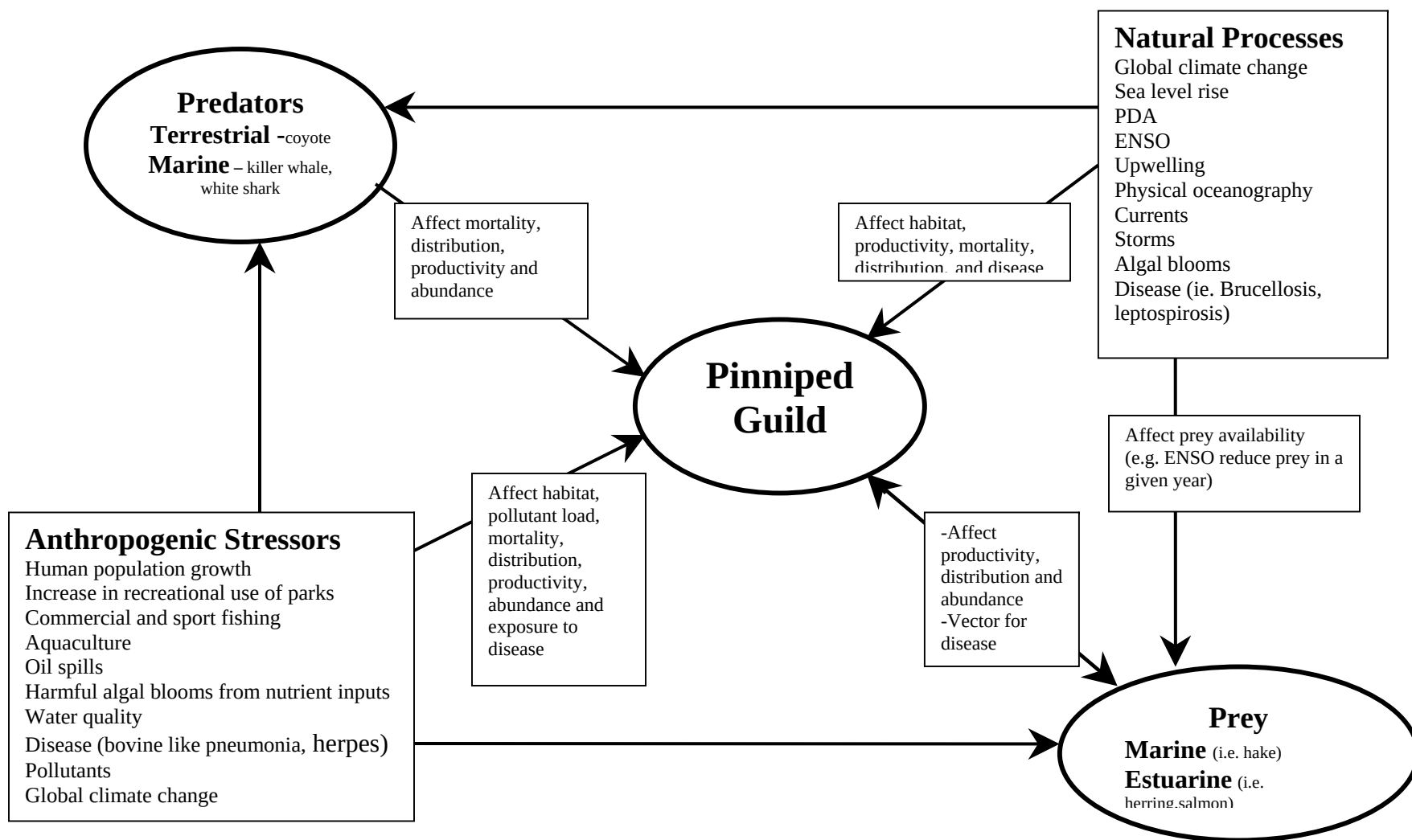


Figure 1. Conceptual model of pinnipeds of the marine ecosystem.

History of monitoring

For harbor seals and northern elephant seals, there are impressive time-series from PORE sites (25+ years) and nation-wide (Sydeman and Allen 1999, Forney et al. 2002).

The California Department of Fish and Game, Minerals Management Service and National Marine Fisheries Service have independently and collaboratively inventoried and monitored pinnipeds along the Pacific coast of the continental United States since the 1920s (Bonnot 1928, Bonnell et al. 1979, Miller et al. 1982); however, these studies were limited to aerial surveys, and did not include ground-based monitoring.

Researchers from the University of California initiated ground-based surveys of harbor seals at PORE in association with surveys in San Francisco Bay in the mid-1970s (Risebrough et al. 1978). The Point Reyes Bird Observatory conducted an inventory of pinnipeds at PORE in the 1980's and began monitoring in conjunction with their monitoring program on the Farallon Islands when elephant seals colonized Point Reyes (Allen and Huber 1984 and 1986, Allen et al. 1989). A collective of volunteers from various organizations and agencies continued monitoring pinnipeds at Point Reyes between 1990 and 1995. In 1995, NPS initiated a standardized monitoring program (Allen et al. 1996, Sydeman and Allen 1999). This document represents the first effort, however, to formalize monitoring protocols for pinnipeds in the region.

Monitoring history of pinnipeds and related indicators

Monitoring Program	GOGA	PORE	Agencies/partners
Harbor seals	26	27	PRBO, NPS, NOAA, CDFG
Northern elephant seals		24	PRBO, NPS, NMFS
Steller and California sea lions		14	NPS, NMFS
Stranded marine mammals	10+	25+	NMFS, MMC, MVZ, CAS
Wildlife diseases (several)		8	NPS, UCD
Weather		38	NPS, NOAA
Nearshore productivity (CODAR)		3	UCD
Pacific herring	25	25	CDFG
Coho salmon and steelhead trout	10	7	NPS, CDFG, NMFS

CDFG=California Department of Fish and Game; MMC=Marine Mammal Center; MVZ=Museum of Vertebrate Zoology; NMFS=US National Marine Fisheries Service; NOAA=US National Oceanographic and Atmospheric Administration; NPS=National Park Service; PRBO=Point Reyes Bird Observatory; State=California state agencies; UCD=University of California at Davis; USGS=US Geological Survey.

Much has been learned at the parks from such monitoring, particularly regarding the recovery of northern elephant seals and harbor seals since passage of the Marine Mammal Protection Act (see Program Products Appendix 3). Managers at PORE have developed an adaptive management program, structured to collect long-term population

data and respond to shifts in distribution and haul-out use patterns in order to protect the species.

PORE has adaptively managed harbor seals based on monitoring change of population numbers and annual productivity at several seal colonies. Seal numbers have changed at each site because of various stressors including predation by coyotes, human disturbance and climatic events. The park responded adaptively with different strategies for management ranging from no-action to seasonal closures.

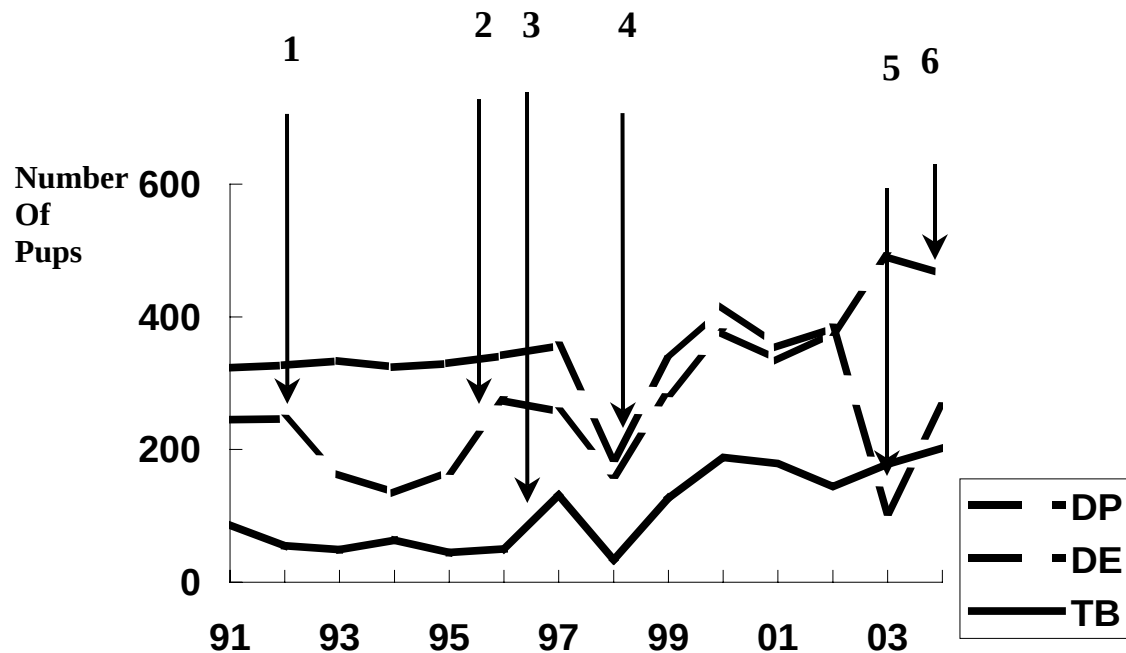


Figure 2. Adaptive management of harbor seals at three colonies at Point Reyes (DP=Double Point, DE=Drakes Estero, TB=Tomales Bay). Numbers above arrows refer to 1=kayak increased use at DE; 2=limited closure at DE; 3=NOAA education program at TB; 4=ENSO climate event affects all sites; 5=aggressive male elephant seal at DP; 6=coyote predation at DE.

Monitoring Questions

In the SFAN Phase II Report on Monitoring (2003), specific monitoring questions were identified for pinnipeds. They include:

- What are the status and trends of the pinniped guild?
- What is the natural level of variation in the pinniped population distribution and abundance?
- Are selected pinnipeds reproducing successfully?

- Climate change/altered disturbance regimes: Does climate change and changes in ocean condition affect distribution and productivity of pinnipeds?
- Land/resource use: Does human activity affect distribution and productivity of pinnipeds?

Other monitoring questions that are linked to pinnipeds, and together, provide information on the status of the marine ecosystem include the following:

- Seabirds - Is climate change affecting the species diversity, distribution and abundance of seabirds? Are human activities affecting the distribution, abundance and productivity of seabirds? Where and what species of seabirds are vulnerable to oil spills, fishing effort?
- Pelagic wildlife - Is climate change affecting the species diversity, distribution and abundance of pelagic wildlife? Where and what species of seabirds are vulnerable to oil spills, fishing effort?
- Marine oceanography - Is climate changing?
- Marine and estuarine fish - Is climate change affecting the species diversity, distribution and abundance of marine fish? Are human activities, including fishing, affecting the distribution, abundance of marine fish? Where and what species of marine fish are vulnerable to oil spills, fishing effort?
- Wildlife diseases - What diseases are endemic to the population (baseline data)? Do these diseases fluctuate in incidence, virulence, and presentation? What is population or species wide effect of the disease? What are risks to other species, including man?
- Cetaceans - Is the presence/absence and abundance of cetaceans changing at the parks? Is human activity such as fishing boats or pleasure boats affecting the presence/absence of cetaceans? Is climate change affecting the presence/absence of cetaceans?
- Marine water quality - Are the baseline levels of core water quality parameters changing? Are levels of contaminants decreasing? Are water quality levels in compliance with beneficial uses? What are the trends in water quality parameters?
- Coastal processes - Is the shoreline changing? Is the mean sea level changing?
- Subtidal habitat - Is distribution, relative abundance, species composition changing in the sub-tidal habitat? Does climate change affect the distribution, composition of sub-tidal species? What is the natural level of variation in marine sub-tidal species distribution, species composition and relative abundance?

Monitoring Goals and Objectives

Monitoring of pinnipeds will address the overall goals and objectives for “vital signs” monitoring as described in the SFAN Phase II Report (2003). The overall goals of the Pinniped Long-term Monitoring Program are to:

1. Determine the population size, distribution, reproductive success, and population ecology of pinniped populations that depend on resources within the SFAN of parks, and thereby, the condition of the marine ecosystem;

2. Provide an early warning of abnormal conditions and impairment of the marine ecosystem and of pinniped populations;
3. Provide better data to understand the dynamic nature of the marine ecosystem;
4. Present a means for measuring progress towards performance goals and objectives.

For measuring performance, the following specific GPRA goals are achieved by pinniped monitoring:

Resources protected, restored and maintained	Ia
Improving federal T&E species with critical habitat are improving	Ia2A
Stable federal T&E species with critical habitat are improving	Ia2B
Unknown federal T&E species with critical habitat have improved status	Ia2D
Species of concern populations are at scientifically acceptable levels	Ia2X
Preserve and protect standards for museum collections	Ia6
Visitor understanding	Iib1
Education programs and understanding of natural and cultural heritage	Iib1X
Data systems integrated	IVa1
Volunteer hours	IVb1

The overall management objectives, as defined in the SFAN Phase II Report (2003), are both general and specific to marine mammals.

Golden Gate NRA	• Maintain and restore the character of natural environmental lands by maintaining the diversity of native park plant and animal life, identifying and protecting threatened and endangered species, marine mammals, and other sensitive natural resources, controlling exotic plants and checking erosion whenever feasible.
Point Reyes NS	• Identify, protect, and perpetuate the diversity of existing ecosystems, which are representative of the California seacoast. • Preserve and manage wilderness. • Protect marine mammals, threatened and endangered species, and other sensitive natural resources found within the seashore. • Retain research natural area status for the Estero de Limantour and the Point Reyes Headlands. • Manage seashore activities in the pastoral and

	estuarine areas in a manner compatible with resource carrying capacity. • Enhance knowledge and expertise of ecosystem management through research and experimental programs that provide sound scientific information to guide management relating to wildlife, prescribed burning techniques, exotic plant and animal reduction, regulation and control of resource use, and pollution control. • Monitor mariculture operations, in particular, the oyster farm operation in Drakes Estero, in cooperation with the California Department of Fish and Game.
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Specific Management Objectives

Specific management objectives fall into two categories threshold/target objectives and condition/trend objectives (Elzinga et al. 1998; see glossary). Specific management objectives will vary by species and will meet certain assumptions regarding the inherent variability of the data. The assumptions for the pinniped guild data are: 1) the survey frequency captures the normal range of variability during the season of importance (i.e. breeding, molt), 2) the survey frequency captures the population maximum during the season of importance (i.e. breeding, molt), 3) all primary survey sites are included in the analyses, and 4) the survey frequency captures the potential effects of natural and anthropogenic stressors. (For more explanation, see Elzinga et al. 1998).

The threshold/target objectives for the pinniped guild are as follows:

- Detect any change in the number of primary colony sites of harbor seals within a year
- Detect any change in breeding/molting sites of elephant seals within a year
- Detect any new breeding site of Steller or California sea lions within a year
- Detect mass stranding of any marine mammals (see NMFS website http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/mmhsrp.html for details)

The condition/trend objectives for the pinniped guild are as follows:

- Detect a 25% reduction in the productivity of harbor seals in one season
- Detect a 25% change in the productivity of northern elephant seals in one season
- Detect a 25% change in the abundance of northern elephant seals in one season
- Detect a 50% change in the abundance of California sea lions in one year
- Detect 50% change in the abundance of Steller sea lions in one year.

A management action might be initiated if any of the above threshold or trend objectives is detected. For example, if a new elephant seal colony forms in a given year, the parks would close the area to the public in order to protect female seals and pups from human disturbance and exposure to dogs.

Setting and Study Area

Study Area

Point Reyes National Seashore (PORE) and Golden Gate National Recreation Area (GOGA) are situated north and south of San Francisco Bay in Marin and San Francisco Counties, California (Figure 2). PORE was established in 1962 and has one of the most accessible congressionally designated wilderness areas in the United States (71,046 acres

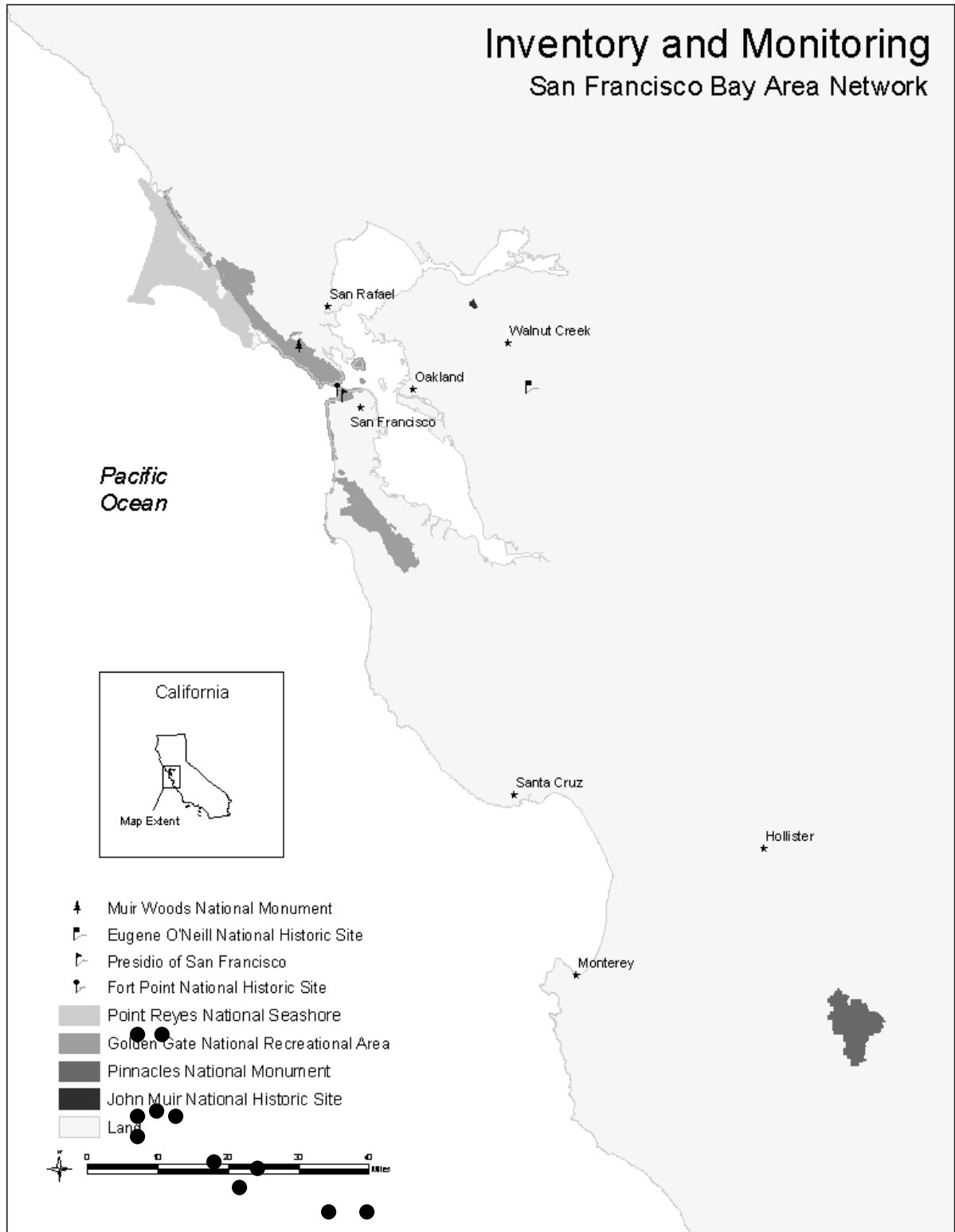


Figure 3. Study area and primary seal colony sites in the parks.

Pinniped guild

Six pinniped species occur regularly in central California to breed, migrate through or rest onshore (see species accounts Appendix I). The species that have been documented breeding in the SFBAN include the harbor seal (*Phoca vitulina richardii*) and northern elephant seal (*Mirounga angustirostris*). The five numerically dominant species that haul-out and molt in the region include harbor seal, northern elephant seal, California sea lion (*Zalophus californianus*), northern fur seal (*Callorhinus ursinus*), and Steller sea lion (*Eumetopias jubatus*). Guadalupe fur seals (*Arctocephalus townsendi*) have been reported at Point Reyes, although they occur only incidentally. Other species (California sea lions) may breed in the future in region and some species, particularly northern fur seals, likely dominated coastal sites historically. In 2003, one California sea lion pup was born at PORE, and the breeding range of this species has been expanding north over the past decade (NPS, unpubl. data). Steller sea lions are listed as federally threatened and historically bred up until the 1970's at PORE but this species is declining in the region (Sydeman and Allen 1999, Hastings et al. 2002). Tens of thousands of northern fur seals forage offshore in central California; however, in 19xx, a small group of fur seals recolonized the Farallon Islands, and the occurrence of fur seals at PORE may increase in the future (Pyle et al. 19xx). Guadalupe fur seals are listed as a federally and state threatened species and breed on Guadalupe Island, Mexico.

Scammon described northern elephant seals at Point Reyes during early sealing voyages in the early 1800's, but by the late 1800's, the species was extirpated from the region and nearly extinct (Scammon 1874, Le Bouef and Laws 1992, Allen et al. 1989). The seals were hunted for their blubber for cooking and heating oil. By the late 1800's, the species only occurred on Guadalupe Island, Mexico. From that small colony of less than a few thousand animals, the current population grew to nearly 170,000 seals after receiving protection from the Mexican and US governments.

Most pinniped populations in California are still recovering from a long period of exploitation that did not end until the passage of the MMPA. Two species, the northern elephant seal and Guadalupe fur seal, were over-hunted to the verge of extinction (Twiss and Reeves 1999). Harbor seals and California sea lions were hunted with a bounty fee provided by the California Department of Fish and Game (DFG) prior to MMPA and sea lions were hunted for dog food on the Channel Islands NP up until the 1960s.

Harbor seals, California sea lions, northern fur seals, and northern elephant seals have increased in number and distribution at California rookeries over the past two decades (Marine Mammal Commission 2001, DFG 2001, Sydeman and Allen 1999). An exception is the Steller sea lion, populations have declined sharply throughout their range in just the last 20 years, and the population from California to southeastern Alaska is currently classified as threatened under ESA (Hastings et al. 2002, Sydeman and Allen 1999). In California, the Steller sea lion population has slowly declined to about 1,500 and less than 20 at PORE (Hastings et al. 2002, Sydeman and Allen 1999).

Overview of Monitoring Programs

The monitoring program sampling design is based on protocols developed over several decades by the National Marine Fisheries Service (NMFS) and modified to regional conditions and requirements (Eberhardt et al 1979, Le Boeuf and Laws 1992, Forney et al. 2002). The regional design is based on the seasonal occurrence of each species (see species profiles Appendix I), the data required to assess population condition and the need to adaptively manage the resource. Additionally, the program limits the level of invasive methods to maintain low levels of disturbance from research activities.

Operationally, the program must also consider the personnel effort, other staff resources, volunteer coordination, and budget constraints. In response to sporadic events, other monitoring may be conducted and/or efforts shifted (i.e. mass stranding event, disease outbreak, storm damage, and aberrant interactions among species/individuals).

To achieve these goals, there are four specific programs for pinniped monitoring:

- Harbor Seal Population,
- Elephant Seal Population,
- All Pinniped Species Habitat Use, and
- Partner of the National Marine Mammal Stranding Network (NMMSN; <http://swr.nmfs.noaa.gov/>; Twiss and Reeves 1999).

Sampling Design and Parameters monitored

Population Size

Assessing the number of individuals is complex given pinniped natural history and vulnerability to disturbance. Not all individuals are hauled-out and visible at one time, making complete direct counts impossible. Common methods for censusing pinnipeds include direct counts of a population subsample or index from ground/boat/aerial observations and mark-recapture methods to estimate population size (Eberhardt et al. 1979). Standard protocols have been used by the NMFS for decades to conduct population stock assessments and are the basis for protocol development on the Channel Islands (DeMaster et al. 1988) and at the Farallon Islands (Sydeman and Allen 1999) and PORE (Allen et al. 1983 and 1989).

As an index of regional population status at PORE and GOGA, the number of individuals, by age class and gender, if possible, is quantified annually for each species. Status of northern and Guadalupe fur seals are represented in strandings, as they do not haul out regularly on coastal beaches at this time. The proportion of the entire “stock”, as determined by NMFS stock assessments, that utilize SFBAN habitats can then be evaluated and management and program resource allocation wisely directed (Barlow et al. 1992 and 1993, DeMaster et al. 1988).

Distribution

Due to inaccessibility of many coastal sites for pinnipeds, shifts in breeding and non-breeding habitats can go undocumented without regular surveys (Forney et al. 2000). In addition to tracking range shifts for protection, these shifts also contribute to our understanding of how populations contract and expand in response to environmental

changes. Haul-out sites are documented annually, and mapped periodically, to assist in assessing shifts in distribution.

Reproductive Success

The productivity or reproductive success of a population can be measured and defined in several ways. At SFBAN sites, the most accurate data that can be collected without disturbance is direct ground counts of pups and females at haul-out sites. Using appropriate correction factors, an index of reproductive success is calculated annually by site for harbor seals and northern elephant seals (Eberhardt et al. 1979, Le Bouef and Laws 1992, Sydeman and Allen 1999, Forney et al. 2002). Some data are also collected on pup mortality, survivorship to weaning, and lifetime pup production of marked females (Eberhardt et al. 1979, DeMaster et al. 1988, Huber et al. 1985).

