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San Francisco Bay Area Network Pinniped Monitoring Protocol

Version 3.02

Natural Resource Report NPS/SFAN/NRR—2009/170

ON THE COVER
Volunteer monitoring harbor seals at Drakes Estero, Point Reyes National Seashore.
Photograph by: Judith Fitzpatrick

San Francisco Bay Area Network Pinniped Monitoring Protocol

Version 3.02

Natural Resource Report NPS/SFAN/NRR—2009/170

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Executive Summary

The purpose of this document is to describe the National Park Service's monitoring program for pinniped 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.

Within the order Carnivora, the Pinnipedia sub-order is a group of marine mammals that includes sea lions, fur seals, true seals, and walruses. The numerically dominant pinniped species that breed, haul out, and molt in the region include the Pacific harbor seal (*Phoca vitulina richardii*) and northern elephant seal (*Mirounga angustirostris*). 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).

The SFAN Inventory and Monitoring Program is committed to long-term, full-funding of the harbor seal monitoring program within Point Reyes National Seashore and Golden Gate National Recreation Area. As funding permits, the SFAN will reconsider funding for the northern elephant seal monitoring program. The SFAN will continue to provide logistical and technical support to the northern elephant seal monitoring program. For this reason, this protocol and associated standard operating procedures (SOPs) encompass both monitoring programs. For simplicity's sake, although this protocol only addresses harbor seals and northern elephant seals, it is known and referred to as the pinniped monitoring protocol.

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

1. Determine the long-term trends in population size and seasonal distribution of harbor seal populations at primary sites in the SFAN parks during the breeding and molt seasons.

2. Determine long-term trends in reproductive success of harbor seals through annual estimates of pup production at PORE and GOGA.

3. Determine the long-term trends in sources, frequency and level of effects of natural and anthropogenic disturbances on harbor seal haul out use and productivity.

General guidelines for field methods, data analyses, reporting requirements, and project budgets to meet these objectives are provided in the protocol and detailed in the SOPs. The protocol and SOPs will be updated as methods are revised or as new analytical methods are adapted. Data are housed in a Microsoft Access database with front-end files available for data entry and analyses.

The document outlines ongoing collaborations with other agencies and researchers. 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 analyses. The SFAN monitoring program contributes to regional and national efforts to assess pinniped population status and trends.

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1.0 Background and Objectives

1.1 Background

Point Reyes National Seashore (PORE) and Golden Gate National Recreation Area (GOGA) are situated north and south of San Francisco Bay in Marin, San Francisco and San Mateo Counties, California. PORE was established in 1962 and has one of the most accessible congressionally designated wilderness areas in the United States (71,046 acres with 80 miles of coastline). GOGA was established in 1972 as part of the “parks to the people” program, and includes approximately 95,000 acres and 20 miles of coastline. Marine boundaries are shared with the Gulf of the Farallones National Marine Sanctuary, the Monterey Bay National Marine Sanctuary, and Tomales Bay State Park. In 1988, UNESCO Man in the Biosphere program designated the Central California Coast Biosphere Reserve (CCCBR) under the International Biosphere Program; CCCBR includes PORE and GOGA and other public lands in the region. The state of California designated four "Areas of Special Biological Significance" within the study area in the 1970’s: Tomales Point, Point Reyes Headlands, Duxbury Reef, and Double Point. In 1990, under implementation of the California Marine Life Protection Act, the California Department of Fish and Game (CDFG) designated four marine protected areas within PORE boundaries, Point Reyes Headlands, Drakes Estero, Limantour Estero and Duxbury Reef.

Because of its agricultural character, much of the coastline north of San Francisco Bay 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 some protection from human disruption during seal terrestrial resting periods; however, most pinniped populations in California are still recovering from a long period of exploitation that did not end until the passage of the Marine Mammal Protection Act (MMPA; Public Law 92-522) in 1972. Prior to the MMPA, Pacific harbor seals at PORE were likely disturbed by humans, as throughout their range, and hunted extensively. Currently, disturbances are likely reduced from those earlier years with protection provided by National Park status and enforcement of the MMPA. Nevertheless, with over 2 million visitors to PORE and almost 14.5 million visitors to GOGA in 2008 (NPS 2008), human disturbances to seals do occur within the parks.