Population Ecology

Understanding the pattern of relations between organisms and their environment (abiotic and biotic, environmental and anthropogenic) is a necessary goal for population management. These relationships are complex for pinnipeds and patterns vary by species and season. The effort expended to collect ecological and anthropological data at SFBAN sites varies and is often the outcome of collaborations with other researchers and resource agencies. Sampling designs are based on standard methods developed over several years (Huber et al. 1985, Allen et al. 1984 and 1989, DeLong et al. 1999, Sydeman and Allen 1999).

Examples:

- Recruitment - information on origin of recruiting individuals gathered from resighting tagged/marked individuals
- Survival - tagging and resighting effort designed to calculate indices of survival
- Phenology - Frequency of censuses designed to track timing of arrival, departure, molt, and breeding.
- Disturbances - Sources and occurrences of potential and actual disturbances to seals are recorded from direct observations during censuses.
- Environmental variables - parameters collected remotely and locally.

Although not a component of the current protocol, some relationships, such as trophic requirements, are extremely valuable and information would enhance the program and our management. Standardized protocols for measuring diet from collected feces may prove valuable for long-term assessments, but samples are only collected opportunistically now (Harvey et al. 19xx). Some species forage locally, harbor seals, while others, such as northern elephant seals, feed mainly in the central north Pacific.

In addition to population size indices, CHIS also focuses on indices of “condition”, such as pup weight at weaning and adult weight upon arrival (DeMaster et al. 1988, Reynolds and Rommel 1999). This is not a goal of pinniped monitoring at SFBAN due to the level of disturbance and expense necessary to collect such data. However, through the stranding network, the parks are monitoring health parameters. Opportunistically, the parks are collecting blood, tissue and other tissue from stranded or captured (tagged)

seals to be used as reference data on health (Gulland et al. 1997, Neal et al. 20xx. Most dead marine mammals, including pinnipeds, are necropsied by the National Marine Mammal Stranding Network (NMMSN), of which PORE is a member, to determine cause of death.

III. SPECIFIC PROGRAMS

Harbor Seal Program

Program Objectives

Minimum monitoring effort includes objectives 1, 2, 3, 4a, and 4b from above.

Monitoring of diet and condition requires increased effort/funding and often more disturbance to the rookeries; therefore, they are conducted opportunistically.

1. *Monitor Population size*

- a. Conduct annual and long-term trends monitoring of population size using direct counts at standardized sites as an index of abundance.
- b. Participate in metapopulation monitoring by collaborating with other agencies to coordinate region-wide, California, and national surveys during breed and molt seasons.

2. *Monitor Distribution*

- a. Document the breeding distribution of harbor seals at PORE and GOGA. Pupping sites need special protection and management. Pupping locations can shift in response to chronic disturbances, accessibility, habitat changes, and immigration. New sites will be identified with GPS locations and entered into the pinniped GIS database.

3. *Monitor Reproductive Success*

- a. Annual pup production by site as an index of annual reproductive success using direct counts of pups at each of the sites monitored. The maximum pup count and date will be extracted from field survey data for each site and all sites summed (see SOP 3).

4. *Monitor Population Ecology*

Understand the patterns and mechanisms of population changes at PORE and GOGA, and in context of the California breeding stock.

- a. Monitor the presence and effects of disease on individuals and populations by documenting affected animals and coordinating investigations with the Marine Mammal Center, other researchers, and the National Stranding Network. Currently these data are collected opportunistically when seals are captured for research or when an unusual stranding event occurs (Gulland et al. 1997).
- b. Monitor disturbance events by researchers, as mandated by NMFS, and all other anthropogenic disturbances to understand haul-out site use and guide protection and education. These data are currently collected routinely during all surveys (see SOP 3).
- c. Annual pup mortality using direct counts to track unusual mortality events. These data are currently collected routinely during all surveys (see SOP 3).
- d. Resighting tagged individuals from other colonies and rehabilitation centers to understand recruitment, seasonal distribution, and success of rehabilitation efforts.

These data are collected opportunistically and during routine surveys. Data are submitted with the annual report to the NMFS.

e. Monitor diet opportunistically by collecting scat to identify prey of harbor seals during other research efforts and by analyzing carcasses of dead seals.

History of Program

Because of its agricultural character, much of this coastline has remained largely undeveloped, even prior to inclusion in the 1960's and 70's in PORE and GOGA. The inaccessibility of much of the area has historically afforded protection from human disruption during the seals' terrestrial resting periods; however, prior to the Marine Mammal Protection Act (MMPA), harbor seals at Point Reyes were commonly hunted by fishermen and ranchers (S. Allen, pers. comm.). After passage of the MMPA, the colonies at Point Reyes grew significantly (Allen et al. 1989, Sydeman and Allen 1999). Currently, human disturbances may be on the rise with increased recreational use of public lands. From 1997-2000, PRNS alone recorded close to 2.4 million visitors annually (Monthly Statistical Report, PRNS, 2002).

Harbor Seal populations in this region have been monitored by resource agencies, Point Reyes Bird Observatory (PRBO), and other investigators since at least the 1970s (see reports section). PORE has been monitoring and managing the population intensively and adaptively since 1995 (see figure 2).

Regionwide Coordination

California Surveys

The California Dept. of Fish and Game conducts statewide aerial surveys of Harbor Seal sites during peak molting season. Surveys are conducted on an annual basis during June, weather permitting (Hanan 1996).

The Gulf of the Farallones National Marine Sanctuary (GFNMS)

GFNMS supports a volunteer stewardship program, SEALS, to monitor harbor seal pupping sites at Bolinas Lagoon and Tomales Bay. The Program includes the presence of volunteer docents to educate visitors to these easily accessible sites and to protect the haul-out sites from disturbance. Their focus is on interpretive efforts and monitoring to determine the effectiveness of their stewardship program. The GFNMS participates in the breeding and molt season region-wide surveys, and provides the results in their annual reports (Tezak et al. 2004).

San Francisco Bay Study by San Francisco State University (SFSU)

This study is funded by Cal Trans to mitigate the effects of the San Rafael and Bay Bridges Retrofit projects. Seals are monitored four to six days per week at three locations in SF Bay depending on season. Seals are also radio, satellite and flipper tagged for tracking movements. These tagged seals frequently travel to haul out sites in the SFAN. Data on sightings and movements are shared amongst researchers. SFSU monitors during the breeding and molt season, and participates in the region-wide surveys.

Sonoma County, Russian River -California State Parks Association

Harbor seals are surveyed daily at the Russian River and during the breeding season and molt season, and this group participates in the region-wide surveys.

Sampling Design and Field Methods

Study Sites

The topographic diversity of this coastal zone provides a broad range of substrates upon which harbor seals haul out: tidal mud flats, rocky intertidal, offshore tidal ledges, and sandy beaches.

There are nine major survey sites: Double Point (3 subsites), Drakes Estero (five subsites), Limantour Estero, Tomales Point (2 subsites - Bird Rock and adjacent mainland), Tomales Bay (3 subsites), Point Reyes Headland, Bolinas Lagoon, Duxbury Reef, and Point Bonita. Most sites are in PORE, and in GOGA, the study sites are Bolinas Lagoon and Point Bonita. Duxbury Reef is in a County park and adjacent to PORE.

Observation Points

Location and access of standardized observation points for each site and subsite are described in SOP 3.

Frequency

Shore-based harbor seal surveys are conducted during the breeding and molting (shedding) seasons, which respectively run from 15 March to 1 June and 1 June to 30 July, respectively. Volunteers and park biologists survey each site a minimum of twice per week, weather and logistics permitting. During the rest of the year, select sites are surveyed once per month. Regardless of season, surveys target low to medium tides between 10:00 and 4:00 (ideally +2.0ft tide or less); the time when the maximum number of seals haul out in the San Francisco Bay region (Allen 1980, Allen et al. 1989, Fancher 1979, Grigg et al. 2002, Risebrough 1978, Stewart and Yochem 1984).

Survey period lasts at least two hours, with counts occurring every half-hour. The number of seals in the water and/or moving between sites fluctuates; therefore, multiple counts within a two-hour period better reflect the maximum number of seals present. Each subsite is surveyed separately, comprising a grand total for the site. All subsites at each site are visible from one site location with the exception of Tomales Point and Tomales Bay. The Tomales Point and Tomales Bay subsites are a considerable distance from each other, and are usually counted twice during a survey event (instead of four times at other sites).

Methods and Field Data Collection

Population data - Shore-based surveys are conducted from standardized observation points using binoculars and/or spotting scope. Trained volunteers and park biologists

conduct surveys. This program is currently dependent on an extensive volunteer program. To maintain data quality and standardization, volunteers are trained by park biologists (see SOPs 2 and 3 for training documentation) and surveys coordinated by a volunteer coordinator.

For each sub-site, the observer records the total number of adult/immature seals, pups, dead pups, red-pelage seals, fresh shark bitten animals present, and disturbance events. Because of the difficulty in distinguishing adult from immature seals, these two groups are lumped. Pup numbers are reliable only between March and June¹ because older weaned pups are difficult to distinguish from adults/immatures at a distance. Red pelage results from the deposition of iron oxide precipitates on the hair shaft and usually extends from the head down to the shoulder (Allen et al. 1993). Red pelage data are collected for comparison to other regional and national sites. In San Francisco Bay around 40% of the population has red fur; however, in coastal areas only 1% has red fur. Red fur may be associated with health, pollutant load or foraging areas.

Anthropogenic data - These data involve the number of potential and actual disturbance sources (e.g., human, dog, cattle, other). Disturbances include source, distance, and effect of activity (e.g., no response, number of seals flushed). Harbor seals are very reactive to human activities and will flush into the water when disturbed (Allen et al. 1980). If disturbances are chronic, seals will alter haul out patterns, shifting to nighttime haul out or abandoning sites completely (Grigg et al. 2002).

Environmental data - Weather data during surveys and provide information on visibility (fog), precipitation, and wind speed. These three parameters can affect the presence or visibility of seals. Other environmental data include information on sea swell, erosion of sand on beaches (captured through LIDAR surveys by USGS), and climate. Climate data include ENSO events, La Nina events, North Atlantic Decadal Oscillation, and Pacific Decadal Oscillation.

Northern Elephant Seal Program

Program Objectives

Minimal monitoring effort includes objectives 1, 2, 3, 4a, and 4b.

1. Monitor Population size

- a. Annual and long-term trends in population size by age and sex class using direct counts.

2. Monitor Distribution

- a. Annual distribution of breeding colonies - to identify expansion and contraction of colony for adaptive management and habitat protection.

3. Monitor Reproductive Success

- a. Annual colony-wide pup production as an index of annual reproductive success using direct counts of females, pups, and applying correction factors.

4. Monitor Population Ecology

Understand the patterns and mechanisms of colony growth and dispersal at PORE in context of the California breeding stock. Ecological information is necessary to guide management decisions as the population changes.

- a. Region-wide metapopulation monitoring by tagging PORE pups and resighting tagged individuals from other colonies.
- b. Annual pup mortality using direct counts - to identify local seasonal factors affecting the population.
- c. Survivorship of breeding age individuals using resighting data from PORE and other colonies.
- e. Male movements within season to understand mechanisms of dispersal and colony expansion using direct observations of seasonally dye-marked males and resighting data from PORE and other colonies.
- f. Life-time reproductive success of females by direct observations of tagged breeding females.

History of Study

In 1981, northern elephant seals reestablished a breeding colony at the Point Reyes National Seashore after being absent for over 150 years (Allen et al. 1989). The colony has rapidly grown, with seals now using multiple breeding sites within the park. In response to the increase of seals and associated park visitor interactions, an elephant seal management plan was initiated in 1995 to set guidelines for research, interpretation, and enforcement (Allen 1995). The management plan outlines management programs for issues such as disturbance, conflicts with sensitive animals and plants, and safety for both the seals and the public.

Survey methods are based on those used by the National Marine Fisheries Service on CHIS, the US Fish and Wildlife Service on the Farallon Islands and the University of California at Santa Cruz at Ano Nuevo (Barlow et al. 1993, Sydeman and Allen 1999 and Le Boeuf and Laws 1992). Survey methods over the years were modified as the PORE colony grew.

Early database structure was standardized to the USFWS Farallon Islands' study using Dbase database management software. This dataset evolved as software products became available. In 1999, an NPS created an Access dataset, which is the standard used up to the present.

Since recolonization, elephant seals were monitored a minimum of eight times per year, all years during the breeding season at all sites where present. They were also monitored during the molt season but not as intensively. Beginning in 1995, elephant seals were monitored on a weekly schedule year-round, weather permitting. New breeding sites are identified during winter months by surveying harbor seal haul out sites in the park (elephant seals will haul out with harbor seals on coastal sites) and by reports from park visitors or other researchers.

Nationwide Coordination

The NMFS annually collects data on demography, which is used for stock assessments on the number of total seals and the number of pups produced and pups weaned. The NMFS also requires an annual report from the park as part of the permit authorization. The park, in conjunction with PRBO, is working under NMFS permit number 373-1575.

Resighting data are shared amongst researchers from tagged (flipper and satellite tags) from other colonies including Piedras Blancas, San Miguel Island, Southeast Farallon Islands, and Ano Nuevo. Data on resights of tags are also shared with the NMFS as part of annual reporting. Resight data of pups tagged at PORE have been provided by other researchers from Russia, Alaska, Oregon State and Washington State. Additionally, the Marine Mammal Center shares resight data from rehabilitated seals.

Sampling Design and Field Methods

Study Sites

There are three main survey sites: Point Reyes Headlands, North Drakes Beach, and South Beach (Figure 2). There are seven subsites at Point Reyes Headlands (see SOP 6): Cove 1 (C1), Cove 2 (C2), Cove 3 (C3), Cove 4 (C4), and Tip Ridge (TIP), Loser Beach (LB), and Dead Seal Beach (DSB). There are four subsites at North Drakes Beach: North Drakes Beach (NDB), Lifeboat Station (LBS), Gus' Cove (GUS), and Chimney Rock Cove (OTH). At South Beach, there are three subsites: Lighthouse Beach (LTH), Nunes Beach (NUN), and Mendoza Beach (MEN). Incidental observations occur at other sites including Double Point, the Fish Dock at Point Reyes Headland and Abbott's Lagoon.

Observation Points

Location and access of standardized observation points for each site and subsite are described in SOP 6.

Frequency

Survey period for the breeding season extends from late November through end of March. Surveys are conducted a minimum of two times weekly at all sites, except at SLO Overlook, which is done once a week (not regularly used by pupping elephant seals). One count is conducted per survey. Tags are resighted at each site once every two weeks at minimum. During the rest of the year, elephant seals are surveyed twice per month, weather permitting at Point Reyes Headland.

Methods and Field Data Collection

Population data - Direct counts of breeding sites are conducted from beaches or fixed cliffside vantage points with the aid of a spotting scope and binoculars. Age class and gender of individuals are identified and recorded in the following categories: Bull, Male Sub adult 4, Male Subadult 3, Male Subadult 2, Male Subadult 1, Other Subadult Male, Cow, Pup, Dead Pup, Weaned Pup, Immature of unknown sex, Yearling (See Le Boeuf and Laws 1992 for age class determination). Other species noted include number of harbor seals, California sea lions, and other pinnipeds.

Beginning in 1988, weaned pups at all sites were given a minimum of one flipper tag; a second tag was applied, when possible. Individually numbered pink plastic Dalton cattle ear tags (Jumbo roto tags) are applied to sleeping or resting seals. The NMFS selected the color for PORE colony tag; NMFS coordinates the colors for each of the colonies so that movement between colonies and source populations for new colonies can be identified.

When the colony was small, >90% of the weaned pups were tagged; however, since the largest colony at PRH has grown, access is limited, and the number of pups tagged has declined to around 60-70%. At the newer colonies, access is not limited and 80-90% of pups are tagged. Opportunistically, some sub-adult and adult males are also tagged to track movement of males between breeding sites and to identify the alpha and beta males. Tag information is recorded in the field on data sheets, including date, location, size, sex, tag color, number and tag position and presence or absence of other tags.

Tag resighting is done in conjunction with other research activities while on the beach using binoculars and spotting scopes. Pertinent data are recorded including the presence of other tags or dye marks, breeding status of the seal (e.g. with pup, pregnant, alpha bull, etc.), visibility, and observer.

To accomplish the objective of monitoring male movements within a season, alpha and beta males are opportunistically dye-marked and their occurrences at PORE sites are documented in conjunction with regular surveys.

Environmental data - weather is recorded on resighting field forms and includes precipitation, cloud cover, wind speed and direction. Other environmental data include information on sea swell, erosion of sand on beaches (captured through LIDAR surveys by USGS), and climate. Climate data include ENSO events, La Nina events, North Atlantic Decadal Oscillation, and Pacific Decadal Oscillation.

Anthropogenic data – disturbance data are collected on source (e.g. human, dog, cattle, other) and on effect to seals including potential versus actual disturbances. Elephant seals are not as reactive to human disturbance as harbor seals; however, responses of seals to humans can have indirect effects on productivity due to disruption of nursing or causing males to interact.

All Species Pinniped Program

Program Objectives

1. Monitor Haul-out Use for all species, year round

Year round monitoring of all pinniped species will provide information on seasonal use patterns of mainland sites compared to the Farallon Islands. Outside the harbor seal and elephant seal breeding seasons, August thru November, surveys focus on the Point Reyes Headlands and Drakes Beach. This focus is on documenting elephant seal, harbor seal

and California sea lion population trends, as these are the dominant species at the Headlands.

Study History

CDFG and MMS conducted infrequent aerial surveys of sea lions at PORE as part of statewide surveys since the 1920s (Bonnot 1928, Bonnell et al. 1980). Between 1982 and 1987, researchers conducted a general inventory of pinnipeds in Point Reyes (Allen and Huber 1986). Beginning in 1995, the park initiated weekly surveys at Point Reyes Headland. Surveys were timed to coincide with weekly surveys on the Southeast Farallon Islands, in order to compare population trends of island versus mainland colonies (Sydeman and Allen 1999).

Regionwide Coordination

The weekly surveys are shared with the NMFS for stock assessments. These data are also relevant for ground-truthing aerial surveys during the Steller sea lion pupping season, June and July. Although Steller sea lions no longer breed at PORE, male sea lions do appear during May and June, and individuals are present year round.

Additionally, data are shared with PRBO for comparison with Southeast Farallon Island colonies (Sydeman and Allen 1999).

Sampling Design and Field Methods

Study Sites

There are three main survey sites: Point Reyes Headlands, North Drakes Beach, and Sea Lion Overlook. No sites are surveyed in GOGA.

Observation Points

Location and access of standardized observation points for each site and subsite are described in SOP 8.

Frequency

Sites are surveyed once per week by one or more observers (Park biologist or trained volunteer). Counts are conducted in the afternoons during a desired window from Thursday to Saturday to account for poor weather and visibility.

Methods and Field Data Collection

Population counts - Shore-based counts are conducted from standardized observation points using binoculars and spotting scopes. Species, age, and sex, if appropriate, are recorded.

Data Collected:

Mirounga - Separate by age class and sex (refer to form)

Phoca - total number of individuals (lumped)

Zalophus - total number of individuals (When possible, adult males are identified and

age and sex classes are lumped). The population has recently expanded to northern sites for pupping: Ano Nuevo Island and Farallones. Females likely will pup on mainland sites in the near future, and one was born at PORE in 2003. All suckling observations are recorded, as this confirms age class.

Eumetopias - total number of individuals (If possible, adult males are identified and other

age and sex classes are lumped)

Callorhinus - total number of individuals (lumped)*

Arctocephalus - total number of individuals (lumped)*

*Observations of fur seals are rare and all appropriate notes describing age class, sex, and behavior are noted to contribute to our understanding of species distribution at PORE and GOGA.

Observations of marked California sea lions are shared with NMFS and will be used to estimate survival and natality rates for the population. California sea lions were branded at San Miguel Island to continue studies of survival and natality of the population (R. DeLong, NMFS, pers. com.)

Weather – basic information on weather is collected, including visibility, precipitation. Other environmental data include information on sea swell, erosion of sand on beaches (captured through LIDAR surveys by USGS), and climate. Climate data include ENSO events, La Nina events, North Atlantic Decadal Oscillation, and Pacific Decadal Oscillation.

Anthropogenic data – disturbance data are collected on source (e.g. human, dog, cattle, other) and on effect to seals including potential versus actual disturbances. Reactivity of seals varies with species, sex and age of individuals.

Stranding Network Program

Program Objectives

1. Monitor stranded marine mammals year round

An important component of monitoring the health and status of pinniped populations is documenting stranded dead, injured, and sick animals. Levels of contaminants in marine mammals that die and wash ashore often provide a useful indicator of certain pollutants in coastal marine ecosystems, particularly pollutants that are lipophilic and are bio-magnified in marine food webs. Point Reyes National Seashore is a member of the National Marine Fisheries Service, Southwest Region Marine Mammal Stranding Network (see NOAA website

http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/mm_hsrp.html for details). The Stranding Network is linked to the Marine Mammal Health

and Stranding Response Program, which tracks various health parameters the across the nation, and PORE contributes to the National marine Mammal Tissue bank.

Additionally, PORE banks tissue with the CMMC for future analysis of baseline diseases and pollutant loads.

Two major stranding events have occurred over the past decade at PORE; in 1997 and 2000, sick and dead adult harbor seals washed ashore. The MMC, UC Davis, NMFS and the National Stranding Network documented disease as the reason for the mortality events. In one case, a newly identified virus was the cause of mortality (Gulland et al. 1997).

Regionwide Coordination

Regional Stranding Network partners include California Academy of Sciences (CAS), University of California - Museum of Vertebrate Zoology (MVZ), Marine Mammal Center and Gulf of the Farallones National Marine Sanctuary (GFNMS). GFNMS conducts a monthly regional beach-monitoring program (BEACH WATCH), which alerts NPS to any stranded marine mammals within PORE and GOGA lands. Additionally, PORE maintains a reporting form for all marine mammals that visitors or park employees document (digital form located at u:\science\stranding network\forms).

Methods and Field Data Collection

The SFBA Network follows NMFS standard protocols as part of the Stranding Network (see Geraci and Lounsbury 1993 for protocols and http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/mm_hsrp.html website). Stranding frequency data at SFBAN sites is captured from several sources including 1) NPS survey data from breeding and haul-out monitoring for elephant seals, harbor seals and all species, 2) GFNMS BEACH WATCH monthly beach surveys, 3) miscellaneous reports from visitors and NPS staff. Occurrence of disease is documented based on protocols as noted above and in collaboration with partners.

All specimens collected within the parks are vouchered with an NPS accession number, as well as a number from the collecting agency. Most specimens are housed at MVZ or CAS because of limited space at the parks.

IV. DATA MANAGEMENT, ANALYSES AND REPORTS

Data Management

Data management includes the following tasks: database design and metadata, maintenance, archiving,

Legacy Datasets

Database design and structure evolved over two decades as software and hardware improved. The original three separate databases were maintained with reduced field in Dbase up to 1995 when the data were transferred first to Excel and then to Access. These original databases are archived from the PORE server and on CD in the Science Office. In 1997, the structure was revised for productivity data and this was preserved to the present for both elephant seals and harbor seals. The elephant seal data and the all species data structure was based on that used on the Farallon Islands for productivity data and Ano Nuevo for tracking resight data. In 1997, the data structure was changed to better process resighting data. The harbor seal data structure was based on earlier versions of databases used to track productivity at Point Reyes Headland.

The primary list of legacy databases include the following:

- Pinhead.dbf – harbor seal and northern elephant seal productivity, maximum numbers of all species and upwelling index (1974-2003)
- Pinnsurvey.xls – all species at Point Reyes Headland (1995-1999)
- Tagbook.dbf – master list of elephant seal tags and resight (1988-1996)
- Phocafacts(year).xls – annual summary data for harbor seals (1993-present)
- Phoca(year).xls – survey data collected each year for harbor seals (1995-97)
- ESSurvey(year).xls – survey data collected each year for elephant seals (1995-99)
- ESresight(year).xls – tag resight data each year for elephant seals (1997-99)
- EStags(year).xls – tags applied to elephant seals each year (1997-99)

Database Design and Structure

The legacy pinniped databases were combined into a new single database designed with MS Access during the 2003/04 field seasons. The new database (pinniped.mdb) is modeled after the NPS Database Template (see details and examples in SOP 8).

Primary data sets fall into several categories:

- Number of pinnipeds censused on selected beaches.
- Resightings of tagged individuals.
- Ecology and behavioral observations.
- Disturbance documentation.
- Stranded marine mammals.
- Links to the databases of other indicators such as weather, marine oceanography and salmon.

Data Archival Procedures

Data archiving will focus on long-term storage and access through the network server with additional offsite storage being achieved through cooperation with the National I&M Data Manager, located in Ft. Collins, CO. The actual process (taken from the Prairie Cluster Data Management Plan) by which data is archived is described in SOP 8.

MetaData Procedures

Final metadata reporting for both spatial and tabular data is accomplished through entry into DataSet Catalog. Spatial metadata reporting is accomplished through ArcCatalog 8.3. See SOP 8 for details on metadata procedures. Scheduling of metadata reporting can be found in the project timeline.

In response to concerns about T&E species data being released, where appropriate, only the metadata will be posted to public websites. Requests for digital or hardcopies of actual data will be referred to the project manager for approval.

Data Maintenance

Data sets are rarely static. They often change through additions, corrections, and improvements made following the archival of a data set. There are three main caveats to this process:

- Only make changes that improve or update the data while maintaining data integrity.
- Once archived, document any changes made to the data set.
- Be prepared to recover from mistakes made during editing.

Any editing of archived data is accomplished jointly by the Project Manager and Data Manager. Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. The reader is referred to Tessler & Gregson (1997) for a complete description of prescribed data editing procedures and an example edit log.

Data Version Control

Prior to any major changes of a dataset, a copy is stored with the appropriate version number. This allows for the tracking of changes over time. With proper controls and communication, versioning ensures that only the most current version is used in any analysis. Versioning of archived data sets is handled by adding a three-digit number to the file name, with the first version being numbered 001. Each additional version is assigned a sequentially higher number. Frequent users of the data are notified of the updates, and provided with a copy of the most recent archived version.

Data Analyses

Data summaries and analyses are completed annually and a comprehensive analysis is prepared every five years. (See SOP 8 for details).

Harbor Seals

1. Monitor Population size

- a. Annual and long-term trends in population size using direct counts at standardized sites as an index of abundance.
- b. Four annual counts are produced by site:
 - Pupping season - Maximum and mean number of adults/immatures (combined)
 - Pupping season - Maximum number of pups
 - Molting season - Maximum and mean number of individuals (pups/adults/immatures combined)
 - Non-molting and non-pupping season – maximum numbers of adults/immatures (combined).

In order to contribute to statewide surveys and evaluate the SFA Network sites in context of the larger population, standardized estimates of total population are also calculated. Data collected at PORE and GOGA are combined with surveys conducted in SF Bay and Sonoma County to produce an annual regional population estimate.

2. Monitor Distribution

- a. Annual distribution of pupping and haul-out sites using direct counts - to identify expansion and contraction of colony and manage for changes.

3. Monitor Reproductive Success

- a. Annual maximum pup production as an index of annual reproductive success using direct counts of pups by site.

4. Monitor Disturbance

- a. Annual analysis of sources for disturbance (e.g. human, dog, boat, other),
- b. Annual analysis of rate of disturbance by site (presented as number of disturbances/hour of survey),
- c. Annual comparison of weekday and weekend disturbance rates, and
- d. Five-year analysis of the number of potential versus actual disturbance sources.

Evaluate trends in disturbances using frequency distributions. Test with a t-test differences in weekday and weekend disturbance rates and between sites. Care is taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years is evaluated by site.

Northern Elephant Seals

1. Monitor Population size

- a. Annual and long-term trends in population size by age and sex class using direct counts

In order to contribute to national surveys and evaluate the SFA Network sites in context of the larger population, standardized estimates of total population are also calculated

based on NMFS requirements (Barlow et al. 1993). Data collected at PORE are combined with surveys conducted at other northern elephant seal colonies including Ano Nuevo and the Channel Islands to produce an annual national population estimate (Barlow et al. 1993).

2. Monitor Reproductive Success

- a. Annual pup production and trends as an index of annual reproductive success using direct counts of females, pups, and applying correction factors.

We estimated two parameters for reproductive productivity, (1) *pup production* and (2) *pup survival* to weaning.

3. Monitor Population Ecology

- a. Annual pup mortality using direct counts - to identify local factors affecting the population.

Pup mortality is estimated indirectly by subtracting the maximum number of weaned pups counted in late February from the estimate of births derived from the adjusted female counts. These data are then compared to environmental data such as ENSO events, winter storm events and erosion of haul out beaches.

4. Monitor Disturbance

- a. Annual analysis of sources for disturbance (e.g. human, dog, cattle, other),
- b. Five year analysis of the number of potential versus actual disturbance sources,

Evaluate trends in disturbances using frequency distributions. Care is taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years is evaluated by site.

Pinniped Habitat Use

1. Data summaries will be provided as:

- Histograms presenting the seasonal occurrence and distribution of pinniped species at PR Headlands and Drakes Beach.
- Tabular data on maximum and average numbers by season.
- Five-year analysis to detect trends in population distribution and abundance.
- Annual births of species such as California or Steller sea lion.

Stranding Network

1. Data summaries will be provided as:

- Data are provided to NMFS through the Stranding Network.
- Data are linked to the GIS for spatially mapping distribution of strandings.

Reports

Reporting falls into four categories:

- NPS weekly summaries during the breeding seasons
- NPS annual summary report
- NPS five year annual report
- NMFS annual report

Elephant Seal Weekly Breeding Summary

A standardized graph presenting the attendance of elephant seals at PORE for the purpose of updating the superintendent, the staff and docents of interpretation, and the public via the website.

Harbor Seal Weekly Breeding Summary

A standardized graph presenting the attendance of harbor seals at PORE and GOGA for the purpose of updating the superintendent, the staff of interpretation, volunteer monitors, and the public via the website.

Park Annual Reporting

Brief summary of the season with summary of population numbers, pups produced, disturbances and any natural history items of note.

Park 5-yr Breeding Reports

Beginning in 1997, the park initiated a 5-year report, summarizing the status and trends of the breeding populations of harbor seals and northern elephant seals.

NMFS reports

The NMFS reports include information on seals tagged, location, date, and age-sex of individual, and resighting of tags from non-PORE sites, and on the number of seals disturbed during research activities. The park is conducting research under NMFS permit 373-1575, in cooperation with PRBO, who is conducting research on pinnipeds on the Farallon Islands NWR. Research on harbor seals tagged in San Francisco Bay for the SFSU study also occurs under this permit.

VI. PERSONNEL AND OPERATIONS

NPS Personnel

Project Managers: Science Advisor (Sarah Allen) and I&M Coordinator (Dawn Adams). Both oversee the program, train volunteers and conduct field surveys.

Biotechnicians: Presently, a part-time Marin Conservation Corps/Americorps member has coordinated volunteers conducted field surveys and entered data for harbor seal program, and a part-time biotech has conducted primary surveys and data entry during the elephant seal breeding season.

Volunteers

Volunteers are the backbone of the monitoring program. NPS biologists train over 30 volunteers per year who participate in the monitoring of harbor seals; many of the volunteers have been active for more than three years. Volunteers with particular skills and interest are trained to monitor elephant seals.

Harbor seal volunteers are trained in two in-class sessions and four field sessions. Older volunteers mentor new volunteers. (See SOP 2 for summary of volunteer training guide.) Training documentation includes background information, papers, tide charts, safety information and contact information.

A few, highly trained volunteers assist in the elephant seal monitoring program. Usually, these volunteers have worked with northern elephant seals at other locations or have trained extensively in the harbor seal program.

Qualifications

Project personnel are required to be physically fit in order to hike long distances and off trail. Staff requirements include either one season of experience doing surveys, including field data collection, or training in seal survey techniques.

Permits

The National Park Service jointly holds a permit with PRBO with the National Marine Fisheries Service under permit 373-1575. Listed authorized personnel include William Sydeman from PRBO, and Sarah Allen from PORE. This permit is required for disturbing, collecting tissue and tagging seals. The permit is valid through October 2005 and requires annual reporting.

Annual Workload

The harbor seal long-term monitoring study requires an average of 270 visits per year, and 30 visits per site during the breeding/molt seasons. This has been accomplished with 25-30 volunteers working from 1 March until July 30. Two part-time biologists oversee the program, scheduling, and coordinating volunteers.

The elephant seal monitoring study requires an average of 70 visits per year. This is accomplished with two part-time biologists and 5-8 volunteers. The volunteers conduct field surveys only. The biologists oversee the program, scheduling, coordinating volunteers, data entry and weekly reporting, and conduct surveys.

The pinniped long-term monitoring study requires an average of 45 visits per year, depending on weather. This is accomplished with one part-time biologist and five volunteers. Two part-time biologists oversee the program, scheduling, and coordinating volunteers.

Budget

The annual budget includes costs for personnel, vehicle, travel, equipment, and housing.

Budget detail

Item		Annual Expenses	Five year Expenses
Personnel	GS-6/7	\$35,000	
	GS-9		\$5,000
	Americorps	10,000	
Equipment	Repair/replacement	500*	
Supplies	Miscellaneous	200	
Travel	Vehicle	4,000	
	Conference		1,000
Housing		2,000	
Data analysis			2,500
Report (GS-9)			
Peer Review			1,500
Totals		\$51,700	\$10,000

* Donation accounts usually cover this cost.

Funding for aspects of this program comes from various sources. The park association (PRNSA) usually contributes funds to cover costs for equipment replacement and miscellaneous supplies.

Hours contributed in 2003 are an example of the volunteer contribution to the program; over 30 volunteers donated 3,288 hours resulting in an in kind contribution of \$55,896 (rate of \$17/hour). Partners contribute many hours of in-kind funds in personnel time and supplies by conducting various tasks ranging from tagging seals to collecting tissue sample.

Annual schedule

The annual schedule for pinniped monitoring is divided into three major periods: 1) harbor seal breeding season (March 1-July 30), 2) data processing and reporting (August

1-November 30); and northern elephant seal breeding season (December 1- March 1). Within each of these periods, there are several tasks both specific to the season and general to all seasons. For example, monitoring all species takes place weekly, year round.

Annual Schedule											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		1									
2										2	
								3			
4											
5a HS	5b HS								5a ES	5b ES	
	6 HS							6a ES	6 ES		6a HS
							7				
						8					
									9		
											10

Task

Code

- 1 Monitor harbor seals during breeding season
- 2 Monitor northern elephant seals during breeding season
- 3 Monitor northern elephant seal tag resights during fall season
- 4 Monitor all species weekly
- 5 Prepare for season (equipment, notification, etc.)
 - a. Prepare equipment
 - b. Establish schedule
- 6 Train volunteers
 - a. Solicit new volunteers
- 7 Budget analysis
- 8 Data analysis
- 9 Write reports
- 10 Revise SOPs

* HS = harbor seal; ES = elephant seal

VI. PARTNERS

Collaborators

The following agencies and institutions have expertise and complementary programs that contribute to the NPS program goals and give a broader context.

- California Academy of Sciences
- California Department of Fish and Game
- California State University - San Francisco
- California State University - Sonoma
- California State University – San Jose
- Channel Islands National Park
- Marine Mammal Center
- Moss Landing Marine Lab
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration
- National Marine Sanctuary Program
- Oiled Wildlife Care Network
- Point Reyes Bird Observatory Conservation Science
- University of California at Santa Cruz
- University of California at Davis
- University of California at Bodega Marine Lab
- University of California at Berkeley, Museum of Vertebrate Zoology

Collaborative Products

State

CDFG – Ground-truth data for annual CDFG/NMFS harbor seal aerial surveys.

Federal

NMFS/NOAA Stock Assessments

Under the 1994 amendments to the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) are required to publish Stock Assessment Reports for all stocks of marine mammals within U.S. waters, to review new information every year for strategic stocks and every three years for non-strategic stocks, and to update the stock assessment reports when significant new information becomes available. The most recent stock assessments occurred in 2001 (Carretta et al. 2001).

National Marine Sanctuaries annual reports on harbor seals. Data from the NPS study are included in the annual reports of the Gulf of the Farallones National Marine Sanctuary (1998-2002).

International

Collaboration with researchers in other countries occurs on a sporadic basis.

Mamaev, E. and S. Allen. A northern elephant seal migrates to the Commander Islands, Russia. Manuscript in preparation.

VII. ACKNOWLEDGEMENTS

Key persons who have contributed to this program and methods over the years include Josh Adams, David Ainley, Katie Fehring, Peter Boveng, Robert Jones, James Harvey, Harriet Huber, David Press, Jessica Pettee, Mark Lowry, Dave Notthelfer, Jerry Nusbaum, Christine Ribic, Sue Waber, and William Sydeman. We thank the hundreds of volunteers who have contributed thousands of hours to pinniped monitoring at Point Reyes. We are also grateful to various federal and state agencies and their representatives that have collaborated to analyze population status, including R. DeLong, D. DeMaster, and J. Barlow of NMFS, J. Roletto and J. Mortenson of NOAA, H. Markowitz, E. Grigg and D. Green of SFSU, and D. Hanan and D. Miller of CDFG.

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IX. LIST OF FIGURES

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Figure 2. Adaptive management of harbor seals

Figure 3. Study area and primary seal colony locations

X. STANDARD OPERATING PROCEDURES

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SOP 2: Train harbor seal observers

SOP 3: Conduct harbor seal field surveys

SOP 4: Northern elephant seal monitoring preparations

SOP 5: Train elephant seal observers

SOP 6: Conduct elephant seal field surveys

SOP 7: Conduct all pinniped field surveys

SOP 8: Data management

SOP 9: Data analysis and reports

SOP 10: Revise the protocol

SOP: Survey forms

SOP: Survey maps

XI. APPENDICES

Appendix I. Species accounts (under development)

Appendix II. Research needs

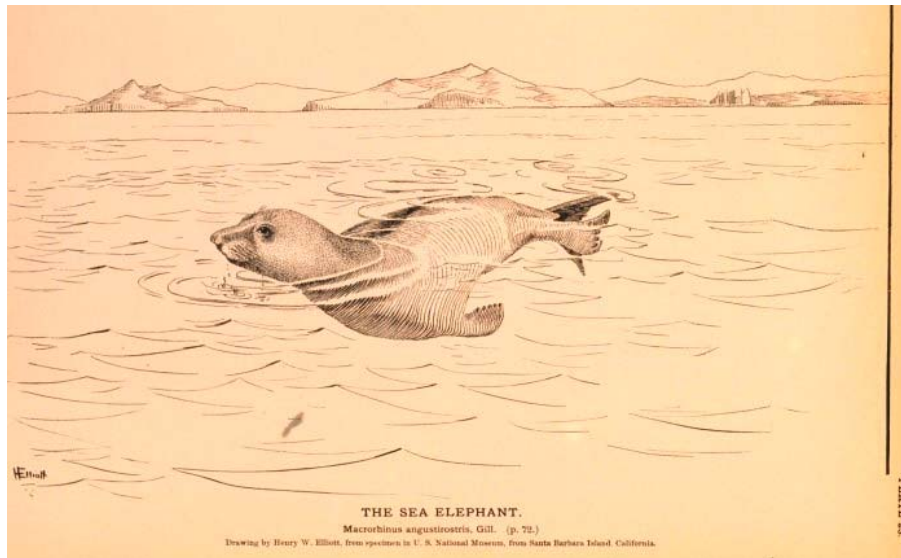
Appendix III. Program products

Appendix IV. Glossary

DRAFT

STANDARD OPERATING PROCEDURES For PINNIPED PROTOCOL

**National Park Service
San Francisco Bay Area Network**



Henry W. Elliott 1872

Version 1: July 30, 2004

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SOP 1: Harbor seal monitoring preparations

New volunteers

Each year in December, the park initiates a training schedule for new volunteers and a refresher for returning volunteers. A minimum of 20 volunteers is required to run the program. Around 15 volunteers return each year and so 5-10 new volunteers are needed annually. The first step is to advertise in the local newspaper (Point Reyes Light) and the Sierra Club Yodeler to attract new volunteers. A fee is required to put an advertisement in the Yodeler. A digital copy of the advertisement is located at u:\science\Phoca.

Prepare training sessions

In January, the park distributes an announcement on training dates to new and returning volunteers. Volunteer packets are assembled. Dates are selected for February and early March and coinciding with medium to low tide levels to maximize the number of seals onshore at the colonies (see below).

Prepare and maintain equipment

In January, the equipment needs are reviewed, and missing or damaged items are replaced.

Equipment includes:

Equipment for observers is housed in the Science office. Equipment includes:

- Binoculars (3 - 8x40 Eagle Optics or equivalent)
- Spotting scopes and tripods (5; Bushnell Spacemaster or equivalent)
- Hand counters (10)
- Clipboards (5 metal to hold forms and maps)
- Backpacks (4 to carry gear)
- Digital camera
- Marking equipment
 - Hand-held pliers for attaching flipper tags (2; Veterinary Supplies)
 - Plastic tags (Veterinary Supplies; color green; series 100-500)
- Field vest for carrying gear (3)

Optical equipment is easily damaged by salt air, wind and dust/sand and should be checked for damage and corrosion. Equipment is housed in an outside, weatherproof and secure box for access to volunteers during non-office hours.

Schedule regional surveys

By February 1, select dates for regional semi-monthly surveys between March 1 and July 30. Surveys should coincide with medium to low tide cycles in the middle of the day to maximize seal numbers onshore. Share schedule with partners that survey in other areas such as San Francisco State University San Francisco Bay seal study, Moss Landing Marine Lab, Friends of Slavianska and NOAA, Gulf of the Farallones National Marine Sanctuary.

SOP 2: Train harbor seal observers

Observer requirements

Observers must be physically fit; have an ability to use binoculars; ability to record data into a field form; be in excellent physical shape to hike several miles in rugged terrain and carry a backpack with 30 lbs; and to hike off trail and orient using a topographic map. Older volunteers will mentor new volunteers. See also personnel section of protocol.

Training sessions

Training includes two half-day sessions in the classroom and five field trips. Field trips include one trip to each of the primary seal haul out sites (Tomales Point and Bay, Drakes Estero, Double Point and Bolinas Lagoon) and a trip in April to train new volunteers on harbor seal pup identification and behavior. Other optional field trips include a visit to the Marine Mammal Center. New volunteers are encouraged to go out on surveys with a returning volunteer who will mentor them for the first few surveys. New volunteers are required to attend all in-class training sessions, and all five field trips, and to commit to a minimum of 10 surveys per year.

In class training

There are two ½ day training sessions that include presentations on the following topics:

- General marine ecology and Point Reyes
 - Speaker from the Gulf of the Farallones National Marine Sanctuary
- General information on marine mammals and pinnipeds
 - Speaker from the Cetacean Society
 - Speaker from the NPS
- Specific information on long-term monitoring of harbor seals at Point Reyes (u:\science\presentations\phocaclass04.ppt)
- Specific information on long-term monitoring of elephant seals at Point Reyes (u:\science\presentations\phocaclassa04.ppt)
- Specific information on safety in the field including
 - Poison oak identification and avoidance
 - Interactions with park visitors

Training guide

A full packet of information for volunteers includes a binder with the following:

- Volunteer form
- General guide (u:\science\Phoca\guidephoca.doc)
- Procedures for field data collection (explained in General Guide (u:\science\phoca\guidephoca.doc))
- Published articles with background information (see Appendix III)
- Data forms (see SOP 3)
- Examples of field data forms filled out
- Data management (see SOP 8)

- Maps of each location and observation sites (see SOP 3)
- Equipment list (see SOP 2)
- Equipment care and maintenance (see SOP 2)
- Tide book (updated annually)
- Park brochure
- Safety issues (Lyme disease, poison oak, West Nile virus)
- Contacts (update annually)

SOP 3: Conduct harbor seal field surveys

Field schedule

Surveys are conducted March 1 through July 31 to cover the breeding season (March 1-May 30) and the molt season (June 1-July 31). A monthly field schedule is maintained by the volunteer coordinator and updated once per week. The coordinator ensures that each site is covered a minimum of two times per week. The weekly updated schedule is emailed to the volunteers weekly.

Field locations

There are ten distinct survey locations. Survey locations include sites in Golden Gate NRA (Alcatraz Island, Point Bonita, Bolinas Lagoon) and Point Reyes NS (Duxbury Reef, Double Point, Limantour Estero, Drakes Estero, Point Reyes Headland, Tomales Point and Tomales Bay). Each survey location is further subdivided based on habitat features. Maps for all locations are attached at the end of this SOP.

Field surveys

Time commitment for each survey is around six to eight hours depending on the location. Bolinas Lagoon requires only one half hour travel time but Double Point requires two hours travel time (car and hiking). Volunteers retrieve equipment and survey forms from out-side storage containers distributed in the parks (one is located at the back porch of the RM building of PORE, one is behind the building at PRBO, and one is located at the RM office at GOGA) and then go to their assigned survey location. Each survey site has a specific field map with marked locations for observations (see field maps below).

Upon conclusion of surveys, observers return and clean equipment, QA/QC data forms and put data forms into the data envelope in the storage box.

Census data (see data form)

Observers count all seals at each site and/or subsite where seals are hauled out and separate out age class only into two categories (adults/immatures and pups). After May 31, all seal age classes are combined because pups cannot be easily identified. Seals in the water are not counted unless there are no seals onshore, and then the observer only makes a general estimate of the number of seals present. Other data collected include number of red-pelaged seals, number of fresh shark attacked seals, and number of dead pups. In the comments section, observers can add information on the dead or stranded seals and any marked seals (radio or flipper tag).

To maximize the number of seals on the haul out site, surveys should be conducted between a medium (2.5 ft) to a low (-1.0 ft) tide level during mid-day. Some weeks, though, that is not possible, and so schedules should coincide with the low tide with the early morning. For example, if low tide of -1.0 is at 7am, survey between 8-11 am.

Each location has an adjusted tide level to the tide book.

Tomales Bay	+30 min
Tomales Point	-30 min

Point Reyes Head	-25 min
Drakes Estero	+45 min
Double Point	-30 min
Bolinas Lagoon	+37 min
Point Bonita	no correction
Alcatraz	+10 min

Surveys should last for a minimum of 2 hours with counts of all seals every 30 minutes. However, some sites may have very large numbers of seals (>1000) and observers may only be able to count once every hour. Observers should count when they arrive, repeat every 30 min, and count when they leave.

Additional data included in the form are weather and other species of note. Weather data are limited to visibility that may affect observers' ability to see the seals and rain that can cause seals to flush into the water. Information on white and brown pelicans is included on the form because both species are of interest and often occur in the same area as the seals. Brown pelicans are a federally threatened species and occur in the parks most months of the year and white pelicans are a species of concern in the state of California.

Disturbance events (see data form)

Disturbance data include any potential or actual disturbance of the seals while they are resting onshore causing them to alter their behavior. Information collected includes source for disturbance (various anthropogenic or non-anthropogenic sources) and seal response (a gradient from no response to flush into water).

Survey forms

There are two survey forms:

- Harbor seal survey form
- Harbor seal disturbance form

Digital copies of forms are located at u:\science\Phoca\phoca03.frm. Examples of forms are attached at the end of the SOPs.

Maps of survey locations

There are 5 maps of survey locations with positional information on the seal haul out sites and on the observation points (see attached documents at end of SOPs). The survey maps include:

- Bolinas Lagoon
- Double Point
- Drakes Estero and Limantour Estero
- Duxbury Reef
- Point Bonita
- Point Reyes Headland
- Tomales Bay and Tomales Point

Additional maps will be provided for new locations in GOGA lands such as Alcatraz.

The GIS database and ESRI Arcview files for reproducing or updating maps are located at s:\gis\vector1\marine\pinnipeds. Seal haul out sites and observer positions are represented as point locations in the GIS database.

Maps for quick printouts are located in the following subdirectory:
u:\science\phoca\fieldmaps.

SOP 4: Northern elephant seal monitoring preparations

New observers

Each year in September, the park searches for new volunteers. A minimum of 4 volunteers is required to run the program. Most volunteers are selected from the pool of trained volunteers in the harbor seal monitoring program or from elephant seal monitoring programs in other areas.

Prepare and maintain equipment

In October, equipment needs are reviewed and missing or damaged items are replaced. Equipment for observers is housed in the Science office. Equipment includes:

- Binoculars (3)
- Spotting scopes and tripods (3)
- Hand counters (5)
- Digital camera
- Marking equipment
 - Hand-held pliers for attaching flipper tags (4; Dalton Veterinary Supplies)
 - Plastic tags (Dalton Veterinary Supplies; jumbo-roto tags; color pink; series P, H, R, J, K-0)
 - Hair dye (Lady Clairol blue-black hair dye donated to NPS)
- Rope ladder and 50 feet of climbing rope
- Tape measure
- 5x8 field binders with data forms
- Field vest for carrying gear

Optical equipment is easily damaged by salt air, wind and dust/sand and should be wiped down with a damp cloth after each use. Other optical cleaning products include items such as Eagle Optics Lenspens or microfiber cloth.

SOP 5: Train elephant seal observers

Observer requirements

Observers should be physically fit, and have extensive experience in observing wildlife, particularly seals. Observers must have the ability to use binoculars and spotting scope; ability to record data into a field form and computer database; be in excellent physical shape to hike several miles in rugged terrain and carry a backpack with up to 40 lbs; and to hike off trail and orient using a topographic map. See also personnel section of protocol.

Training

Training for new observers includes intensive one on one field training over one breeding season with the Science Advisor and the I&M Coordinator, or someone who has extensive experience studying elephant seals.