Exploitation through hunting was seen in all pinniped species in California, but with varying long-term effects. Sea lions were hunted in California in the late 1800s for oil, hides, and “trimmings” that were sold to Chinese markets (Scammon 1874); and were hunted by commercial fisheries around 1900 to reduce competition for fish (Bonnot 1937). A bounty was offered for Steller sea lions in the early 1900s in areas north of California (Rowley 1929; Bonnot 1931, 1951). Pacific harbor seals and California sea lions (*Zalophus californianus*) were hunted with a bounty fee provided by the CDFG prior to the MMPA and sea lions were hunted for dog food on the Channel Islands National Park until the 1960s.

Northern elephant seals were over-hunted to the verge of extinction for their blubber, used for cooking and heating oil (Twiss and Reeves 1999). Scammon described northern elephant seals at Point Reyes during early sealing voyages in the early 1800s, but by the late 1800s, the species was extirpated from the region and nearly extinct (Scammon 1874; Allen et al. 1989; Le Boeuf and Laws 1994). In the late 1800s, the northern elephant seals only occurred on Guadalupe Island, Mexico. From that small colony of less than a few thousand animals, the population grew

to the current level of greater than 170,000 seals after receiving protection from the Mexican and US governments. Guadalupe fur seals (*Arctocephalus townsendi*) were hunted for their fur and currently are listed as a federally and state threatened species and breed on Guadalupe Island, Mexico.

Harbor seals, California sea lions, northern fur seals (*Callorhinus ursinus*), and northern elephant seals have increased in number and distribution at California rookeries over the past two decades (Sydeman and Allen 1999; Pyle et al. 2001; Carretta et al. 2007). An exception is the Steller sea lion, whose populations have declined sharply in California in just the last 20 years, and the population from California to southeastern Alaska is currently classified as threatened under the Endangered Species Act (ESA; Public Law 93-205; Sydeman and Allen 1999, Hastings and Sydeman 2002). In California, the Steller sea lion population has slowly declined to about 1,500 individuals with less than 20 at PORE where they had historically bred up until the 1970s (Chan 1980; Sydeman and Allen 1999, Hastings and Sydeman 2002).

Six pinniped species occur in central California to breed, migrate through or rest onshore. The five numerically dominant species that haul out and molt in the region include harbor seal, northern elephant seal, California sea lion, northern fur seal, and Steller sea lion. Guadalupe fur seals have been reported at PORE, although they occur only incidentally. The species that have been documented breeding within the parks of the San Francisco Bay Area Inventory and Monitoring Network (SFAN) include the harbor seal (GOGA and PORE) and northern elephant seal (PORE).

Northern elephant seals breed and molt on islands and remote coastal locations from Baja California, Mexico north to Point Reyes National Seashore (Figure 1). For most of the year, northern elephant seals forage in the open ocean, and studies using satellite tags and time-depth recorders have documented remarkable differences in where female and male northern elephant seals spend that time. Males generally forage along the continental shelf north to at least Oregon and often much further north and then west to the Aleutian Islands. Females on the other hand forage in significantly deeper waters far to the west of the continental shelf (Figure 2).

Harbor seals inhabit the temperate and subarctic waters of the North Atlantic and the North Pacific oceans. In the northeast Pacific, the Pacific harbor seal ranges from Cedros Island off of Baja California, Mexico and north along the California, Oregon, Washington, and Canadian coasts to the Gulf of Alaska, then west to the Aleutian Islands (Figure 2). Harbor seals occur along the entire nearshore coast of California, but the larger haul-out and breeding colonies are found in protected estuaries and at river mouths.

Other species (e.g., California sea lions) may breed in the future in the San Francisco region and some species, particularly northern fur seals, likely dominated these coastal sites historically. Tens of thousands of northern fur seals forage offshore in central California; however, in 1974, 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. 2001). 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, now breeding on the Farallon Islands and Ano Nuevo Island in low numbers (NPS, unpublished data; Sydeman and Allen 1999).