Training guide. The training guide should be updated annually. The full packet of information is presented to all new observers and includes the following:

- Volunteer form (for volunteers only)
- General guide (u:\science\Eseal\Esealguide04.doc)
- Maps of each location and observation sites (see SOP 6)
- Tide book (updated annually)
- Data forms (see SOP 6 and 8)
- Data management (see SOP 8)
- Equipment list (see SOP 6)
- Equipment care and maintenance (see SOP 6)
- Safety (see general guide and special information on Lyme disease, poison oak)
- Contact list (update annually)

SOP 6: Conduct northern elephant seal field surveys

Field schedule

Field surveys for the breeding season are conducted November 1 through March 31. A monthly field schedule is maintained by the volunteer coordinator and updated once per week. The weekly updated schedule is maintained in the Science office. During the rest of the year, elephant seal counts are combined into the “all pinnipeds” weekly surveys.

Field locations

There are five survey locations. Survey sites include South Beach, Point Reyes Headland (Main colony), North Drakes Beach colony, Life Boat Station, and Chimney Rock loop. Each survey location is further subdivided based on habitat features. New colony and haul out locations are identified annually. See maps attached at end of SOPs.

Field surveys

Surveys fall into two categories: 1) full count surveys and 2) resight surveys.

Full count surveys (see data form). Full count surveys occur a minimum of two times per week, weather permitting, between December 1 and March 15, and one time per week the rest of the breeding season. Observers count all seals at each subsite where seals are hauled out, and separate seals into categories based on sex and age. Categories include bull, subadult male 4, subadult male 3, subadult male 2, subadult male, female, pup, weaned pup, immature (see chart for male age classes; B. Le Boeuf, unpubl. data). To maximize the number of seals on the haul out sites, surveys should be conducted between a medium (3.0 ft) to a low (-1.0 ft) tide level. Time of day is not a limiting constraint when conducting surveys since seals are hauled out all day long. Surveys usually require a minimum of 4 hours to complete.

Resight surveys (see 2 data forms). Resight surveys occur a minimum of two times per week between December 1 and March 15, and one time per week the rest of the breeding season. Observers usually can only access sites during medium to low tide levels to conduct these surveys. Seals are hauled out regardless of time of day. Surveys usually require a minimum of 4 hours to complete.

Upon conclusion of surveys, observers return and clean equipment, QA/QC data forms and put data forms into the data envelope in the storage box.

Resight data form: Observers identify all seals with flipper tags or dye markings at each site where seals are hauled out. The mark (dye or number of tag) should be recorded, along with the sex, age class and the reproductive status of the seal. Categories include bull, subadult male 4, subadult male 3, subadult male 2, subadult male, female, pup, weaned pup, immature.

Seal mark data form: Some individual seals are tracked throughout the breeding season and for multiple years based on flipper tags and scars. Individual data forms track the histories of these individuals.

Upon conclusion of surveys, observers should return and clean equipment, QA/QC data forms and place forms in the pinniped survey box located on the back porch of the Resource Management building.

Survey forms

There are three survey forms, one for surveys and two for resights. Digital copies of forms are located at u:\science\Eseal\Forms and SOPs. (Examples of survey forms are attached at end of the SOPs).

- Northern elephant seal survey form
- Northern elephant seal resight form
- Northern elephant seal mark form

Maps of survey locations

There is one general map of all survey locations with positional information on the elephant seal haul out sites and three specific location maps with the observation points (see attached maps at end of SOPs). The survey maps include:

- Point Reyes Headland - General
- Point Reyes Headland - Main colony
- South Beach
- Chimney Rock

Additional maps will be provided as new locations are established.

The GIS database and ESRI Arcview files for reproducing or updating maps are located at s:\gis\vector1\marine\pinnipeds. Seal haul out sites and observer positions are represented as point locations in the GIS database.

To produce quick maps with no changes, files are located at u:\science\eseal\forms and sops.

SOP 7: Conducting all species pinniped field surveys

Observer requirements

Observers should have experience observing wildlife, particularly pinnipeds. Observers must have the ability to use binoculars and spotting scope; ability to record data into a field form; be in excellent physical shape to hike several miles in rugged terrain and carry a backpack with 30 lbs; and to hike off trail and orient using a topographic map. Most observers have gone through the harbor seal monitoring program. See also personnel section of protocol.

Training

Training for new observers includes field training during one northern elephant seal breeding season with the Science Advisor and the I&M Coordinator, or someone who has extensive experience identifying pinnipeds.

Training guide. The training guide is the same guide as is used for the northern elephant seal monitoring program. The full packet of information is presented to all observers and includes the following information:

- Volunteer form (for volunteers only)
- General guide (u:\science\Eseal\Esealguide04.doc)
- Maps of each location and observation sites (see SOP 6)
- Tide book (updated annually)
- Data forms (see SOP 6 and 8)
- Data management (see SOP 8)
- Equipment list (see SOP 2)
- Equipment care and maintenance (see SOP 6)
- Safety (see general guide and packet of information distributed to harbor seal volunteers with special information on Lyme disease, poison oak)
- Contacts (updated annually)

Prepare and maintain equipment

In October, the equipment needs are reviewed, and missing or damaged items are replaced. Equipment includes binoculars (8x40 Eagle Optics or equivalent), spotting scopes (Bushnell Spacemaster or equivalent) and tripods, and hand counters. Equipment is located in the Science office.

Field schedule

Surveys are conducted weekly (preferably on Friday to coincide with the PRBO pinniped survey on Southeast Farallon Island) and year round. During the elephant seal breeding season, “all species pinniped” counts are combined into the “northern elephant seal” weekly surveys.

Field locations

There are four survey locations. Survey sites include Sea Lion Overlook, Point Reyes Headland (Main elephant seal colony), South Beach, and North Drakes Beach colony.

Each survey location is further subdivided based on habitat features (see field maps below).

Field surveys

Time commitment for each survey is four hours, including travel time. Survey equipment and survey forms are located in the Science office.

Observers count all seals at each subsite where seals are hauled out and separate out age and sex class depending upon the season of year and the species.

Harbor seals. There are two age classes (adults/immatures and pups) during the breeding season (March 1-June 1) but all seal age classes are combined the rest of the year because pups cannot be easily identified.

Northern elephant seals. Categories are based on sex and age. Categories include bull, subadult male 4, subadult male 3, subadult male 2, subadult male, female, pup, weaned pup, immature (see chart for male age classes; B. Le Boeuf, unpubl. data).

Steller sea lions. Categories are based on sex and size, and include bull, subadult male, female, and immature. Adult females are indistinguishable from immature males but when with pup can be identified.

California sea lions. Categories are based on sex and size, and include adult male, female, and immature. Adult females are indistinguishable from immature males but when with pup can be identified.

Seals in the water are not counted unless there are no seals onshore, and then the observer only makes a general estimate of the number of seals present. Other data collected include number of seals with fresh shark bites, number of dead seals, and any marked seals (dye mark, brand, radio or flipper tags).

To maximize the number of seals on the haul out site, surveys should be conducted between a medium (3 ft) to a low (-1.0 ft) tide level during mid-day. Some weeks, though, that is not possible, and so schedules should coincide with the low tide with the afternoon.

Upon conclusion of surveys, observers should return and clean equipment, QA/QC data forms and place forms in the pinniped survey box located on the back porch of the Resource Management building.

Survey form

There is one survey form and a digital copy of the form is located at u:\science\pinniped\pinnipedsurveydataform.doc. (See attached form at end of SOPs).

Map of survey location

There is one map of survey locations with positional information on the seal and sea lion haul out sites and on the observation points (see attached documents at end of SOPs).

The survey map include:

- Sea lion Overlook
- Point Reyes Headland Main colony
- North Drakes Beach
- South Beach (a portion of the Great Beach)

Additional maps will be provided if new locations form with significant changes in sea lion or northern elephant seal populations at Point Reyes Headland.

The GIS database and ESRI Arcview files for reproducing or updating maps are located at s:\gis\vector1\marine\pinnipeds. Seal haul out sites and observer positions are represented as point locations in the GIS database.

SOP 8: Data management

Database design and structure

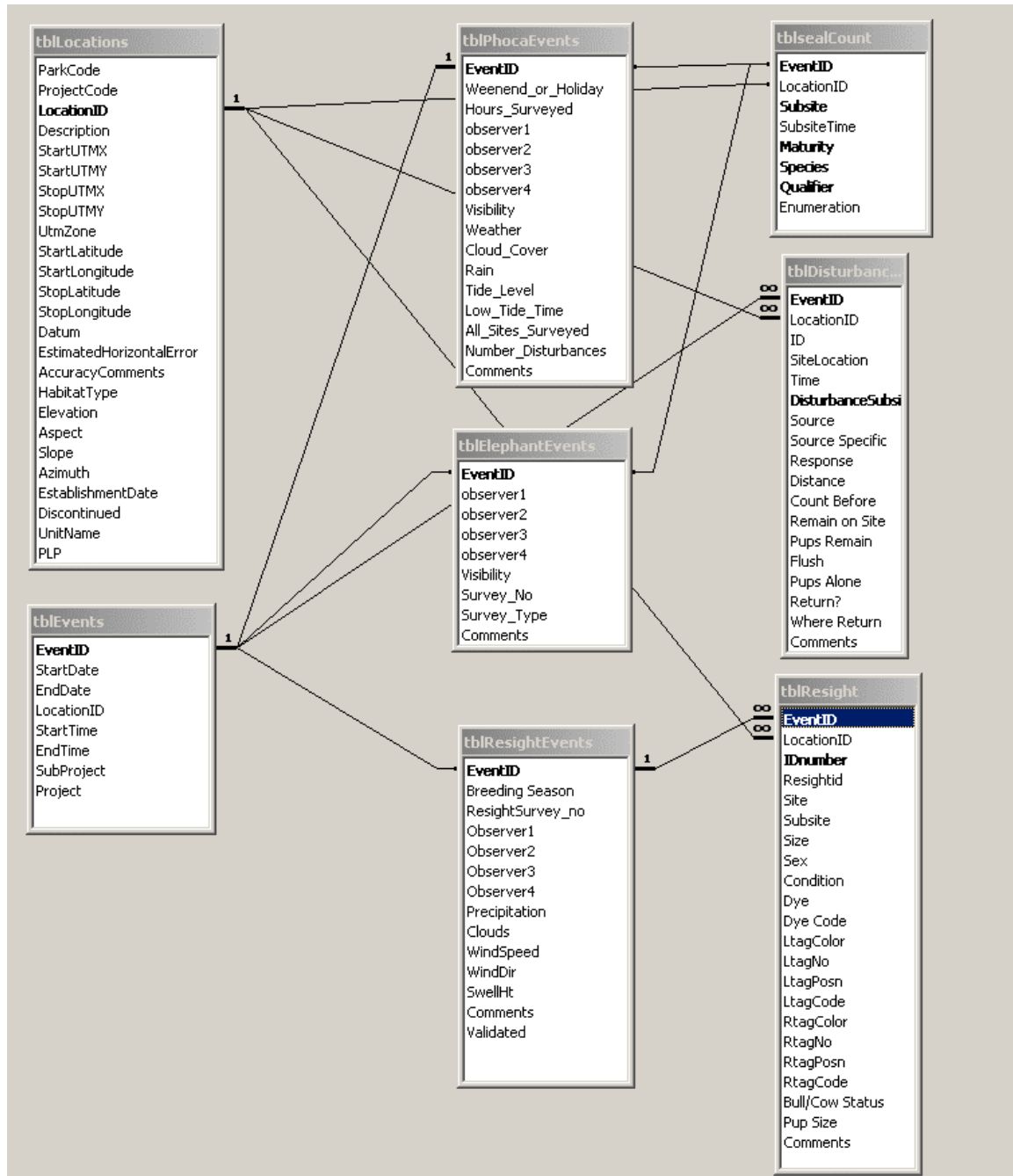
The pinniped databases (elephant seal database (esealtag.mdb) and harbor seal database (ophocabase.mdb)) were moved to a newly designed MS Access database during the 2003/04 field seasons. The new database (pinniped.mdb) is modeled after the NPS Database Template. References in this section to earlier pinniped data structures are provided for historical continuity.

Primary data sets:

- Number of pinnipeds censused on selected beaches.
- Resightings of tagged individuals.
- Ecology and behavioral observations.
- Disturbance documentation.

Database templates

1. Table Relationships



2. Contents of tblLocations.

This table specifies the coordinates and characteristics of pinniped sampling locations at Pt. Reyes National Seashore. Fields are those specified in the I&M Natural Resources Database Template with some customization for the PINNIPED project.

Microsoft Access - [tblLocations : Table]			
File Edit View Insert Tools Window Help			
Field Name	Data Type	Description	
ParkCode	Text	4-character Park Code	
ProjectCode	Text	Code for component of monitoring project (Weather, Birds, Fish, Veg Plots, etc.)	
LocationID	Text	Unique Location ID code (when combined with ParkCode and Program)	
Description	Text	Description of this location	
StartUTMX	Number	UTM X (northing) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)	
StartUTMY	Number	UTM Y (easting) coordinate for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)	
StopUTMX	Number	UTM X coordinate (northing) of ending point of line or polygon (double precision to15 significant digits)	
StopUTMY	Number	UTM Y coordinate (easting) of ending point of line or polygon (double precision to15 significant digits)	
UtmZone	Number	UTM zone	
StartLatitude	Number	Latitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)	
StartLongitude	Number	Longitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon (double precision to15 significant digits)	
StopLatitude	Number	Latitude in decimal degrees for the ending point of a line or polygon (double precision to15 significant digits)	
StopLongitude	Number	Longitude in decimal degrees for the ending point of a line or polygon (double precision to15 significant digits)	
Datum	Text	Datum of mapping ellipsoid	
EstimatedHorizontalError	Number	Estimated horizontal accuracy error--see users guide for complete details and examples	
AccuracyComments	Memo	Comments about how positional (horizontal) accuracy was estimated	
HabitatType	Text	Habitat type	
Elevation	Number	Elevation in meters	
Aspect	Text	Aspect (N, S, E, W)	
Slope	Number	Slope in degrees	
Azimuth	Number	Compass bearing between start and stop coordinates	
EstablishmentDate	Date/Time	Date site was established	
Discontinued	Date/Time	Date site was discontinued	
UnitName	Text	Management unit in which site is located	
PLP	Text	Indicates whether location is a point, line, or polygon	

3. Contents of tblEvents.

This table specifies the date and time of a sampling event. Fields are those specified in the I&M Natural Resources Database Template with some customization for the PINNIPED project.

Field Name	Data Type	
EventID	Text	Sampling event ID code
StartDate	Date/Time	Date (mm/dd/yy) when sampling began
EndDate	Date/Time	Date (mm/dd/yy) when sampling ended
LocationID	Text	Location identification code
StartTime	Date/Time	Time (hh:mm) when sampling began
EndTime	Date/Time	Time (hh:mm) when sampling ended
SubProject	Text	SubProject (Elephant Seal, Harbor Seal, Pinniped)
Project	Text	1-10 character Project Code

4. Contents of tblPhocaEvents.

This table contains event fields unique to the PHOCA subproject.

Field Name	Data Type	
Weenend_or_Holiday	Text	Survey performed on weekend or holiday
Hours_Surveyed	Number	Duration of survey (hours)
observer1	Text	Name of observer 1
observer2	Text	Name of observer 2
observer3	Text	Name of observer 3
observer4	Text	Name of observer 4
Visibility	Number	Visibility
Weather	Text	Weather conditions
Cloud_Cover	Number	Cloud cover code
Rain	Yes/No	Rain code
Tide_Level	Number	Tide level
Low_Tide_Time	Date/Time	Time low tide occurred
All_Sites_Surveyed	Yes/No	Were all sites surveyed?
Number_Disturbances	Number	Number of disturbances
Comments	Memo	Comments

5. Contents of tblElephantEvents.

This table contains event fields unique to the ELEPHANT seal subproject.

Microsoft Access - [tblElephantEvents : Table]

Field Name	Data Type	
EventID	Text	Sampling event ID code
observer1	Text	Name of observer 1
observer2	Text	Name of observer 2
observer3	Text	Name of observer 3
observer4	Text	Name of observer 4
Visibility	Number	Visibility Code (1 = good, 2=fair, 3=poor)
Survey_No	Text	Sequential Survey Number
Survey_Type	Text	Type of survey (S or I)
Comments	Text	Comments

6. Contents of tblResightEvents.

This table contains event fields unique to the seal RESIGHT activity.

Microsoft Access - [tblResightEvents : Table]

Field Name	Data Type	
EventID	Text	Sampling event ID code
Breeding Season	Text	Breeding Season
ResightSurvey_no	Number	Resight Survey ID number
Observer1	Text	Name of Observer 1
Observer2	Text	Name of Observer 2
Observer3	Text	Name of Observer 3
Observer4	Text	Name of Observer 4
Precipitation	Number	Precipitation Code (0 = None, 1 = Rain)
Clouds	Number	Cloud Cover Code (0 = Clear, 1 = Partly, 2 = Totally Overcast)
WindSpeed	Number	Wind Speed Code (0 = None, 1 = Light, 2 = Medium, 3 = Strong)
WindDir	Text	Wind Direction (N,E,S,W,NW,NE,SW,SE)
SwellHt	Number	Swell Height (ft)
Comments	Memo	Comments
Validated	Yes/No	Data Validated?

7. Contents of tblsealCount.

This table contains the seal census data from all three PINNIPED subprojects

Microsoft Access - [tblsealCount : Table]

Field Name	Data Type	
EventID	Text	Sampling event ID code
LocationID	Text	Unique Location ID code (when combined with ParkCode and Program)
Subsite	Text	Subsite name
SubsiteTime	Date/Time	Time observations were made at a subsite
Maturity	Text	Maturity of seal
Species	Text	Species of seal
Qualifier	Text	Qualifier describing condition of the seal
Enumeration	Number	Number of seals counted

8. Contents of tblDisturbances.

This table contains harbor seal disturbance data.

Microsoft Access - [tblDisturbances : Table]

Field Name	Data Type	
EventID	Text	Sampling event ID code
LocationID	Text	Unique Location ID code (when combined with ParkCode and Program)
ID	Number	Sequential identification number
SiteLocation	Text	Location where observations took place
Time	Date/Time	Time of observation at subsite
DisturbanceSubsite	Text	Subsite where observations took place
Source	Text	General category of disturbance source
Source Specific	Text	Specific cause of disturbance
Response	Text	Response of seals to disturbance
Distance	Text	Distance to disturbance
Count Before	Number	Count before disturbance began.
Remain on Site	Number	Number of seals that remain on the site after the disturbance.
Pups Remain	Number	Pups remaining on beach.
Flush	Number	The number of animals that leave the beach and enter the water.
Pups Alone	Number	Pups that were left alone on the beach. (No longer used).
Return?	Text	Did seals return? (yes/no)
Where Return	Text	Sites where seals returned
Comments	Text	Comments

9. Contents of tblResight.

This table contains information pertaining to the resighting of tagged seals.

Microsoft Access - [tblResight : Table]

File Edit View Insert Tools Window Help

Field Name	Data Type	Description
EventID	Text	Sampling event ID code
LocationID	Text	Unique Location ID code (when combined with ParkCode and Program)
IDnumber	AutoNumber	Identification Number
Resightid	Text	Rmm/dd/yy-# (#=resight survey #)
Site	Text	Site Designation
Subsite	Text	Subsite Designation
Size	Text	Seal size (A=Adult, B= Bull, (SA4,SA3, SA2, SA1 all self explanatory), IM=immature, YR=yearling, W=Weaner, U=unknown or data not taken)
Sex	Text	Seal sex
Condition	Text	Seal condition
Dye	Text	Number as read, use "-" for place holder
Dye Code	Text	Dye Code (1 = Dye mark partially read, 2 = Newly applied dye mark, use first time animal is marked, 4 = Data edited)
LtagColor	Text	Left tag color
LtagNo	Text	Left tag number
LtagPosn	Text	Left tag position
LtagCode	Text	Left tag code (1 = Tag partially read, 2 = Newly applied tag, use first time animal is marked, 4 = Data edited, 8 = tag recovered, 9 = tag destroyed)
RtagColor	Text	Right tag color
RtagNo	Text	Right tag number
RtagPosn	Text	Right tag position
RtagCode	Text	1 = Tag partially read, 2 = Newly applied tag, use first time animal is marked, 4 = Data edited, 8 = tag recovered, 9 = tag destroyed
Bull/Cow Status	Text	A=Alpha Male, B=Beta Male, P=Periphery, NA=Not Associated, PG=Pregnant, NU=Nursing, NP=No Pup
Pup Size	Text	Pup size
Comments	Memo	Comments

Data handling and QA/QC

Data handling, quality assurance (QA) and quality control (QC) must meet certain standards in order to ensure that the data are consistent, repeatable and reliable, and so that data stand up to external review. QA ensures that data meet defined standards of

quality with a stated level of confidence. QA refers to the overall management system, which includes the organization, planning, data collection, documentation, metadata, evaluation, and reporting activities of the program. QC refers to the technical procedures involved in controlling errors, such as personnel training, calibration of equipment, repeated measuring to determine differences among observers and the repeatability of measurements by the same person, and exercises to identify the level of error during data recording and data entry.

Harbor Seals

Data Handling

- Data collected in the field are first recorded on the following paper forms:
Harbor Seal Survey (Phoca forms.doc)
Harbor Seal Disturbance Survey (Phoca forms.doc)
- Data are then proofed by two people and entered into the following database (Access compatible): phocabase.mdb
- Annually, the data are checked for errors and consistency.
- Data are currently stored in the Park network at
U:\natural_databases\Phoca\phocabase.mdb
- Database Documentation (metadata)

Data QA/QC

- Intensive and extensive training of volunteers (high retention rate of trained volunteers)
- Repeated counts during each survey
- Several surveys per week during breeding seasons
- Data forms are consistent over years
- Data entry completed by one primary person
- Any editing of archived data is accomplished jointly by the Project Manager and Data Manager
- Database is programmed to capture errors and reviewed annually for errors
- Annual summary analysis to ensure that data are managed and collected properly

Northern Elephant Seals

Data Handling

- Data collected in the field are first recorded on the following paper forms:
Elephant Seal Survey (eseal survey data form.doc)
Elephant Seal Mark Records (eseal dye record form.doc)
PORE Mirounga Resight Form (eseal resight data form.doc)
- Data are then entered into the following database:
Elephant Seal Monitoring Database (esealtag.mdb)
- Data are stored in the Park network at:
U:\natural_databases\elephant seal\esealtag.mdb
- Annually, the data are checked for errors and consistency.
- Database Documentation (metadata).
eseal meta.xls

Data QA/QC

All Pinniped Species

Data Handling

- Data collected in the field are first recorded on the following paper form: Pinniped Survey Form (pinnsurvey form.doc)
- Data currently are then proofed and entered into the new MS Access database (pinniped.mdb).
- Annually, the data are checked for errors and consistency.
- Database Documentation (metadata)

Data QA/QC

- Intensive and extensive training of volunteers (high retention rate of trained volunteers)
- Repeated counts during each survey
- Several surveys season (fall, winter, spring, summer)
- Data forms are consistent over years
- Data entry completed by one primary person
- Any editing of archived data is accomplished jointly by the Project Manager and Data Manager
- Database is programmed to capture errors and reviewed annually for errors
- Annual summary analysis to ensure that data are managed and collected properly

Metadata procedures

Final metadata reporting for both spatial and tabular data is accomplished through entry into DataSet Catalog. Spatial metadata reporting is accomplished through ArcCatalog 8.3. Final reporting of spatial metadata also requires posting information on the NPS Data Clearinghouse website, http://www.nps.gov/gis/data_info/clearinghouse.html as required by Executive Order 12906, <http://www.fgdc.gov/publications/documents/geninfo/execord.html>. For project management and metadata collection the Network also utilizes the Resource Management Project Plan developed at Lake Mead, <http://www.nature.nps.gov/im/units/nw27/RMPP.doc>. This document allows tracking of a project from proposal to completion. Scheduling of metadata reporting can be found in the project timeline.

In response to concerns about T&E species data being released, where appropriate, only the metadata will be posted to public websites. Requests for digital or hardcopies of actual data will be referred to the project manager for approval.

Data maintenance

Data sets are rarely static. They often change through additions, corrections, and improvements made following the archival of a data set. There are three main caveats to this process:

- Only make changes that improve or update the data while maintaining data integrity.
- Once archived, document any changes made to the data set.
- Be prepared to recover from mistakes made during editing.

Any editing of archived data is accomplished jointly by the Project Manager and Data Manager. Every change must be documented in the edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. The reader is referred to Tessler & Gregson (1997) for a complete description of prescribed data editing procedures and an example edit log.

Data version control

Prior to any major changes of a data set a copy is stored with the appropriate version number. This allows for the tracking of changes over time. With proper controls and communication, versioning ensures that only the most current version is used in any analysis. Versioning of archived data sets is handled by adding a three-digit number to the file name, with the first version being numbered 001. Each additional version is assigned a sequentially higher number. Frequent users of the data are notified of the updates, and provided with a copy of the most recent archived version.

Data archival procedures

Data archiving will focus on long-term storage and access through the network server with additional offsite storage being achieved through cooperation with the National I&M Data Manager, located in Ft. Collins, CO. The actual process (taken from the Prairie Cluster Data Management Plan) by which data is archived is described below.

Initial archiving is started once the Project manager has conducted the appropriate QA/QC procedures for specific field seasons and has notified the Network Data Manager that the dataset is ready for archiving. At this point, the Network Data Manager places a copy of the dataset into the appropriate folder within the archive directory on the network server. For example, the Pinnipeds database would be copied onto the network server under Archives/Projects/Pinnipeds/Data. Once the data are archived, any changes made to the data must be documented in an edit log. From this point forward, original field forms are not altered. Field forms can be reconciled to the database through the use of the edit log. Secure data archiving is essential for protecting data files from corruption.

Once a data set has passed the QA/QC procedures specified in the protocol, a formal entry is made in the I&M Data Set Catalog. Subsequently, an electronic version of the data set is maintained in a read-only format on the program server. The IT Branch at Golden Gate NRA, Ft. Mason Bldg. 201, maintains backup copies of the data with an additional digital copy forwarded to Ft. Collins.

- Annually following data proofing and error checking, the project database located on the PORE network (U:\natural_databases\pinniped.mdb

- The databases are archived onto a CD with a copy of annual reports and project protocols. The CD and any hardcopy forms and original field maps will be archived at the GOGA Archival Center for permanent storage two years after completion. A copy of the database is backed up during the standard, weekly PORE network backup.

SOP 9: Data analysis and reports

Data analysis

Harbor Seals

1. *Monitor Population size*

- a. Annual and long-term trends in population size using direct counts at standardized sites as an index of abundance.
- b. Four annual measures are produced by site:
 - Pupping season - Maximum and mean number of adults/immatures (combined)
 - Pupping season - Maximum number of pups
 - Molting season - Maximum and mean number of individuals (pups/adults/immatures combined)
 - Non-molting and non-pupping season – maximum numbers of adults/immatures (combined).

During all surveys, some harbor seals are in the water and cannot be counted. Consequently, aerial and shore-based surveys of seals at their haul-out sites measure only a proportion of the population. If survey methods and timing are standardized and the proportion of animals counted remains constant; such surveys can be used as reliable indices of population trends. The current population estimator is 1.3 times the number of seals onshore (Jeffries et al. 2002). Population trends are evaluated by regression analyses of selected indices from above (Sydeman and Allen 1999; e.g. maximum pups per year).

In order to contribute to statewide surveys and evaluate the SFA Network sites in context of the larger population, standardized estimates of total population are also calculated. Data collected at PORE and GOGA are combined with surveys conducted in SF Bay and Sonoma County to produce an annual regional population estimate.

The following equation is used to calculate the estimate: maximum count during the molt, for all age classes and sites combined, multiplied by 1.30 (Boveng et al. 1988; Jeffries et al. 2002). This correction factor is also used in statewide surveys. Approximately 95% of the sites at PORE are counted. NMFS is developing a new estimator for California based on mark-recapture of harbor seals statewide in California. Forty harbor seals were captured in Point Reyes out of around 120 seals in the state to develop the statewide estimator (M. Lowry, NMFS, pers. com).

2. *Monitor Distribution*

- a. Annual distribution of pupping and haul-out sites using direct counts - to identify expansion and contraction of colony and manage for changes.

3. Monitor Reproductive Success

- a. Annual maximum pup production as an index of annual reproductive success using direct counts of pups by site.

Evaluate trends in productivity using linear or quadratic regression models and rate of increase (Zar 1984, Caughley 1971). Surveys conducted in April and May are used for population growth during the pupping season, before pups become undistinguishable from adults/immatures at a distance. Care is taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years is evaluated by site.

4. Monitor Disturbance

- a. Annual analysis of sources for disturbance (e.g. human, dog, boat, other),
- b. Annual analysis of rate of disturbance by site (presented as number of disturbances/hour of survey),
- c. Annual comparison of weekday and weekend disturbance rates, and
- d. Five-year analysis of the number of potential versus actual disturbance sources.

Evaluate trends in disturbances using frequency distributions. Test with a t-test differences in weekday and weekend disturbance rates and between sites. Care is taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years is evaluated by site.

Northern Elephant Seals

1. Monitor Population size

- a. Annual and long-term trends in population size by age and sex class using direct counts

During all surveys, some elephant seals are in the water and cannot be counted. Consequently, aerial and shore-based surveys of seals at their haul-out sites measure only a proportion of the population. If survey methods and timing are standardized and the proportion of animals counted remains constant; such surveys can be used as reliable indices of population trends. Population trends are evaluated by regression analyses of selected indices such as adult females per year (Sydeman and Allen 1999).

In order to contribute to national surveys and evaluate the SFA Network sites in context of the larger population, standardized estimates of total population are also calculated. Data collected at PORE are combined with surveys conducted at other northern elephant seal colonies including Ano Nuevo and the Channel Islands to produce an annual national population estimate (Barlow et al. 1993, Forney et al. 2002).

2. Monitor Reproductive Success

- a. Annual pup production and trends as an index of annual reproductive success using direct counts of females, pups, and applying correction factors.

We estimated two parameters for reproductive productivity, (1) *pup production* by using the total number of females adjusted by an estimated natality rate (proportion of females giving birth each year; Sydeman and Nur 1994), and (2) *pup survival* using adjusted direct counts of weaned pups divided by pup production.

We estimate the total number of breeding females using the weekly mean - maximum count of adult females during peak pupping (approximately 27 January to 3 February) adjusted by including peak counts 33 days prior and 33 days after the peak count (Le Boeuf and Laws 1994, Adams 1993). This adjustment takes into account females that depart early and those that have not yet arrived at the time of the peak count (average female stay at colony is 6 days arrival prior to pup + 27 days nursing period; Le Boeuf and Laws 1994).

The maximum number of females is estimated in this manner for each site and season. Because all females do not give birth in all years, the female count is multiplied by a natality rate (proportion of females giving birth). We use two natality rates, 93 and 98%, corresponding to reported values for an expanding (Año Nuevo) and stable (Southeastern Farallon Islands) population where good estimates were obtained. Expanding or new colonies are thought to have lower natality because females are younger and therefore have lower birth rates than at more established colony sites. Until a valid natality rate for the PORE population is estimated, we assume these values encompass the potential variability in this parameter for this colony. We also present raw count data for which new productivity values can be estimated when more recent data is available.

To obtain pup survival, we divide the actual pup count (adjusted) divided by estimated pup production. Similar to female counts, pup counts were adjusted by taking the peak count and adding those counted 27 days prior and after the peak (27 day = mean nursing period) and including known pup mortality (i.e. dead pups) and weanling counts (Stewart et al. 1994). Rates of change in births are evaluated by regression using linear and exponential models (see Sydeman and Allen 1999).

3. Monitor Population Ecology

- a. Annual pup mortality using direct counts - to identify local factors affecting the population.

Pup mortality is estimated indirectly by subtracting the maximum number of weaned pups counted in late February from the estimate of births derived from the adjusted female counts (from above). These data are then compared to environmental data such as ENSO events, winter storm events and erosion of haul out beaches.

4. Monitor Disturbance

- a. Annual analysis of sources for disturbance (e.g. human, dog, cattle, other).
- b. Five-year analysis of the number of potential versus actual disturbance sources.

Evaluate trends in disturbances using frequency distributions. Care is taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years is evaluated by site.

All Species Pinniped

1. Data summaries will be provided as:

- Histograms presenting the seasonal occurrence and distribution of pinniped species at PR Headlands and Drakes Beach,
- Tabular data on maximum and average numbers by season
- Five-year analysis to detect trends in population distribution and abundance.
- Annual births of species such as California or Steller sea lion.

Stranding Network

1. Data summaries will be provided as:

- Data are provided to NMFS through the Stranding Network.
- Data are linked to GIS for spatially mapping distribution of strandings.

Reports

NPS Annual Report

Brief summary of the year (5-10 page report) with population numbers, pups produced, mortality events, disturbances and any natural history items of note. Standardized table format for general interpretation and updates. Figures are updated with new productivity and survey data in the following file: u:\science\presentations\pinnipeds.ppt

NPS 5-yr Report

Beginning in 1997, the park initiated a 5-year report, summarizing the status and trends of the breeding populations of harbor seals and northern elephant seals. The first five-year reports are completed (Allen et al. 2004, Nevins et al. 2004).

Harbor seal weekly breeding summary

A standardized graph presenting the attendance of harbor seals at PORE and GOGA for the purpose of updating the superintendent, the staff of interpretation, volunteer monitors, and the public via the website. The digital graph format presents the previous and current year weekly maximum counts by site and is located at u:\science\Phoca\Reports\ phoca weekly report 04.ppt.

Northern elephant seal weekly breeding summary

A standardized graph presenting the attendance of elephant seals at PORE for the purpose of updating the superintendent, the staff and docents of interpretation, and the public via the website. The digital graph format presents the previous and current year weekly maximum counts by site and is located at u:\science\Eseal\Report\es weekly report 04.ppt.

NMFS reports

The parks are conducting research under NMFS Office of Protected Species permit 373-1575, last issued in 1999. The research at the parks is conducted in cooperation with PRBO, who is conducting research on pinnipeds on the Farallon Islands NWR. Research on harbor seals tagged in San Francisco Bay for the SFSU study also occurs under this permit. The digital copies of current and past reports are located u:\science\Pinniped\NMFS\reports. Permit renewals are required every five years and the next renewal is due in October 2005.

The NMFS reports are required annually and include information on seals tagged, location, date, and age-sex of individual, and resighting of tags from non-PORE sites, and on the number of seals disturbed during research activities.

SOP 10: Protocol revision

The protocol and SOPs will be updated annually at the beginning of each fiscal year as new information is obtained and methods are refined. For example, contacts, phone numbers, sources for equipment may change annually. Seal haul out sites may change from year to year due to disturbance or changes in habitat. The protocol will be revised to accommodate these changes.

Changes to the SOPs and to the protocol narrative will include a log of revision history. Archives of revisions of protocols and SOPs (paper and digital) will be housed in the Science Division Office.

Additionally, NPS staff will conduct a detailed and critical analysis of the protocol narrative every five years following a rigorous five-year data analysis and reporting. The revised protocol should then be submitted for peer-review by three experts. NPS staff should then make changes to the protocol, when possible or appropriate, based on the results of the five-year reports and the recommendations of experts. Any structural changes in the protocol must be compatible with the NMFS programs to ensure data can be included in larger national datasets. Any structural changes in the protocol also must ensure that data from earlier years can be included in future analyses.

Any changes to the protocol must also take into account an overlap period, where appropriate, so that data are comparable over time. An overlap period of at least two years should be followed for structural changes in field data collection; however, changes in data analysis may only require one year of overlap. The addition of new locations to survey will not require a period of overlap.

See data management section for handling archived data and accommodating changes in software.

SOP: Survey forms for protocols

The following forms are attached:

- Harbor seal survey form
- Harbor seal disturbance form
- Northern elephant seal survey form
- Northern elephant seal resight form
- Northern elephant seal mark form
- All species survey form

Page ____ of ____

Start Time:_____ **End Time**_____ **Observers:**_____

White Pelicans:_____ **Brown Pelicans:**_____

*SUBSITE: Drakes Estero (A=A sandbar, A1=A1 sandbar, AB=Back of A sandbar, DEM=Drakes Estero Mouth,

OB=Oyster Bar, UEF=Up Estero Far, UEN=Up Estero Near, L=Limantour Spit, DB=Drake's Beach)

Double Point (SB= South Beach, NB=North Beach, NBR=North Beach Rock, TP=Tide Pools, SP=South Point, SS=Stormy Stack)

Tomales Point Oceanside(BR=Bird Rock, RB=Rope Beach, TRB=Two Rock Beach) **Tomales Bay** (SI=Seal Island, CI=Clam Island, HI=Hog Island)

Bolinas Lagoon (KI=Kent Island, PWI=Pickleweed Island, HWY1= Highway 1 channel) **Duxbury Reef** (DUX=Duxbury Reef)

POINT REYES NATIONAL SEASHORE HARBOR SEAL DISTURBANCE SURVEY

Date:_____ Year_____ Location:_____ Observers:_____

[illegible]

Phocafrm03.doc 5/17/04

*SUBSITE: Drakes Estero (A=A sandbar; A1=A1 sandbar; AB=Back of A sandbar, DEM=Drakes Estero Mouth, OB=Oyster Bar, UEF=Up Estero Far, UEN=Up Estero Near, L=Limantour Spit) Double Point (SB= South Beach; NB=North Beach; TP=Tide Pools; SP=South point; SS=Stormy Stack) Tomales Point (BR=Bird Rock, RB=Rope Beach, TRB=Two Rock Beach) Tomales Bay (SI=Seal Island, CI=Clam Island) Bolinas Lagoon (KI=Kent Island, PWI=Pickleweed Island, HWY1= Highway 1 channel) Duxbury Reef (DUX=Duxbury Reef)

****SOURCE (include number):** aircraft (helicopter/fixed wing plane), bird, clammer, dog, fisherman, human, non-motor boat, motor boat, researcher, swimmer, unknown, other

***SEAL BEHAVIOR: NR=no response; HA=head alert; F=flush; FW=flush into water

REYES NATIONAL SEASHORE ELEPHANT SEAL SURVEY

Date:_____ Time Begin:_____ End: _____ Obsr:_____ Vis:_____ No.____ Type:____ Entered ____

Site	PRH							NDB			SB			OTR			Total
Sub-Site	C1	C2	C3	C4	TIP	LB	DSB	NDB	LBS	GUS	LTH	NUN	MEN	CRC	SLO		
BULL																	
SA4																	
SA3																	
SA2																	
SA1																	
Other SA																	
COW																	
PUP																	
Dead Pup																	
WNR																	
IMM																	
YRLNG																	
PHOCA																	
ZALOPHUS																	
OTHER																	

LB=Loser Beach; DSB=Dead Seal Beach; SB=South Beach; NDB=North Drakes Beach; LBS= Life Boat Station; GUS=Gus's Cove; LTH=Lighthouse; NUN=Nunnes Ranch; MEN=Mendoza Ranch; SLO=Sea Lion Overlook; CRC=Chimney Rock Cove; OTR=Other Visibility: 1= Good, 2= Fair, 3= Poor, weather makes obs. difficult. Revised 11/00

Comments: _____

Phoca Flushed _____

Disturbance Noted ☐

Example of northern elephant seal resight form.

PORE Elephant Seal
Resight Form

Entered

Date Time Begin End Observers

Survey # Prec. Clouds Wind Speed Wind Dir. Swell Height

Prec: 1=Rain, 0=None; **Clouds:** 0=Clear, 1=Partly, 2=Total overcast; **Wind:** 0=None, 1=Light, 2=Medium, 3=Strong.

Line	Site	Sub-site	Size	Sex	Condition	Dye		L Tag			R Tag				Reprod. Status		
						Number	Code	Color	Number	Pos	Color	Number	Pos	Code	Bull/Cow Status	P Size	Notes
1																	
2																	
3																	
4																	

Example of northern elephant seal mark form.

PORT REYES ELEPHANT SEAL DYE RECORDS FORM

Seals dyed by location: D = North Drakes Beach, S = South Beach, M = Main Colony (PRH),
L = Lifeboat Station. Check out a number series block before applying any dye numbers.

DYE	DATE	SITE	AGE	SEX	LTAG	RTAG	DYE2	OTHR	OBSR
M1									
M2									
M3									
M4									
M5									
M6									
M7									
M8									
M9									
M10									
M11									
M12									
M13									
M14									
M15									
M16									
M17									
M18									
M19									
M20									
M21									
M22									

Example of all species of pinniped survey form.

POINT REYES NATIONAL SEASHORE PINNIPED SURVEY

Date: _____ Time Begin: _____ End: _____ Obsr: _____ Vis: _____ No. _____ Type: _____ Entered _____

Site	PRH							NDB			SB			OTR			Total
Sub-Site	C1	C2	C3	C4	TIP	LB	DSB	NDB	LBS	GUS	LTH	NUN	MEN	CRC	SLO		
BULL																	
SA4																	
SA3																	
SA2																	
SA1																	
Other SA																	
COW																	
PUP																	
Dead Pup																	
WNR																	
IMM																	
YRLNG																	
PHOCA																	
ZALOPHUS																	
OTHER																	

LB=Loser Beach; DSB=Dead Seal Beach; SB=South Beach; NDB=North Drakes Beach; LBS= Life Boat Station; GUS=Gus's Cove; LTH=Lighthouse; NUN=Nunnes Ranch; MEN=Mendoza Ranch; SLO=Sea Lion Overlook; CRC=Chimney Rock Cove; OTR=Other Visibility: 1= Good, 2= Fair, 3= Poor, weather makes obs. difficult. Revised 11/00

Comments: _____

Phoca Flushed _____

Disturbance Noted ☐

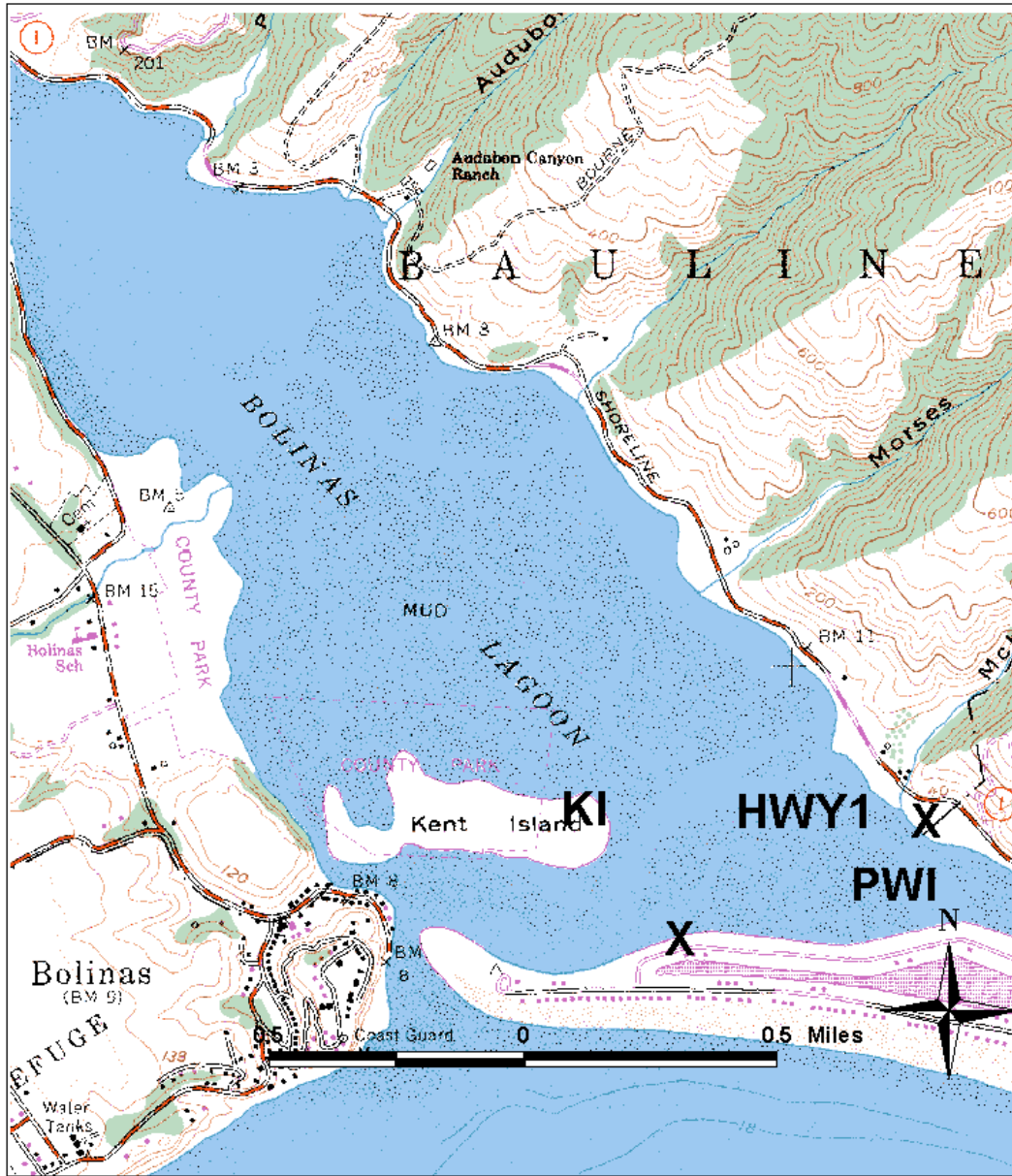
SOP: Survey maps for protocols

Harbor seal survey locations

The following maps are attached:

- Bolinas Lagoon
- Double Point
- Drakes Estero and Limantour Estero
- Duxbury Reef
- Point Bonita
- Point Reyes Headland
- Tomales Bay and Tomales Point

BOLINAS LAGOON



Map of Bolinas Lagoon haul out sites. Sub-sites include: KI = Kent Island, HWY1 = Highway 1 sand bars, PWI = Pickle Weed Island. X= Observation Points

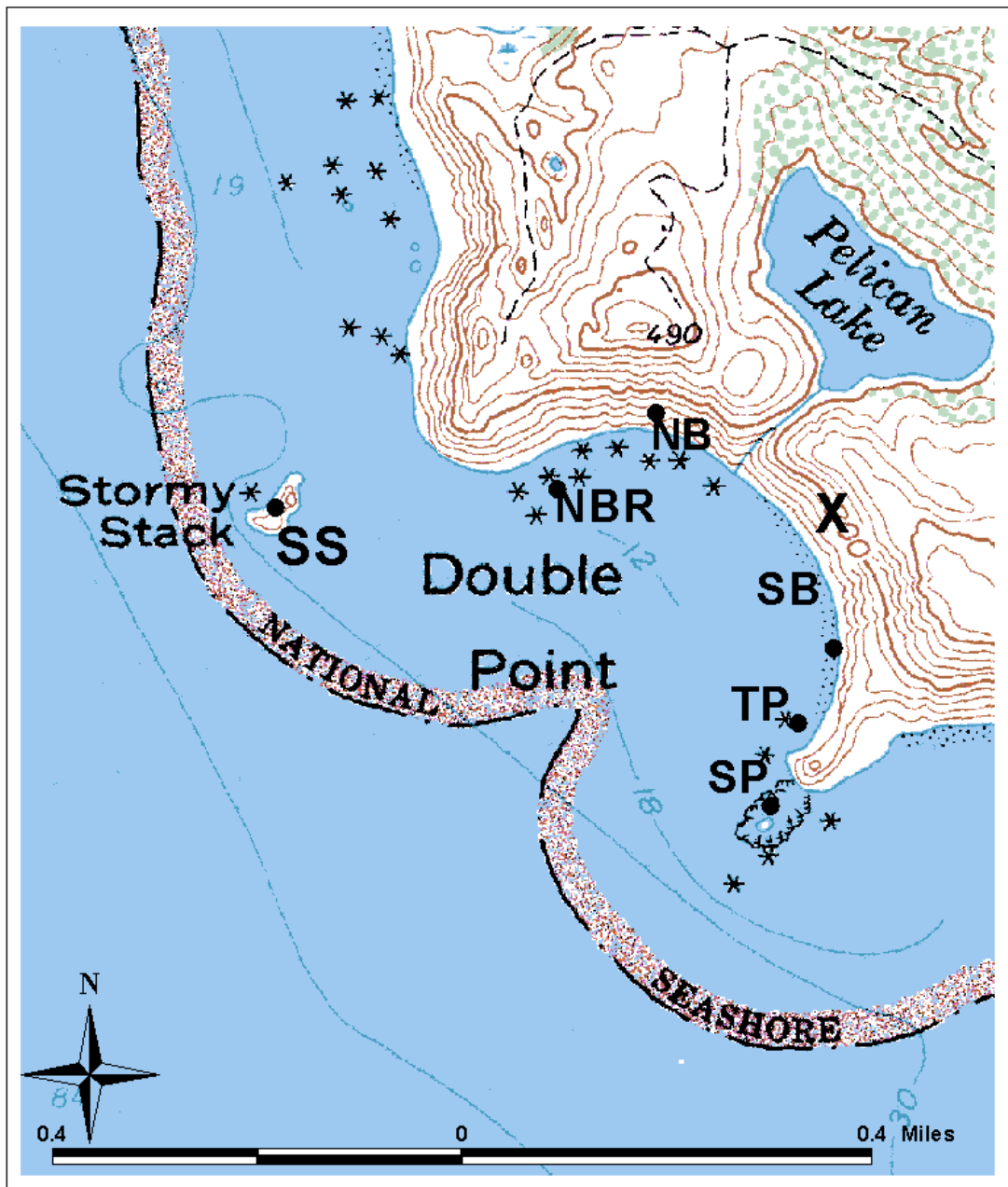
DUXBURY REEF



Map of Duxbury Reef haul out site. DUX = Duxbury Reef

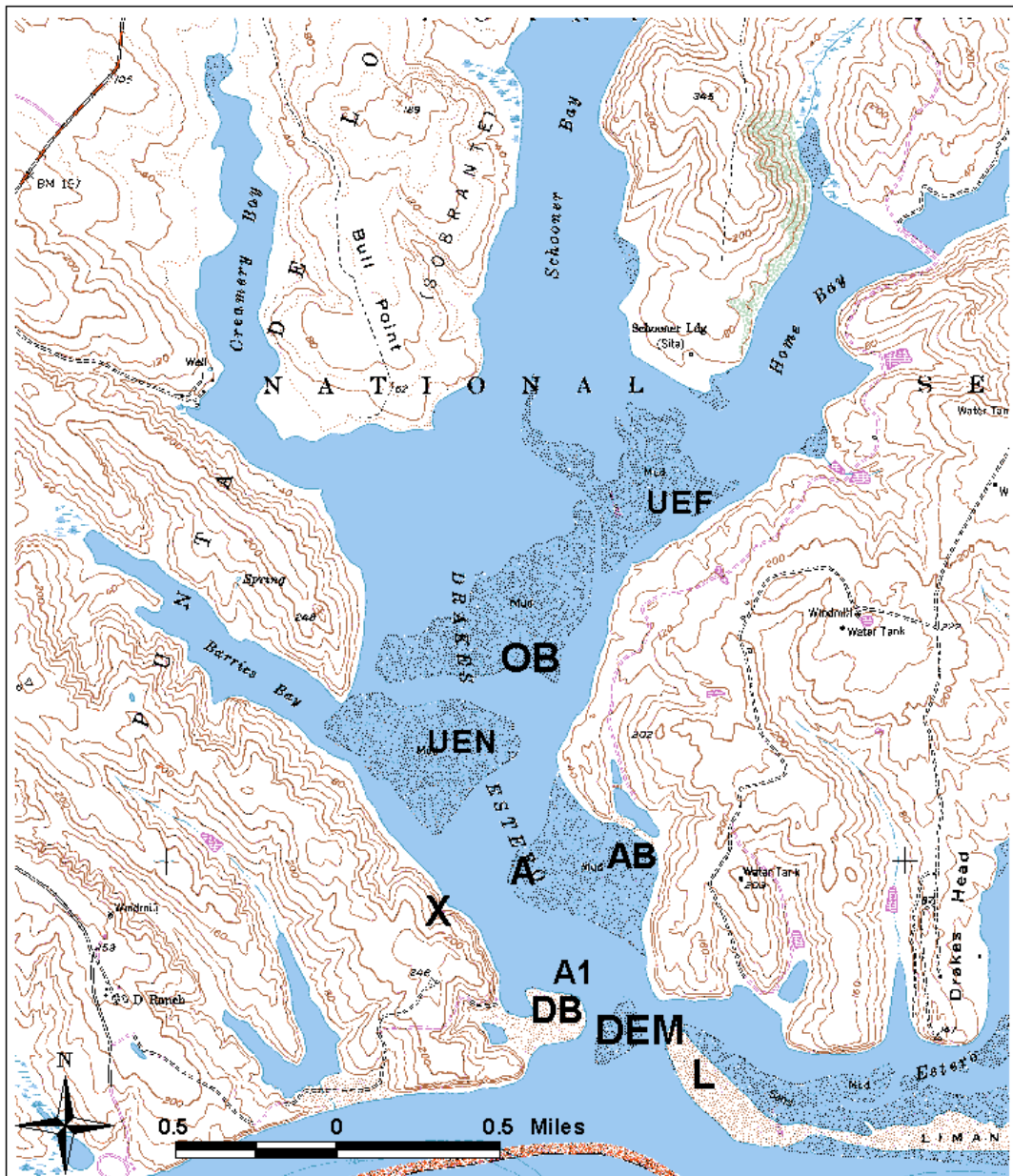
0.5 0 0.5 Miles

DOUBLE POINT



Map of Double Point haul out sites. Sub-sites include: SP = South Point, TP = Tide Pools, SB = South Beach, NB = North Beach, NBR = North Beach Rocks, SS = Stormy Stack. X= Observation Point.