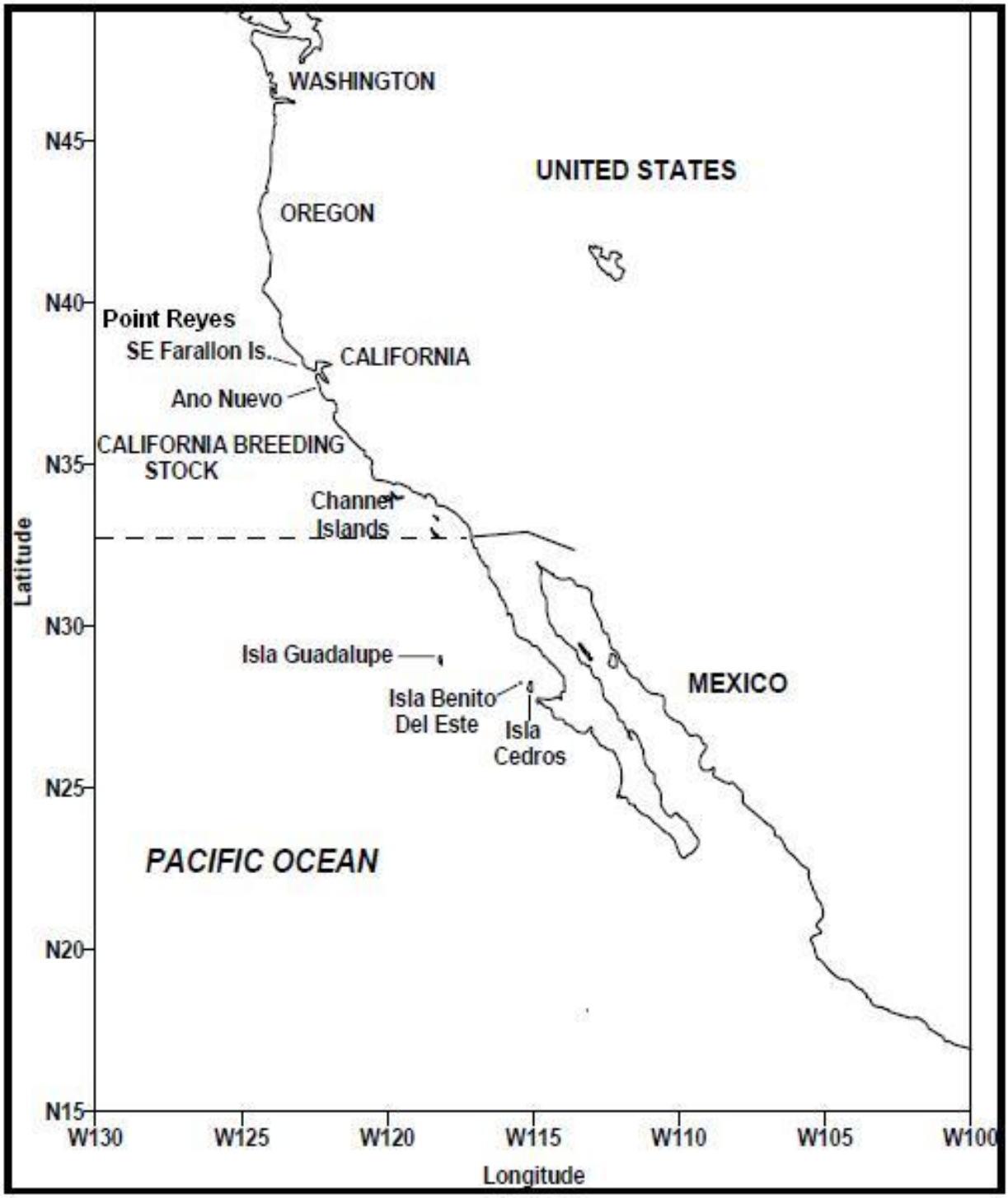

Figure 1. Northern elephant seal breeding and molting locations along the coast of western North America (Carretta et al. 2007).