DRAKES ESTERO



Map of Drake's Estero haul out sites. Sub-sites include: L = Limantour Spit, DEM = Drake's mouth sandbars, DB = Drake's Beach, sandbars attached to land. A1 = sandbar next to main haul out, A = sandbar main haul out, AB = back of A sandbar, UEM = Upper Estero Middle, OB = Oyster Bar, UEF = Upper Estero Far. X=Observation Point.

POINT BONITA

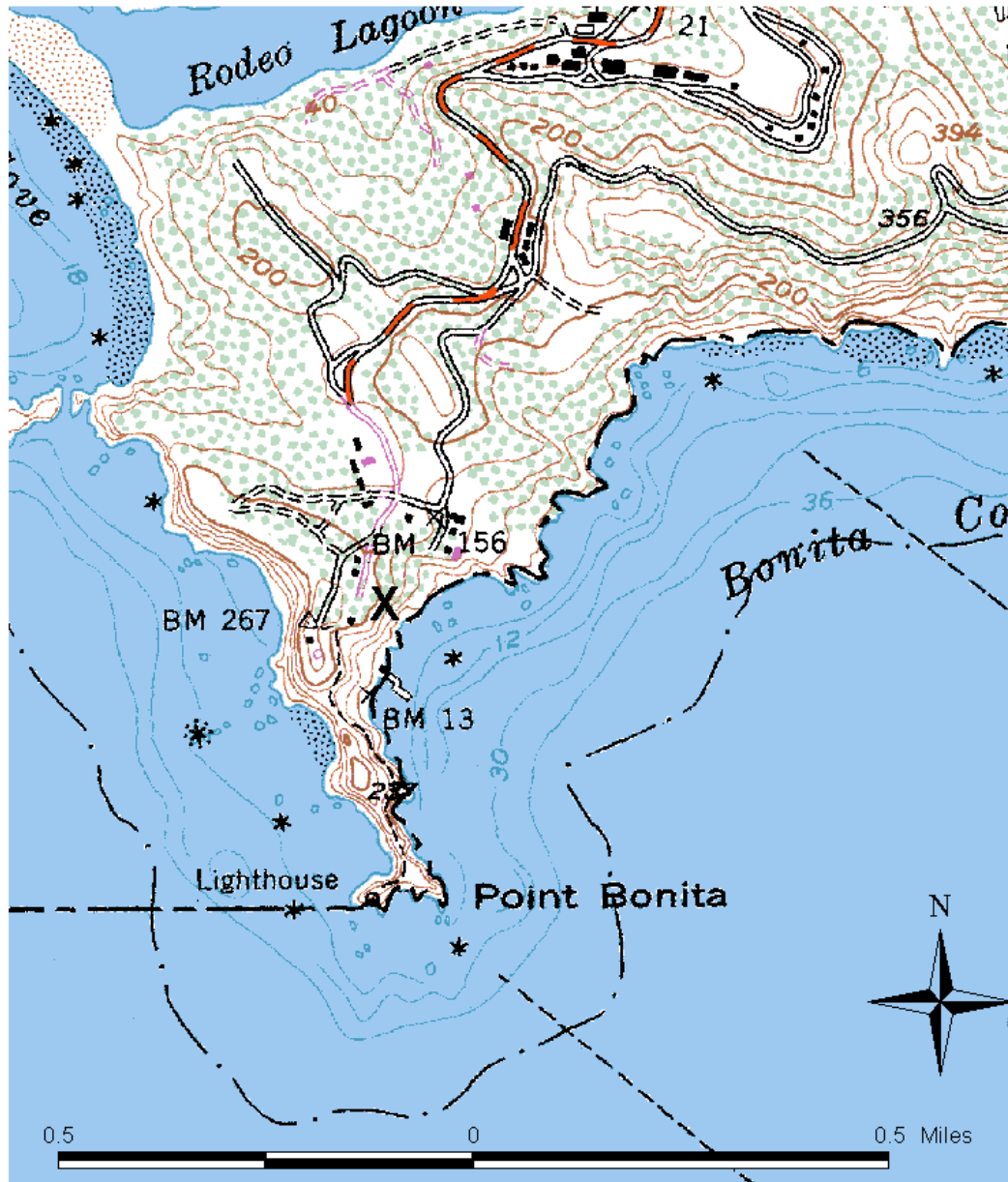
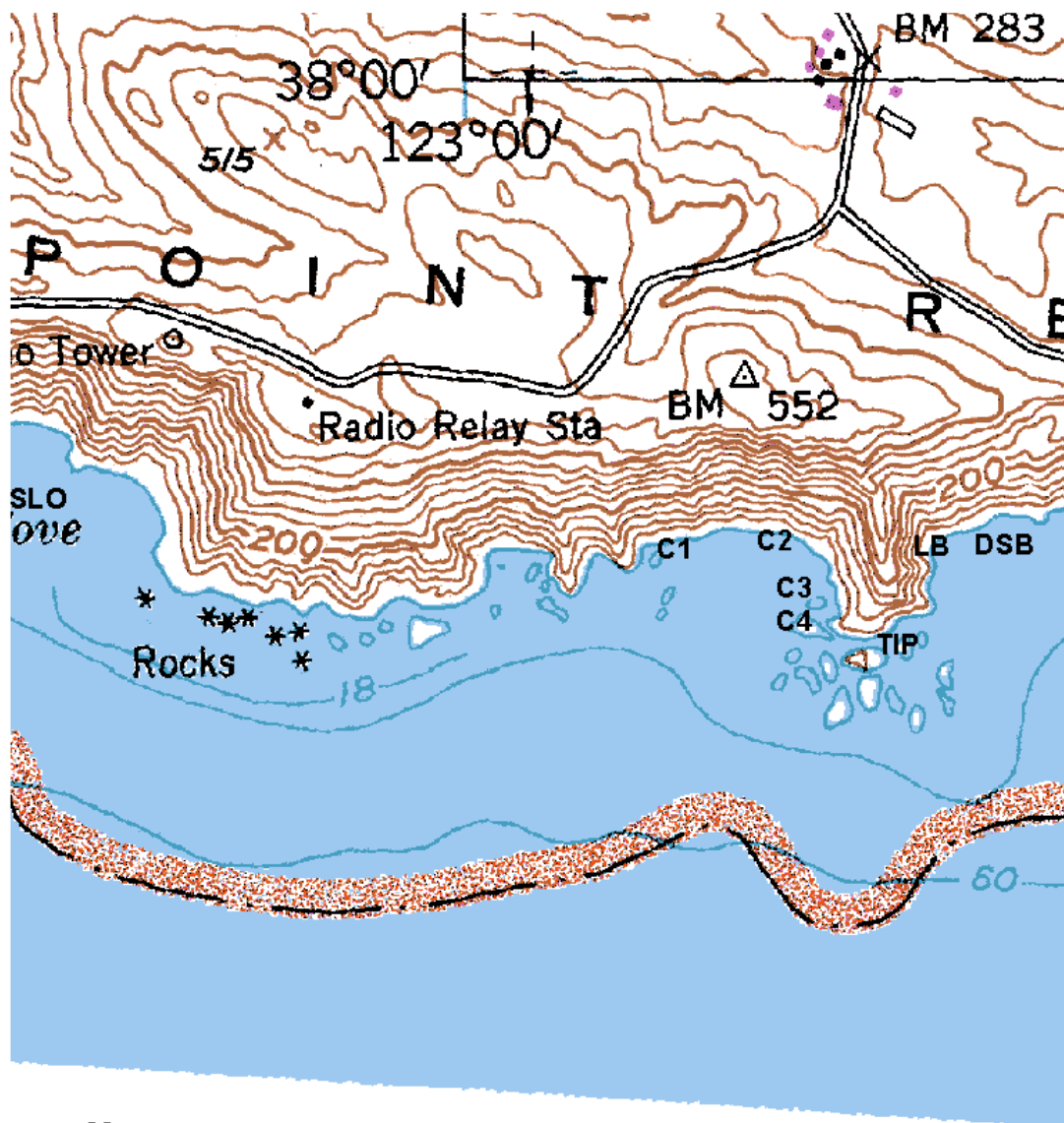


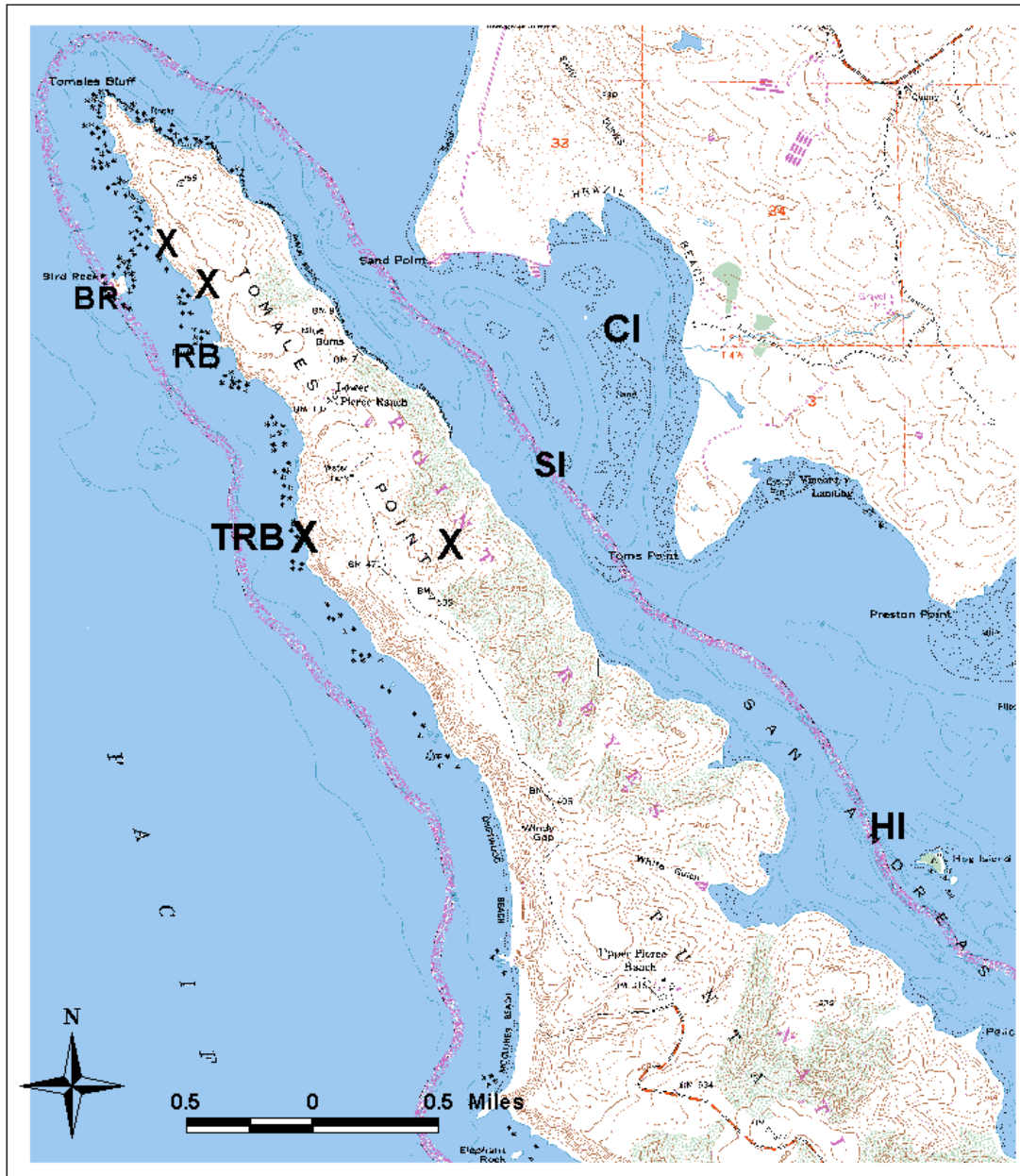
Figure 1. Map of Point Bonita haul out sites.



0 0.5 Miles

Map of Point Reyes Headlands elephant seal haul out sites. Main Colony Sub-sites include: C1 = Cove 1, C2 = Cove 2, C3 = Cove 3, C4 = Cove 4, TIP = Tip of Main Colony, DSB = Dead Seal Beach, LB = Loser Beach.

TOMALES BAY/ TOMALES POINT

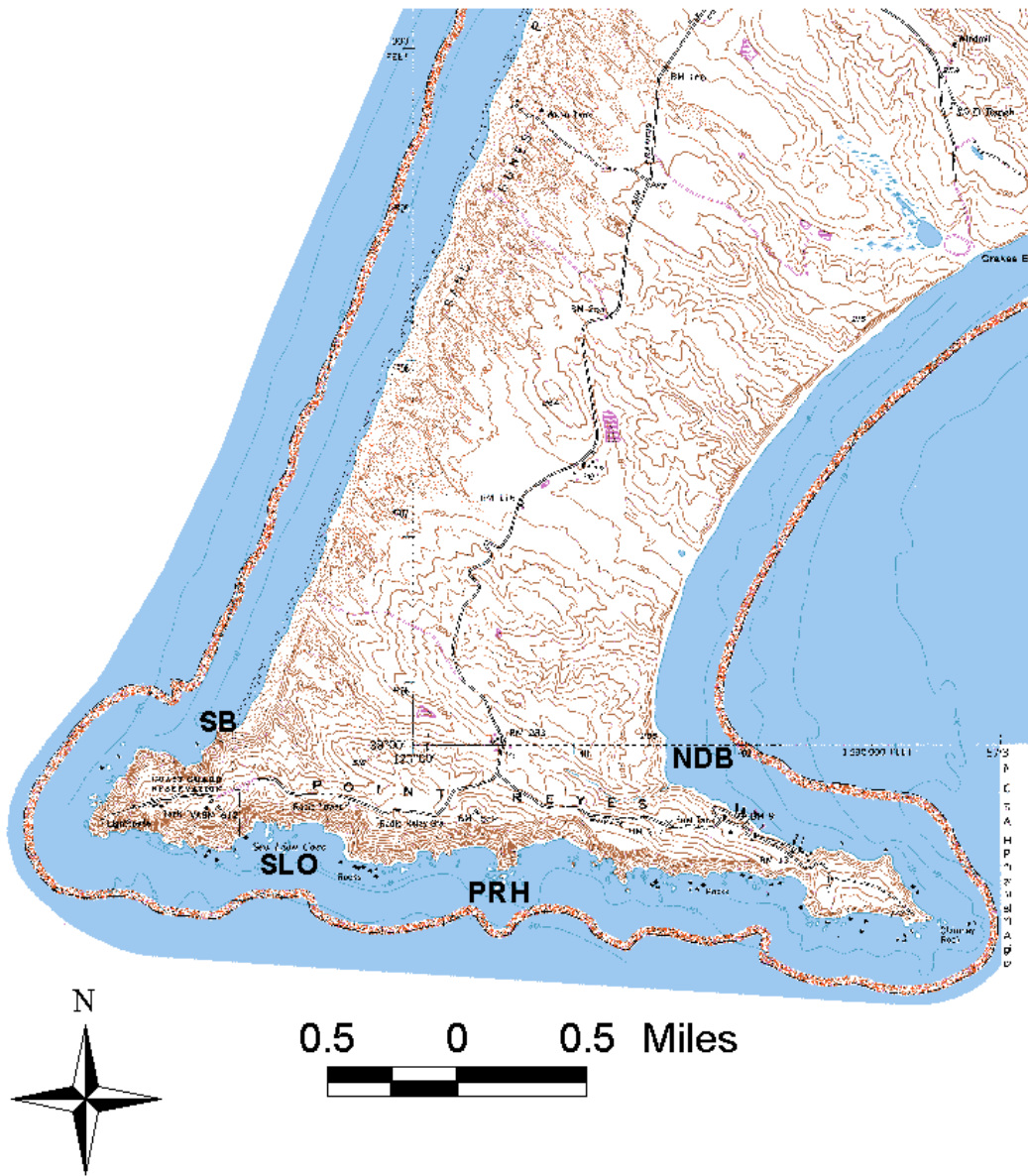


Map of Tomales Bay and Tomales Point haul out sites. Bay Sub-sites include: CI = Clam Island, SI = Seal Island, HI = Hog Island, Point Sub-sites include: BR = Bird Rock, RB = Rope Beach, TRB = Two Rock Beach. X=Observation Point.

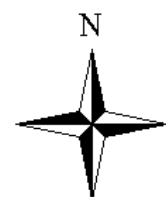
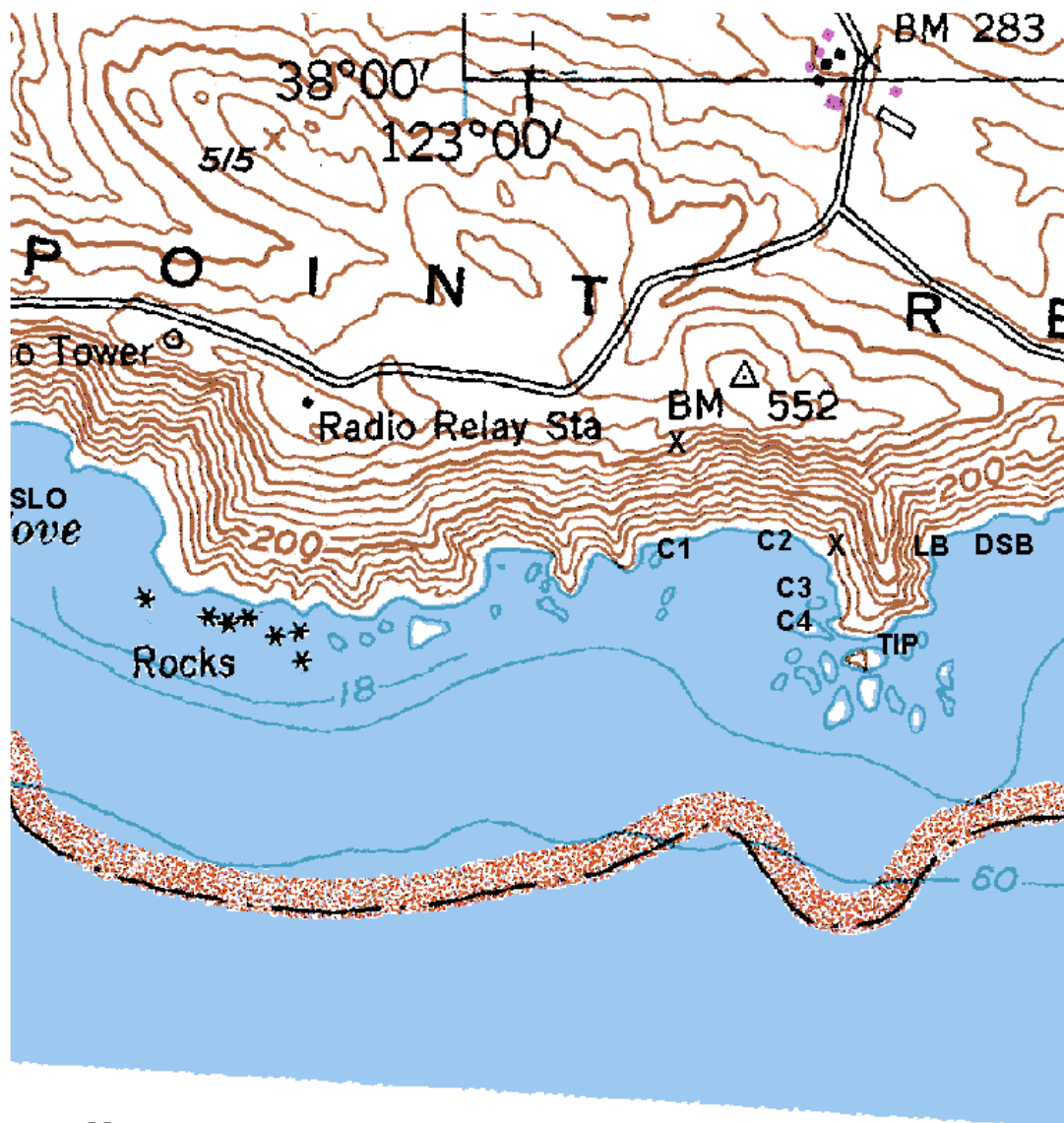
Northern elephant seal survey locations

The following maps are attached:

- Point Reyes Headland - General
- Point Reyes Headland - Main colony
- South Beach
- Chimney Rock

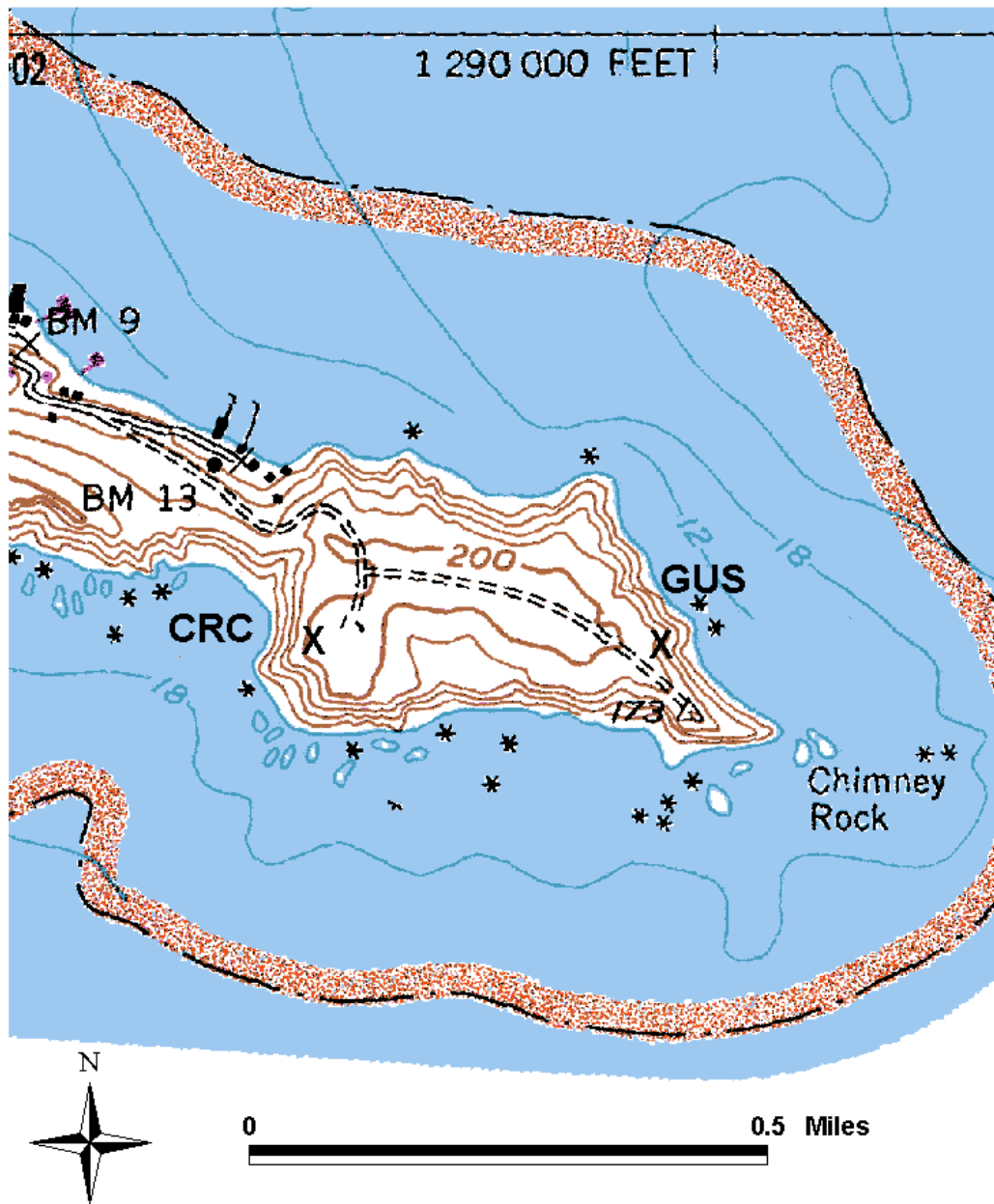


Map of Point Reyes Headlands haul out sites. Sub-sites include: SLO = Sea Lion Overlook, NDB = North Drakes Beach, PRH = Main Colony sites, SB = South Beach.



0 0.5 Miles

Map of Point Reyes Headlands elephant seal haul out sites. Main Colony Sub-sites include:
 C1 = Cove 1, C2 = Cove 2, C3 = Cove 3, C4 = Cove 4, TIP = Tip of Main Colony,
 DSB = Dead Seal Beach, LB = Loser Beach.

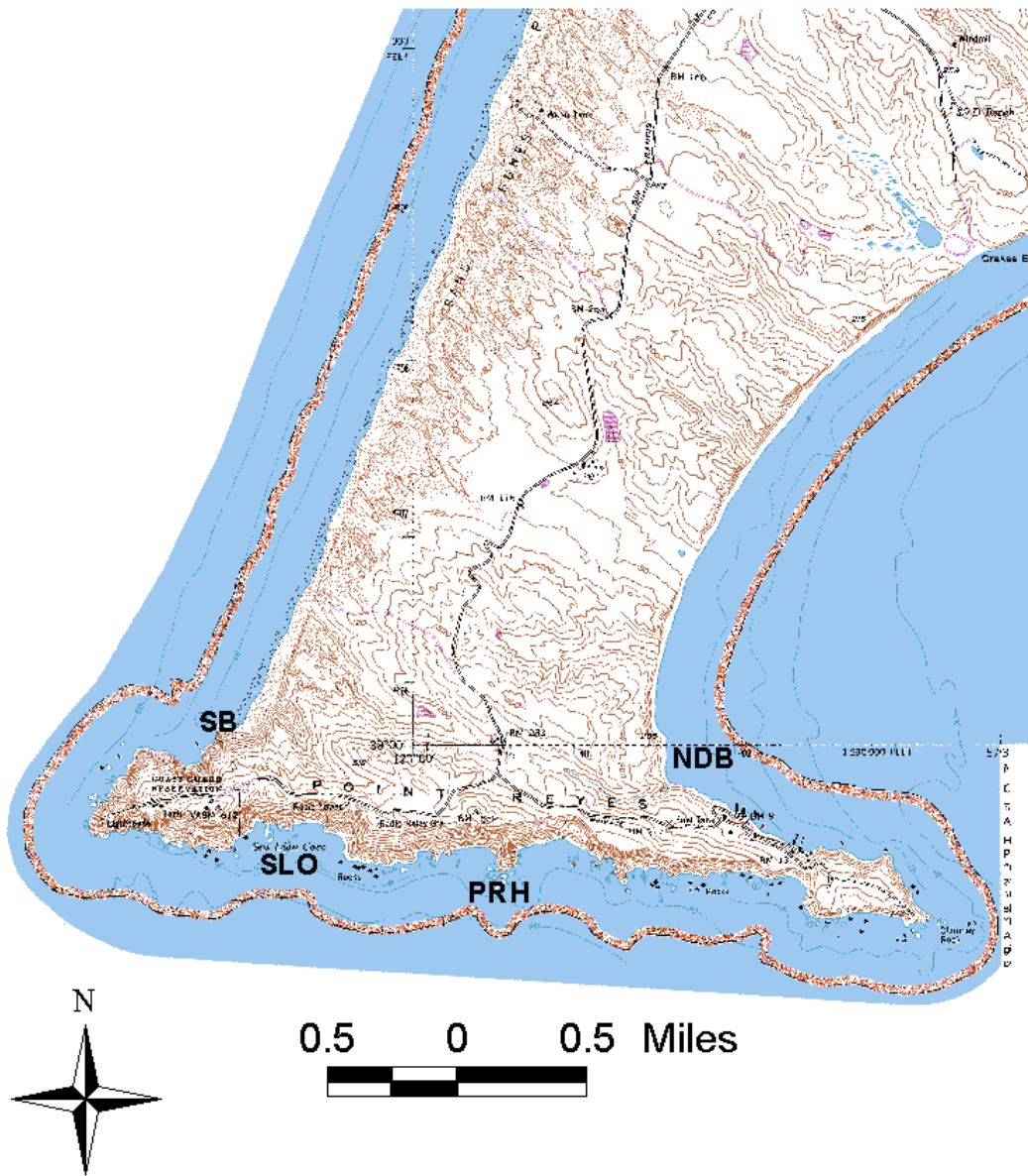


Map of Chimney Rock haul out sites. Sub-sites include: CRC = Chimney Rock Cove, GUS = Gus's Cove.

All species survey locations

The maps used for the all species surveys include two from northern elephant seal surveys. (Examples of Point Reyes Headland locations are in previous section.)

- Point Reyes Headland - General
- Point Reyes Headland - Main colony



Map of Point Reyes Headlands haul out sites. Sub-sites include: SLO = Sea Lion Overlook, NDB = North Drakes Beach, PRH = Main Colony sites, SB = South Beach.

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Appendix I. Species Accounts (under development)

Pinnipeds that occur in the SFAN network of parks.

<i>Scientific name</i>	Common name	Federal status	Park(s)
<u>Pinnipeds</u>			
<i>Arctocephalus townsendi</i>	Guadalupe fur seal	FT	PORE
<i>Callorhinus ursinus</i>	Northern fur seal	(FSC)	PORE
<i>Eumetopias jubatus</i>	Steller sea lion	FT	GOGA, PORE
<i>Mirounga angustirostris</i>	Northern elephant seal		PORE
<i>Phoca vitulina richardii</i>	Harbor seal		GOGA, PORE
<i>Zalophus californianus</i>	California sea lion		GOGA, PORE

Federal Listing Status

FC = Federal Candidate Species; FE = Federally Endangered; FSC = Federal Species of Concern – former Category 2 candidates (no longer an active, legal term); FT = Federally Threatened

SPECIES PROFILES

California Sea Lion



Sub-order – Pinnipedia

Family - Otariidae (eared seals)

Subfamily - Otariinae (sea lions)

Genus species - *Zalophus californianus*

Similar subspecies - *Z. c. japonicus* (Japanese sea lion - extinct), *Z. c. wolfebaeki* (Galapagos sea lion)

Special Status/Protection

Protected under the Marine Mammal Protection Act. No other special California or U.S. status designated

Killing of California sea lions has been banned in Mexico and Canada since 1969 and 1970, respectively.

Natural History

Habitat

California sea lions forage over the continental shelf off central California more often than over deeper break and slope habitats. Characterize haul-out sites and interspecies interactions?

Cycles - migration and reproduction

The breeding season for California sea lions lasts from May to July. Presently, no sites in SFBN have been used for pupping in recent years, although females have begun pupping on nearby islands (Ano Nuevo Island and Southeast Farallon Island) and expansion to mainland sites is likely. One pup was born at PORE at Wildcat Beach in 2003.

Typically, during the breeding season, individuals at PORE are predominantly immatures and subadult males. At breeding sites, the adult males arrive at the start of the season in order to establish territories where a number of females haul out to give birth. Females usually give birth 4-5 days after coming ashore. Pups are born from mid-June to mid-July with a dark brown to black coat that they will molt for a lighter brown color within a month, and will molt again after 5-6 months and appear like that of adult female pelage. The mother nurses her pup for about 8 days before leaving to feed at sea, beginning a cycle of alternately feeding at sea for 2-4 days, usually within 100km of the rookery, and nursing her pup on shore for about 1-3 days. About 3-4 weeks after her pup is born, the mother mates with a territorial male, usually in the water or at the water's edge. Territorial males can mate with many females. Nursing lasts 4-8 months although some mothers have been observed nursing their pup for over a year.

After the breeding season, male adults and subadults migrate northwards to feed and winter along the coasts of California, Oregon, Washington and British Columbia. In central California, numbers increase dramatically after July. Many of the males from Baja California spend the winter in California. Return southern migrations occur from March to May. The majority of females are thought to stay near the rookeries year round. Adult females and immature sea lions molt from August to October, adult males from November to February.

Both males and females of the species reach sexual maturity at about 4-5 years of age, but males may not achieve territorial status until approximately 8-9 years of age. It is thought that they can live for 15-24 years.

Trophic Dynamics

California sea lions generally feed on prey that school or form dense aggregations, diverging from this feeding pattern when their normal prey is not as abundant or not available, as happens for example during moderate and severe El Niño events. Normal prey for California sea lions includes anchovies, sardine, whiting, mackerel, rockfish and market squid (Lowry et al. 1990). California sea lions have also been observed feeding on chicks of the Common Murre. Predators of the sea lions include white sharks, Orcas, and humans.

representative graph of attendance and breeding cycle at PORE

J F M A M J J U A S O N D

B+++F- -----I?

Population Status

Global - Current and Historical Distribution and Abundance

The California sea lion is found from southern Mexico up to British Columbia and breeds almost entirely on islands in southern California, western Baja California and the Gulf of California. It is estimated that there are around 210,000 California sea lions in the United States and there are believed to be 31,000 in the Gulf of California (cite?).

The U.S. population was increasing at a rate of about 10% annually. In 1990, NMFS estimated that the U.S. population was 111,000 individuals.

The California sea lion population, which occurs from the offshore islands of Mexico north to Vancouver Island, British Columbia, has increased substantially this century. Following passage of the Marine Mammal Protection Act (MMPA) in 1972, the California sea lion population off the West Coast of the U.S. increased steadily at an average annual rate of over five percent since the mid-1970s.

Although the population is now very large and may be greater than any time for which we have records, there is no evidence that it has reached its optimal sustainable population level, known as OSP, which is the management goal mandated by the MMPA.

Currently, the California sea lion population off the West Coast of the U.S. is estimated at between 167,000 and 188,000.

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

add ?

Conservation and Management Concerns

Global

A number of human-related interactions, such as incidental take during fishing, entanglement, illegal killing, and pollutants, result in sea lion deaths.

Many of the prey species of California sea lions are also commercially fished, leading to widespread interactions between sea lions and some fisheries, and there is an increasing mortality of sea lions by entanglement in fishing nets and gear throughout their range. The major culprits are set and drift gillnet fisheries, but entanglement also occurs or has occurred in troll, purse seine, trawl, and commercial passenger fishing vessel hook and line fisheries. Available records show that the U.S. fisheries causing the highest mortality are the California set gillnet fishery for halibut and angel shark which kills an average of 1,012 sea lions each year, and the California driftnet fishery for sharks and swordfish which kills an average of 158 sea lions each year. Sea lions are also entangled in nets of the Mexican shark and swordfish drift gillnet fisheries. Some sea lions are released from nets by fishermen and others escape after being entangled, but the subsequent mortality rate of these escapees is unknown

The species can be badly affected by the lack of food caused by El Niño events and there were major reductions in the number of California sea lion pups produced during the 1983-84, 1992-93 and 1997-98 El Niños, pup production falling by 64% in the United States in 1998.

There is currently a great deal of controversy in the United States surrounding plans to allow the selective killing of California sea lions which are being accused of endangering salmon and trout stocks in coastal Washington, Oregon and California. The State of Washington, currently authorized under special permit to kill sea lions in order to protect steelhead trout at the Ballard Locks, has not yet killed any sea lions, but in 1996 captured three of them and transported them to an aquarium. In 1999, the federal National Marine Fisheries Service released a report recommending that Congress allow, in the next reauthorization of the Marine Mammal Protection Act, state and federal wildlife managers to kill California sea lions that are preying on endangered fish species. The report also recommended that authority be given to kill sea lions which pose a threat to public safety and property at locations such as docks and marinas, and that commercial fishermen be allowed to kill sea lions that destroy their catch or gear. Permission for fishermen to kill sea lions in this way was previously withdrawn in 1994. The report has been roundly condemned by animal welfare and conservation groups who argue that effective and humane non-lethal deterrence methods should be developed and that the problem of over fishing should be addressed

Pollution is still seen as a threat to California sea lion populations and may have been the cause of the mass mortality of over 200 sea lions that took place near the island of San Jorge in the northern part of the Mexican Gulf of California in February 1999. An official with the Mexican Environment Ministry in Baja California Sur stated that the mortality may have been caused by Natural Killer 19, a fluorescent chemical containing cyanide, which is used by drug smugglers to mark drop-off points in the water

Specific to SFBA Network populations

Some fishermen illegally shoot California sea lions and there are frequent reports of shot sea lions being washed up on shore. In January 1998, for example, more than a dozen sea lions, including several that were also decapitated, were found shot to death near San Francisco. United States stranding networks reported 78 sea lions as having been found shot in 1998, 70 of which were dead.

In May 1998, nearly 80 California sea lions were washed up in the Monterey area of California suffering from seizures and vomiting, more than 50 dying as a result. Subsequent analysis showed that the cause was a domoic acid toxin from a harmful algal bloom that was concentrated in anchovies and other small marine species eaten by the sea lions. A resultant study of the mortality stated that domoic acid poisoning could also explain other sea lion die-offs in 1978, 1986, 1988 and 1992. An unusually high total of 150 dead California sea lions were reported as having been washed up in California's Ventura County from May-June 2000. A Californian stranding center also reported in August 2000 that since mid-June it had taken in at least 135 California sea lions

exhibiting symptoms indicative of domoic acid poisoning, mostly adult females from San Luis Obispo County, and that over 50 of these had died. There are also occasional outbreaks in the population of the bacterial disease leptospirosis, which not only causes death and debilitation but can also cause reproductive failure in females.

Northern Fur Seal



Family - Otariidae (eared seals)
Sub Family - Arctocephalinae (fur seals)
Genus species - *Callorhinus ursinus*

Special Status/Protection

US MMPA as of 31 Dec. 1994 - listed as “depleted” from NP rim from CA to Japan
The Northern fur seal is listed as **Vulnerable** on the IUCN Red List, and the Pribilof Islands / Bogoslof Island stock is designated as **Depleted** under the U.S. Marine Mammal Protection Act. The species is protected in Canada by the 1993 Marine Mammal Regulations, except for hunting by indigenous peoples.

Natural History

Habitat

Northern fur seals are characterized as a wide-ranging offshore species. Breeding rookeries are generally near the continental slope and are usually predominantly rocky coastlines. The species shows strong fidelity to specific sites. There is a typical structure to fur seal rookeries, the core group of breeding males with females, idle males without females on the fringe of the core area, and idle males and sub-adult males on haul-outs outside the rookery areas.

Cycles - migration, reproduction

Northern fur seal adult males start arriving at the rookeries in May to establish territories that can eventually contain many females. The females start arriving in mid-June and give birth within 2 days of arrival. Pups are born with a black coat. The mother nurses her pup for 8-10 days, usually mating about 5-6 days after her pup's birth, and then leaves to feed at sea. This begins a cycle of feeding at sea for 4-10 days and returning to nurse her pup for 1-2 days, the cycle lasting for about 4 months until the pup is weaned and the

mother leaves to migrate south. The adult males remain ashore while defending their territory during the breeding season and lose up to 20% of their weight since they do not eat during this time.

Adult females normally migrate south in late October to November. Some adult males start their migration in August, while others stay on shore until as late as November. On migrating south, northern fur seals spend the next 6-8 months at sea. Adult males from the Pribilof Islands generally only migrate as far south as the Gulf of Alaska, some remaining in the Bering Sea, while females and juveniles from the Pribilof Islands migrate to offshore waters along the continental shelf from Canada down to California. Females and juveniles in the west migrate as far south as Japan. Individuals are sometimes seen in inshore waters while stragglers occasionally come ashore. Many pups remain at sea for up to 22 months before returning to the breeding islands, very often to the haul-outs surrounding the rookery where they were born.

Females reach sexual maturity at 2-5 years, males at 4-5 years, although males do not start breeding before they are about 8-9 years. Nearly 90% of females in their reproductive prime, 8-13 years old, are pregnant every year with the pregnancy rate gradually decreasing after 13 years of age. The adult male reproductive peak is brief and few adult males breed for more than two seasons. Northern fur seals can live up to about 25 years of age but have a life expectancy at birth of less than 4 years (York 1987).

Trophic Relationships

Studies indicate that northern fur seals feed along the central California coast, mainly off shore, along the continental slope on squid, herring, anchovy, lantern fish, and Pacific saury (cite). Predators include the white shark and humans.

representative graph of attendance at PORE and general breeding cycle

J F M A M J J U A S O N D
BF-----I

Population Status

Global - Current and Historical Distribution and Abundance

The Northern fur seal is found throughout the north Pacific Ocean, ranging from the Bering Sea down to southern California in the east and to central Japan in the west. Almost three quarters of the total population, about 1 million fur seals, breed on the Pribilof Islands of St. George and St. Paul in the southern Bering Sea. Other breeding sites are found on the central Kuril Islands (50,000 - 55,000), Tyuleniy Island in the Okhotsk Sea (55,000 - 65,000), the Commander Islands (225,000 - 230,000), Bogoslof Island in the Aleutian Islands (5,000), and San Miguel Island in southern California (4,300). The total world population is estimated at 1,345,000 - 1,365,000.

Northern fur seals have been subjected to a great deal of intensive commercial hunting for their fur, many millions of the seals being killed following the discovery of the species in the 1700s. Such hunting, particularly unregulated hunting at sea, heavily

reduced the population in the 19th and early 20th centuries and resulted in the signing in 1911 of the North Pacific Fur Seal Convention by the US, Japan, Russia and the UK (for Canada). Among other provisions, the Convention banned the hunting of Northern fur seals at sea and restricted the killing on land to immature males. An experimental hunt of females from 1956-1968 was also intended to stimulate productivity but contributed to a population decline of 6-8% per year from 1975 to 1982

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

Northern fur seals, once abundant along the entire California coastline, have not bred at the Farallon Islands in large numbers since the 1820s. Only since the summer of 1996 have fur seal pups been born on the southeast islands (Pyle et al. citation?). Fur seals do strand on beaches or rest onshore at PORE during ENSO years and intermittently during non-ENSO years.

NMFS stock distinction?

Estimated California population 11,000 on SMI (cite) and ___ on SEFI (cite).

Conservation and Management Concerns

Global

Managers are tracking and monitoring the regulated and unmanaged hunting for population effects. Indirect mortality concerns include oil development, marine debris entanglement, pollution, and prey depletion.

Specific to SFBA Network populations

The rookery on San Miguel Island, California, primarily originated from animals born on the Pribilof Islands during the late 1950s or early 1960s. Studies from monitoring pup production at SMI indicate that the 1997-98 El Niño event has had a long-term impact on this species. Up to 87% of the pups born at the colony in 1997 died before weaning and the population has not yet recovered to prior reproductive levels.

Competition for space? California sea lions

Prey needs unknown?

Likely dominant pinniped in previous centuries.

Guadalupe Fur Seal

Family - Otariidae (eared seals)

Sub Family - Arctocephalinae (fur seals)

Genus species - *Arctocephalus townsendi*

Special Status/Protection

In 1928, the Guadalupe fur seal was considered extinct after most of the population was killed but it was rediscovered in 1954. This species is now fully protected by Mexican national legislation, the Isla de Guadalupe having been declared a pinniped sanctuary in

1975. It is protected in the U.S. portion of its range by Californian law, as a “**Threatened**” species under the U.S. Endangered Species Act in 1985, and as a “**Depleted**” and “**Strategic**” species under the U.S. Marine Mammal Protection Act in 1994. The species is also listed as “**Vulnerable**” on the IUCN Red List and as an “**Appendix I**” species under CITES.

Natural History

Habitat

The Guadalupe fur seal is one of the least-studied of all the fur seal species, due partly to its geographical isolation. However, it is known that Guadalupe fur seals breed at rocky sites or in caves on the eastern coast of Isla de Guadalupe. Guadalupe fur seals are not known to regularly migrate. Research on a group of adult females showed them to be feeding in the California Current south of Isla de Guadalupe, making round trips of 704 - 4,092km (average 2,375km).

Cycles - migration, reproduction

Observations suggest that reproductive males are faithful to particular sites over a number of years. Tenure of territorial males lasts from 35-122 days. Births occur from mid-June through July, with most births taking place in June.

The females start arriving at the breeding sites in June and give birth to a pup within a few days of their arrival. Pups are born from early June to early August with a black coat, similar to the adult coat which is dark brown to black with light tan hairs on the back of the neck. About 7-8 days after the birth of her pup the mother mates and then leaves to feed at sea. This begins a cycle, lasting about 8-9 months, where she will spend an average of 9-13 days at sea before returning to land to nurse her pup for an average of 5-6 days. These feeding and nursing durations are long compared to other eared seals

It is not known how long Guadalupe fur seals can live, but it is thought that males may live over 13 years while females may live up to 23 years.

Trophic Relationships

They are known to feed on squid and fish such as myctophids and mackerel and have been tracked foraging extensively at night. Several species of sharks are known to prey on Guadalupe fur seals.

representative graph of attendance at PORE and general breeding cycle

J F M A M J J A S O N D
BF- -----I?

Population Status

Global - Current and Historical Distribution and Abundance

The rarest fur seal, and only species of *Arctocephalus* found north of the equator, the Guadalupe fur seal breeds on Isla de Guadalupe and Isla Benito del Este off the coast of

Baja California, Mexico. Individuals are also occasionally sighted as far south as Tapachula near the Mexico / Guatemala border, as far north as the Point Reyes National Seashore in California, and in the Gulf of California. There are estimated to be about 7,000 Guadalupe fur seals, the population increasing as it recovers from heavy exploitation

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

The major cause of the Guadalupe fur seal's decline was commercial hunting in the late 1700s and early 1800s, and this species was exterminated in southern California waters by 1825. Commercial sealing continued in Mexican waters through 1894. Currently the Guadalupe fur seal seems to be expanding its range, with regular sightings of animals on San Miguel and San Nicolas Islands off the southern California coast. Including two males documented establishing territories on San Nicolas Island.

Their pre-exploitation range may have extended from the Mexican Revillagigedo Islands north to Monterey Bay in California, and they may have had breeding colonies on the Californian San Miguel and San Nicolas Islands. It is thought that there could have been 20,000 - 100,000 Guadalupe fur seals prior to their commercial exploitation

Conservation and Management Concerns

Global

No recovery plan for this species has been prepared, nor has a recovery team been established. The principal cause of the decline in Guadalupe fur seals was commercial sealing. The species is now protected from such activity throughout its range, and the magnitude of the threat to the species is considered to be low. The portion of the Guadalupe fur seal's range, which is under U.S. jurisdiction, is at the limit of the species range. No activities in areas under U.S. jurisdiction are known to be adversely affecting recovery of this species at the present time. Therefore, management activities in the U.S. portion of its range are not likely to contribute substantially to recovery. However, Guadalupe fur seals are protected from Federal actions that are likely to jeopardize the species through interagency coordination under Section 7 of the Endangered Species Act. No other specific actions necessary for the recovery of the species have been identified, and no direct recovery actions are being implemented (cite).