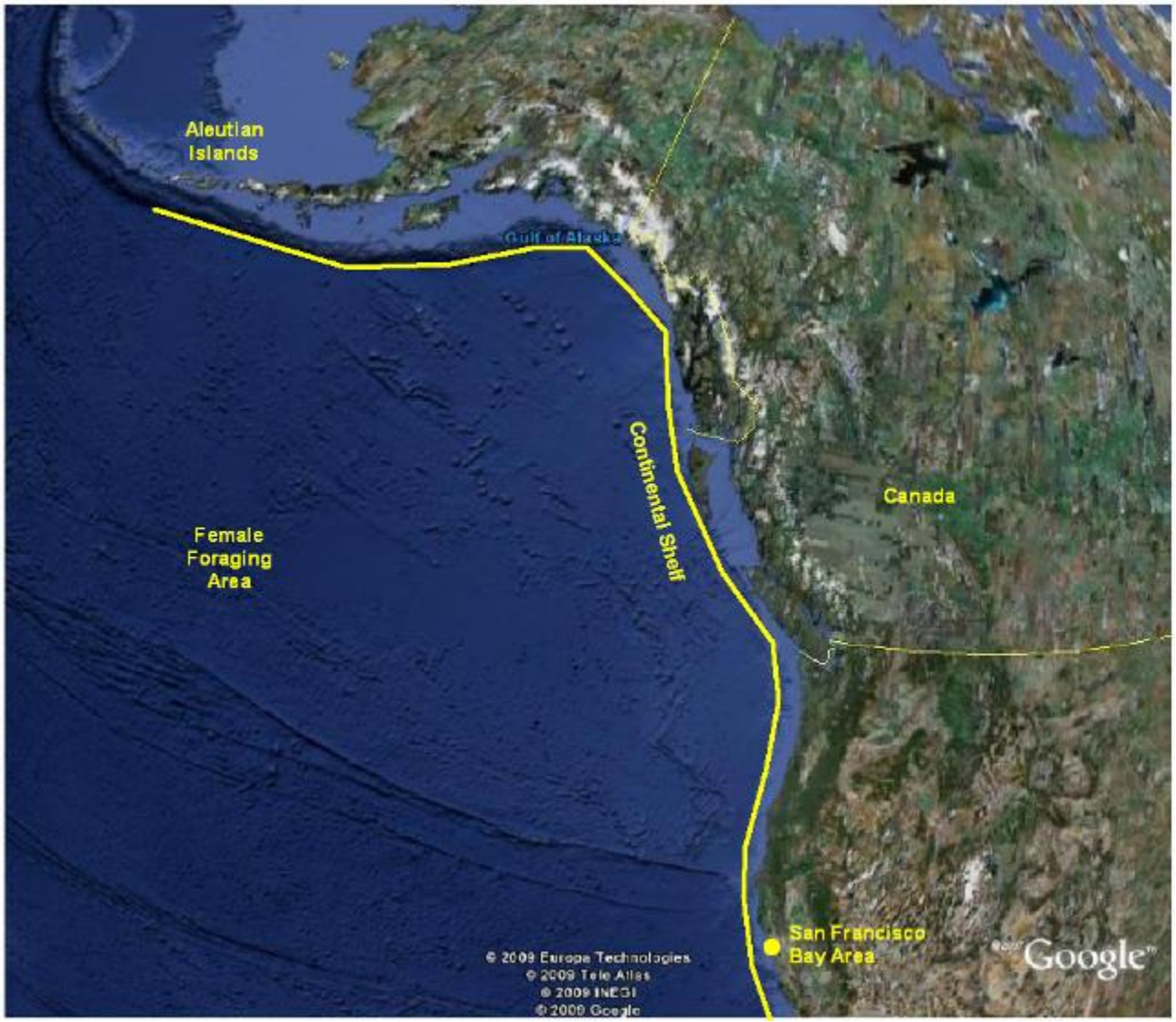

Figure 2. Map of the western coast of North America indicating northern elephant seal foraging areas. Female elephant seals primarily forage far offshore in the North Pacific Gyre whereas male elephant seals forage along the continental shelf. Pacific harbor seals occur along the entire nearshore coastal area. (Image courtesy of Google Earth).

1.2 History of Monitoring

The CDFG, Minerals Management Service and National Marine Fisheries Service (NMFS) 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. 1983; Miller 1983; Carretta et al. 2007); however, these studies were limited to aerial surveys, and did not include ground-based monitoring. The monitoring protocols were developed over several decades by NMFS and modified to regional conditions and requirements (Eberhardt et al.1979; Le Boeuf and Laws 1994; Carretta et al. 2007). The regional design is based on the seasonal occurrence of each species, the data required to assess population condition and the need to adaptively manage the resource. The program limits the level of invasive methods to maintain low levels of

disturbance from research activities. 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).

For harbor seals and northern elephant seals, there are impressive time-series from PORE sites (25+ years) and nation-wide (Sydeman and Allen 1999, Carretta et al. 2007). 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). In the 1980s, PRBO Conservation Science (PRBO) conducted an inventory of pinnipeds at PORE. When northern elephant seals colonized PORE in 1981, PRBO began monitoring pinnipeds in conjunction with their monitoring program on the Farallon Islands (Allen and Huber 1983, 1984; 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, the National Park Service (NPS) initiated a standardized pinniped monitoring program (Allen 1995; Sydeman and Allen 1999).

Monitoring methods for northern elephant seals were adopted from existing regional monitoring programs to allow for comparisons among sites and integration of data. Specifically, northern elephant seal survey methods were based on those used by the NMFS on Channel Islands National Park, the U.S. Fish and Wildlife Service on the Farallon Islands, and the University of California at Santa Cruz at Año Nuevo (Le Boeuf and Laws 1994; Barlow et al. 1993; Sydeman and Allen 1999). Survey methods over the years were modified as the PORE northern elephant seal colony grew.

Between 1982 and 1985, researchers conducted a general inventory of pinnipeds in Point Reyes (Allen and Huber 1983). Beginning in 1995, the park initiated weekly pinniped surveys at Point Reyes Headlands. Surveys were timed to coincide with weekly surveys on the Southeast Farallon Islands, to compare population trends of island versus mainland pinniped colonies (Sydeman and Allen 1999).

In their study on the effects of marine climate variability on pinniped populations following implementation of the MMPA, Sydeman and Allen (1999) analyzed population survey data from the long-term monitoring programs (1973-1997) at the South Farallon Islands and PORE. They found that California sea lions increased over the study period, with peak numbers observed during and after major El Niño events, but the rate of increase appeared to have decreased in later years. Steller sea lions decreased at the South Farallon Islands and remained depleted at PORE. Harbor seal populations increased in a logistic and non-linear fashion at PORE and the South Farallon Islands, respectively. Northern elephant seal abundance increased in a logistic fashion over the study period at both the South Farallon Islands and PORE. The authors felt that oceanographic relationships did not appear to confound interpretations of population recovery since the MMPA for the species with increasing populations, and may help to explain declines in the Steller sea lion population.

More recently, Allen et al. (2004) summarized PORE harbor seal data from 1997-2001. The five-year time period included data collected prior to, during, and three years following the 1998 El Niño Southern Oscillation (ENSO) event. During this period, the harbor seal population

remained relatively stable. Annual maximum counts for the breeding season ranged between 2,481 and 3,506, and annual average counts ranged from 1,744.6 and 2,511.1 (range of SE = 122.5 to 379.0). The maximum numbers of adult/immature seals and pups were higher in 1997 and 2001 than those observed in 1998 (1998 Lambda = -0.46 and 2001 Lambda = +1.36) coinciding with the El Niño year. Significantly fewer seals were breeding in 1998 during the El Niño than in 1997 (-24%). Pup production was also lower (-46%).

From 2000-2008, Drakes Estero and Double Point annually produced the highest numbers of harbor seal pups (Flynn et al. 2009). Taken together, these two sites produced 57% of the pups observed in 2008 at PORE and GOGA. Overall, pup counts in 2008 bounced back from a lull in 2006 and 2007 (Figure 3). The authors speculate that this decline may have been related to changes in marine conditions. Upwelling was much reduced in 2005 and 2006, resulting in reduced krill production, which in turn may have affected food availability for harbor seals. A lag effect from this reduced period of upwelling may be reflected in the lower breeding season adult counts of all sites combined in 2008 (Figure 4).