Specific to SFBA Network Populations

Some Guadalupe fur seals may be killed by entanglement in drift and set gillnets but there is insufficient data on this problem. Individuals, especially juveniles, have also been found stranded on beaches at PORE, particularly during ENSO years and sometimes with injuries caused by entanglement in marine debris. There was a 33% pup mortality in 1992 due to El Niño and Hurricane "Darby" but it is not yet known how the population was affected by the 1997-1998 El Niño event

Steller Sea Lion



Family - Otariid

Subfamily - Otariinae (sea lions)

Genus species - *Eumetopias jubatus*

Other common names - northern sea lion, Steller sea lion (often seen written incorrectly as Steller's sea lion)

Special Status/Protection

Under US ES Act - "threatened" - np rim, CA to Japan

US MmpA as of 31 Dec. 1994 - listed as "depleted" np rim, CA to Japan

The eastern U.S. stock is classified as a "strategic" stock. The status of this stock relative to its Optimum Sustainable Population size is unknown.

Natural History

Habitat

Cycles - migration, reproduction

The Steller sea lion is the largest member of the Otariid (eared seal) family. Bulls become mature between 3 and 8 years of age, but typically are not massive enough to hold territory successfully until 9 or 10 years old. Females reproduce for the first time at 4 to 6 years of age, bearing at most a single pup each year. Pups are born from late May through early July, with peak numbers of births during the second or third week of June. Females stay with their pups for about 9 days before beginning a regular routine of foraging trips to sea. Females mate 11 to 14 days after giving birth. Implantation takes place in late September or early October, after a 3-4 month delay. Weaning is not sharply defined as it is for most other pinniped species, but probably takes place gradually during the winter and spring prior to the following breeding season. It is not uncommon to observe 1- or 2-year-old sea lions suckling from an adult female.

Trophic Relationships

Steller sea lions are opportunistic predators, feeding primarily of a wide variety of fishes and cephalopods. Prey varies geographically and seasonally.

Largely unknown in CA - clues to decline? hard to collect scat at rookeries w/o disturbance, and only represents recent local diet anyway, problem could be during dispersal foraging limitations?

Steller sea lions have been known to prey on harbor seal, fur seal, ringed seal, and possibly sea otter pups, but this would represent only a supplemental component to the diet.

representative graph of attendance and breeding cycle

J F M A M J J A S O N D

B+F-----I

Population Status

Global - Current and Historical Distribution and Abundance

Steller sea lions range along the North Pacific Rim from northern Hokkaido, Japan, to the Channel Islands off California (Loughlin et al. 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The species is not known to migrate, but individuals disperse widely outside of the breeding season (late May-early July), thus potentially intermixing with animals from other areas. Despite the wide-ranging movements of juveniles and adult males in particular, exchange between rookeries by breeding adult females and males (other than between adjoining rookeries) appears low (NMFS 1995); however, resighting data from branded animals have not yet been analyzed.

During the May-to-July breeding season, Steller sea lions congregate at more than 40 rookeries, where adult males defend territories, pups are born, and mating takes place. Non-reproductive animals congregate to rest at more than 200 haul-out sites where little or no breeding takes place (Point Reyes). Sea lions continue to gather at both rookeries and haul-out sites outside of the breeding season.

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

The world population of Steller sea lions includes **two stocks** divided at 144° W longitude (Cape Suckling, just east of Prince William Sound, Alaska). The stock differentiation is based primarily on differences in mitochondrial DNA, but also on differing **population trends** in the two regions. Although, the eastern U. S. stock is stable or increasing in the northern portion of its range (Southeast Alaska and British Columbia), the stock has been declining in the southern end.

In 1996 a total of 6,555 Steller sea lions were counted in California (2,042), Oregon (3,990), and Washington (523), including 5,464 nonpups and 1,091 pups.

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 5,000 and 7,000 non-pups with no apparent trend, but have subsequently declined by over 50%, remaining between 1,500 to 2,000 non-pups during 1980-98. Limited information suggests that counts in northern California appear to be stable

(NMFS 1995). At Año Nuevo, (central) California, a steady decline in ground counts started around 1970, resulting in an 85% reduction in the breeding population by 1987 (Le Boeuf et al. 1991). In vertical aerial photographic counts conducted at Año Nuevo, pups declined at a rate of 9.9% from 1990 to 1993, while non-pups declined at a rate of 31.5% over the same time period (Westlake et al. 1997).

Seller sea lions pupped at PR Penn, but they have not done so since the mid 1970s (Chan 1979; S. Allen personal observation).

Conservation and Management Concerns

Global

The number of adults and juveniles in U.S. waters dropped from 154,000 in 1960 to 40,000 in 1992, a reduction of 73%. Most of this decline occurred in Alaska waters, and is believed due to a combination of factors, including incidental kills, illegal shooting, changes in prey availability and biomass, and perhaps other unidentified factors

Specific to SFBA Network populations

Concerns include reduced prey availability, contaminants, and disease (Sydeman and Allen 1997).

Shooting of sea lions was thought to be a potentially significant source of mortality prior to the listing of sea lions as “threatened” under the ESA in 1990. Such shooting has been illegal since the species was listed as threatened; however, two adult males were found dead from gunshot wounds in the late 1990s at PORE. Steller’s sea lions used to haul out at GOGA at Seal Rock but in the past three decades, they have hauled out infrequently. Steller’s still haul out at PORE at Point Reyes Headland but in low numbers (<20). They also used to breed at PORE but have not done so since the late 1970s. Females with larger pups occasionally show up at PORE.

Although, this species is very hard to distinguish from California sea lions in the water and known shootings by some local hook-line fisherman.

High Mercury loads

Prey requirement in this region unknown but individuals have been seen foraging on salmon and steelhead trout around Point Reyes Headland and Double Point.

Harbor Seal



Family - Phocidae

Subfamily - Phocinae (northern phocids)

Genus species - *Phoca vitulina richardii* (Eastern Pacific harbor seal)

Similar sub-species - western Atlantic (concolor), ungava seal (mellonae), western pacific harbor seal (stejnegeri), eastern Atlantic harbor seal (vitulina)

Special Status/Protection

Protected by the U.S. Marine Mammal Protection Act. No special California or U.S. federal designation

Natural History

Habitat

In California, approximately 400-500 harbor seal haul-out sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores, beaches, lagoons, and estuaries (Hanan 1996).

Harbor seals do not make extensive pelagic migrations, but do travel 300-500 km from Point Reyes depending upon season and food availability (Allen 1988, Herder 1986; D. Hanan unpublished data).

Cycles - migration, reproduction

add

representative graph of attendance and breeding cycle at PORE

J F M A M J J A S O N D

B+++F-----I

Birth, Fertilization, Implantation

Population Status

Global - Current and Historical Distribution and Abundance

The Pacific harbor seal is found along the West Coast of North America from Asuncion Island, off Baja California, northward into Alaska. Harbor seals are the most abundant pinniped in Washington and Oregon, and one of the most common pinnipeds in

California. They are present year-round and pupping occurs in all three West Coast states.

Harbor seal populations have increased dramatically since the MMPA was passed in 1972. Recent preliminary analyses underway by NMFS indicate that at least one harbor seal population, the Washington/ Oregon coastal stock, may be at OSP. OSP status for the other harbor seal stocks is uncertain

Populations of California harbor seals are also increasing; a recent survey resulted in a count of about 23,000 (CK this number – I think it is higher) harbor seals residing in the Channel Islands and along the California mainland, an increase from about 12,000 in 1983. The population of harbor seals in Oregon and Washington has been estimated at 45,700, and is also increasing. Harbor seal counts in the Central Gulf of Alaska, however, have declined by nearly 50% in the past two decades; numbers are currently estimated by NOAA at 63,000 seals.

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

NMFS assessments of the status of harbor seals have recognized 3 stocks along the west coast of the continental U.S.: 1) California, 2) Oregon and Washington outer coast waters, and 3) inland waters of Washington. The San Francisco Bay population may also be recognized as a separate stock, pending genetic analyses. Although the need for stock boundaries for management is real and is supported by biological information, the exact placement of a boundary between California and Oregon was largely a political/jurisdictional convenience.

A small number of harbor seals also occur along the west coast of Baja California, but they are not considered to be a part of the California stock because no international agreements exist for the joint management of this species by the U.S. and Mexico.

Prior to state and federal protection and especially during the nineteenth century, harbor seals along the west coast of North America were greatly reduced by commercial hunting (Bonnot 1928, 1951; Bartholomew and Boolootian 1960). Only a few hundred individuals survived in a few isolated areas along the California coast (Bonnot 1928).

In California, numbers of harbor seals increased by 5.6 per cent annually since the 1970s and are estimated at over 33,000. There are roughly 860 harbor seal haul-out sites in California. (This number does not match that above)

from 2001 stock assessment:

Based on the most recent harbor seal counts (23,302 in May/June 1995, Hanan 1996 – there are more recent surveys that I have from CDFG) and Hanan's revised correction factor, the harbor seal population in California is estimated to number 30,293. A harbor seal count in California was attempted in 1999, but was not successful due to bad weather and camera failure (Hanan, pers. comm.). An aerial survey in May/June 2000 was successful in obtaining a new haul-out estimate for the Channel Islands in southern

California (Fig. 2), but weather and other factors precluded a complete survey of the entire state. There was a successful survey last year.

Conservation and Management Concerns

Global

add

Specific to SFBA Network Populations

from stock assessment:

Annual gillnet mortality may have been as high as 5-10% of the California harbor seal population in the mid-1980s; a kill this large would have depressed population growth rates appreciably.

The California Marine Mammal Stranding database maintained by the National Marine Fisheries Service, Southwest Region, contains the following records of human-related harbor seal mortalities and injuries in 1995-99: (1) boat collision (11 mortalities, 2 injuries), (2) entrapment in power plants (24 mortalities), and (3) shootings (11 mortalities).

Because the vast majority of harbor seal mortality in California fisheries occurs in the set gillnet fishery, because that fishery has undergone dramatic reductions and redistributions of effort, and because the entire fishery has not been observed since 1994, average annual mortality cannot be accurately estimated for the recent years (1995-1999).

The population appears to be growing and the fishery mortality is declining. There are no known habitat issues that are of particular concern for this stock. Two unexplained harbor seal mortality events occurred in Point Reyes National Seashore involving at least 90 seals in 1997 and 25 seals in 2000. Necropsy of 3 seals in 2000 showed severe pneumonia; tests for morbillivirus were negative, but attempts are being made to identify another virus isolated from one of the three (F. Gulland, pers. comm.). All west-coast harbor seals that have been tested for morbilliviruses were found to be seronegative, indicating that this disease is not endemic in the population and that this population is extremely susceptible to an epidemic of this disease (Ham-Lammé et al. 1999). Most seals tested though had herpes virus and some had brucellosis.

Human disturbance of colonies

Changes at Bolinas Lagoon and Tomales Bay...

Northern Elephant Seal



Family - Phocidae

SubFamily - Monachinae (southern phocids)

Genus species - *Mirounga angustirostris*

Special Status/Protection

Protected by the U.S. Marine Mammal Protection Act. No special California or U.S. federal designation

Natural History

Habitat

Elephant seals spend 60-80% of their time at sea, but little is known about their distribution or behavior at sea. In recent years, though, new technology in the form of satellite tags and time-depth recorders has enabled researchers to discover that elephant seals can dive up to 1 mile deep and stay under water for almost two hours. Elephant seals disperse rapidly and widely from the colonies; one elephant seal tagged at San Miguel Island by the National Marine Fisheries Service, for example, was located in the Bering Sea within two weeks. They range west as far as 173°W Longitude, beyond the Hawaiian Islands, and north to the Bering Sea and eastern Aleutians. In the Gulf of the Farallones, we have correlated elephant seal distribution with deep waters off the continental shelf.

Cycles - migration, reproduction

Elephant seals congregate onshore at terrestrial colony sites three times per year, but the total numbers and proportion of various age and sex categories varies per season: the breeding season (December-March), the molt (March-July), and the juvenile haul out (September-November). During the rest of the year (nearly 80%), the seals are entirely pelagic, making their living at sea.

Elephant seals have a hierarchical breeding system with large dominant males aggressively defending their position near groups of females, using both their trumpet and their bulk to intimidate rivals. Females begin pupping within a few days of their arrival with the first pup born around mid-November. Small discrete colonies such as Point Reyes Headland may have only a few dominant bulls; whereas large, continuous

colonies such as San Miguel Island may have an array of bulls and subordinate males at intervals along a beach.

Females usually give birth to a single pup, weighing around 60 lbs. and displaying a black coat of fur. Pups cannot swim at birth, and consequently, are vulnerable to storms and disturbance.

The lifespan of elephant seals is poorly studied but the oldest known-age female at Point Reyes Headlands was 21 years.

Trophic Relationships

Antonnelis et al. 1994(b) cephalopods and whiting, CA

The most current information on the diet of elephant seals indicates that they forage in the mid-water zones, likely eating cephalopods and Pacific hake; although, seals are also known to prey on skates, rays, sharks, shrimp, and crab.

Elephant seals are in turn preyed upon primarily by white sharks (*Carharodon carcharias*), and park rangers have documented many incidences of shark attacks on seals and sea lions at Point Reyes Headland over the past decade. One white shark washed ashore on a Point Reyes beach with an elephant seal head in its stomach (1994).

representative graph of attendance and breeding cycle

J F M A M J J U A S O N D
B+++F-----I? B

Population Status

Global - Current and Historical Distribution and Abundance

Charles Scammon, a British seal hunter, recorded that northern elephant seals were distributed from Cabo San Lazaro, Baja, Mexico, to Point Reyes, California, prior to exploitation by European hunters. Seals nearly became extinct in the last century when commercial sealers hunted them for the oil that could be produced from their blubber. The species was generally considered extinct in the later 1800's until scientists from the Smithsonian discovered a small colony on the remote island of Isle Guadalupe off Baja (Townsend 1912). Only around 20 animals were counted onshore by scientists between 1884 and 1892; although numbers were likely much higher since these seals spend a majority of their annual cycle at sea.

With protection provided first by the Mexican government on Isla Guadalupe and later by the United States on the Channel Islands, California, the population recovered at an astounding level with estimated annual growth rates of 6-8% (Cooper and Stewart 1983, Stewart et al. 1994). As the colony grew and became crowded at Isla Guadalupe, seals began colonizing new sites, expanding northward. Pups were first seen on San Miguel Island in 1957, which presently supports an estimated 25,000 elephant seals during the breeding season. California island breeding colonies slowly expanded to San Nicolas

Island in 1958, Ano Nuevo Island in 1961, South Farallon Islands in 1972, San Clemente in 1977, and Santa Rosa in 1985 (Antonnelis et al. 1980, Le Boeuf et al. 1974, Radford et al. 1965, and Stewart and Yochem 1986).

Regional - Distribution, Abundance, Trends, and NMFS Stock Description

Whether northern elephant seals historically bred on the mainland rather than islands is not known; presumably large predators, such as grizzly bears and native peoples, would have discouraged them. Nevertheless, Scammon (1874) reported their presence at Point Reyes in the nineteenth century. The first pup born on the mainland in this century was at Ano Nuevo in 1975 (Le Boeuf and Panken 1977). Since that birth other California mainland sites have been established at Cape San Martin, Piedras Blancas, Point Saint George and Point Reyes Headland (Stewart et al. 1994). Seals have also been observed resting onshore in Oregon and British Columbia, and a couple pups were documented at Cape Arguelo, Oregon, in the past few years. Point Reyes Headland is currently considered the northern-most, established breeding colony.

Conservation and Management Concerns

Global

Because the species was severely depleted and brought to near extinction, some scientists suggest that they may lack genetic elasticity because they passed through a genetic bottle neck (Bonnell and Selander 1974). Electrophoretic studies indicated that elephant seals show no genetic heterozygosity, and thus, seals have fewer genetic options to compensate for changes in their environment (Le Boeuf 1977, Lim et al. 1995). Nevertheless, there is little evidence to date that the species is presently biologically limited.

[Space limited, loosing habitat at SEFI](#)

Specific to SFBA Network Populations

Challenge in Parks to protect from visitors and monitor interactions with other species - snpl.

Mortality rates of pups have been low most years at Point Reyes Headland, but with increased density coupled with severe storms, as occurred in 1992, 1995 and 1998, the survival of pups decreased. Survival was only around 45% in 1995 and around 20% in 1998.

Appendix II. Research Needs

Research Needs for Harbor Seals

- Population trend analyses - what is the minimum amount of survey effort required to detect meaningful magnitudes of change given the variability and distribution of the data?
- Model effects of recent mortality from viruses to the regional and meta-population level.
- Observer bias study.
- Diet and foraging ecology - Species composition changes by season and by year, salmon fisheries interactions, and contaminant levels. What are the most valuable components of diet to measure?
- What are the primary winter migration locations of harbor seals that breed at Point Reyes?
- Develop a gradient of harbor seal response to disturbance and determine disturbance thresholds at which point seals no longer habituate and productivity is affected.
- Prioritize program components in context of larger pinniped program to direct efforts when funding/staff levels fluctuate.
- Contaminant Monitoring - at 10 yr intervals, evaluate contaminant loads and antibody composition in the harbor seal population - via blood and tissue biopsy.

Research Needs for Northern Elephant Seals

- Contaminant Monitoring - At 10 yr intervals, evaluate contaminant loads and antibody composition in the elephant seal population - via blood and tissue biopsy.
- Determine the dispersal patterns of weaned pups and movement patterns of reproductive males during the breeding season to determine where colonies are likely to expand within or outside of the park. Males regularly haul out in areas adjacent to breeding colonies during the breeding season and these sites often become new colonies. Such information would be important for park managers to plan for protection of new colonies.
- Prioritize program components in context of larger pinniped program to direct efforts when funding/staff levels fluctuate.

Research Needs for All Species

- Adaptive management will drive research needs as monitoring initiates research questions. The park will respond to changes in species distribution, abundance or reproductive status and manage adaptively. For example, if California sea lions begin to pup annually at PORE, then the park would initiate monitoring of sea lion productivity.
- Predator-prey relationships – how do predators such as white sharks affect the distribution and reproductive success of pinnipeds in the Seashore?
- Are Steller sea lions resident to Point Reyes?

- What is the incidence of sea lion interactions with fishermen in the nearshore waters of the Seashore?
- Prioritize program components in context of larger pinniped program to direct efforts when funding/staff levels fluctuate.

Appendix III. Program Products

Peer-reviewed Publications

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- Sydeman, W.J., H.R. Huber, S.D. Emslie, C.A. Ribic, and N. Nur. 1991. Age-specific weaning success of northern elephant seals in relation to previous breeding experience. Ecology 72(6): 2204-2217.
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Webber, M. A. and S. G. Allen. 1986. Resightings of two rehabilitated and released harbor seals in California. Calif. Fish and Game 73:60-61.

Graduate Theses

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Oates, Stori. (in prep). The dispersal of juvenile harbor seals from site of birth. M.S. Thesis. San Jose State University, Moss Landing Marine Lab.

Neale, Jennifer (in prep). Immune function of harbor seals and contaminant loads. Ph. D. Thesis. University of California, Davis.

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- Allen, S., and M. King. 1992. Tomales Bay harbor seals: a colony at risk. Proceedings from the Third Biennial State of Tomales Bay Conference, October 1992. pp. 33-37.
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- NPS website: <http://www.nps.gov/pore/home.htm>
- Numerous handouts and newsletters for the public.

Management Actions

The long-term monitoring program for pinnipeds of PORE and GOGA has provided important information to initiate new research, guide management and educate park visitors. Actions guided by the results of these surveys have included:

1. The initiation of a baseline study of diseases in harbor seals and northern elephant seals in conjunction with the Marine Mammal Center in 1997;
2. A study of the dispersal of weaned pups and the feeding habits of harbor seals at Point Reyes in collaboration with Moss Landing Marine Lab;

3. Proposed delineation of marine protected areas at Point Reyes and GOGA;
4. Continued annual closure of kayaks and other watercraft in Drakes Estero during the harbor seal breeding season March 15 - June 30 beginning in 1994;
5. Collaboration with NOAA on stewardship of rookeries at Tomales Bay and Bolinas Lagoon since 1995;
6. Seasonal closure of new elephant seal breeding sites as they occur;
7. Collaborative monitoring with NOAA and NMFS to assist in regional and national status and trends of pinnipeds.
8. Collaborative monitoring with NMFS to assist in regional and national stranding marine mammal program.
9. Standardized annual training of interpretative staff and elephant seal volunteer docents in elephant seal studies and etiquette;
10. Continuous interaction with various park visitor groups that have the potential to disturb marine mammals (i.e. kayaks groups, Headlands Institute). This includes emerging extreme sports such as boat towed surfers and ultralight flying
11. Educational literature handed out to the public.
12. Update of parks' Compendiums on a periodic basis.

Appendix IV. Glossary

Adaptive Management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form—"active" adaptive management—employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed.

Attributes are any living or nonliving feature or process of the environment that can be measured or estimated and that provide insights into the state of the ecosystem. The term Indicator is reserved for a subset of attributes that is particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (Noon 2002). See Indicator.

Change/trend objectives describe a change relative to the existing situation such as a decrease in pup production by 20% in one year.

Ecological effects are the physical, chemical and biological responses to drivers and stressors.

Ecological integration involves considering the ecological linkages among system drivers and the components, structures, and functions of ecosystems when selecting monitoring indicators.

Ecosystem is defined as, "a spatially explicit unit of the Earth that includes all of the organisms, along with all components of the abiotic environment within its boundaries" (Likens 1992). Three main ecosystems were identified for the network of parks; terrestrial, wetland and marine.

Ecosystem drivers are major external driving forces such as climate, fire cycles, biological invasions, hydrologic cycles, and natural disturbance events (e.g., earthquakes, droughts, floods) that have large scale influences on natural systems. Trends in ecosystem drivers will suggest what kind of changes to expect and may provide an early warning of presently unforeseen changes to the ecosystem. Natural ecosystem processes include both external and internal forces and processes (e.g., herbivory, respiration, productivity).

Ecosystem management is the process of land-use decision making and land-management practice that takes into account the full suite of organisms and processes that characterize and comprise the ecosystem and is based on the best understanding currently available as to how the ecosystem works. Ecosystem management includes a primary goal of sustainability of ecosystem structure and function, recognition that ecosystems are spatially and temporally dynamic, and acceptance of the dictum that ecosystem function depends on ecosystem structure and diversity. Coordination of land-use decisions is implied by the whole-system focus of ecosystem management.

Haul-out site is a terrestrial and/or intertidal location where seals aggregate for periods of rest, birthing, suckling of young, molting, predator escape, thermoregulation, or other reasons not understood.

Indicators are a subset of monitoring attributes that are particularly information-rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong (Noon 2002). Indicators are a selected subset of the physical, chemical, and biological elements and processes of natural systems that are selected to represent the overall health or condition of the system, known or hypothesized effects of stressors, or elements that have important human values.

Measures are the specific feature(s) used to quantify an indicator, as specified in a sampling protocol.

Pinnipeds are a group of marine mammals of the sub-order Pinnipedia that give birth and nurse on land or ice, but feed and travel in aquatic ecosystems.

Rookery and/or breeding site is a haul-out area where female pinnipeds give birth. Not all haul out sites are rookeries.

Spatial integration involves establishing linkages of measurements made at different spatial scales within a park or network of parks, or between individual park programs and broader regional programs (i.e., NPS or other national and regional programs).

Stressors are physical, chemical, or biological perturbations to a system that are either (a) foreign to that system or (b) natural to the system but applied at an excessive [or deficient] level (Barrett et al. 1976:192). Stressors cause significant changes in the ecological components, patterns and processes in natural systems. Examples include water withdrawal, pesticide use, timber harvesting, traffic emissions, stream acidification, trampling, poaching, land-use change, and air pollution. Anthropogenic stressors are those perturbations to a system that directly result from human activity. Monitoring of stressors and their effects, where known, will ensure short-term relevance of the monitoring program and provide information useful to management of current issues.

Temporal integration involves establishing linkages between measurements made at various temporal scales. It requires nesting the more frequent and, often, more intensive sampling within the context of less frequent sampling.

Target/threshold objective is a condition limit exceeded that initiates a management action. The limit exceeded is a measurable parameter that may be the number and location of new seal colony sites, or an increase in population size to a target number.

Vital Signs, as used by the National Park Service, are the subset of indicators chosen by a park or park network as part of the Vital Signs Monitoring Program. They are defined as any measurable feature of the environment that provides insights into changes in the state of the ecosystem. Vital Signs are intended to track changes in a subset of park resources

and processes that are determined to be the most significant indicators of ecological condition of those specific resources that are of the greatest concern to each park. This subset of resources and processes is part of the total suite of natural resources that park managers are directed to preserve “unimpaired for future generations,” including water, air, geological resources, plants and animals, and the various ecological, biological, and physical processes that act on these resources. Vital Signs may occur at any level of organization including landscape, community, population, or genetic levels, and may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes).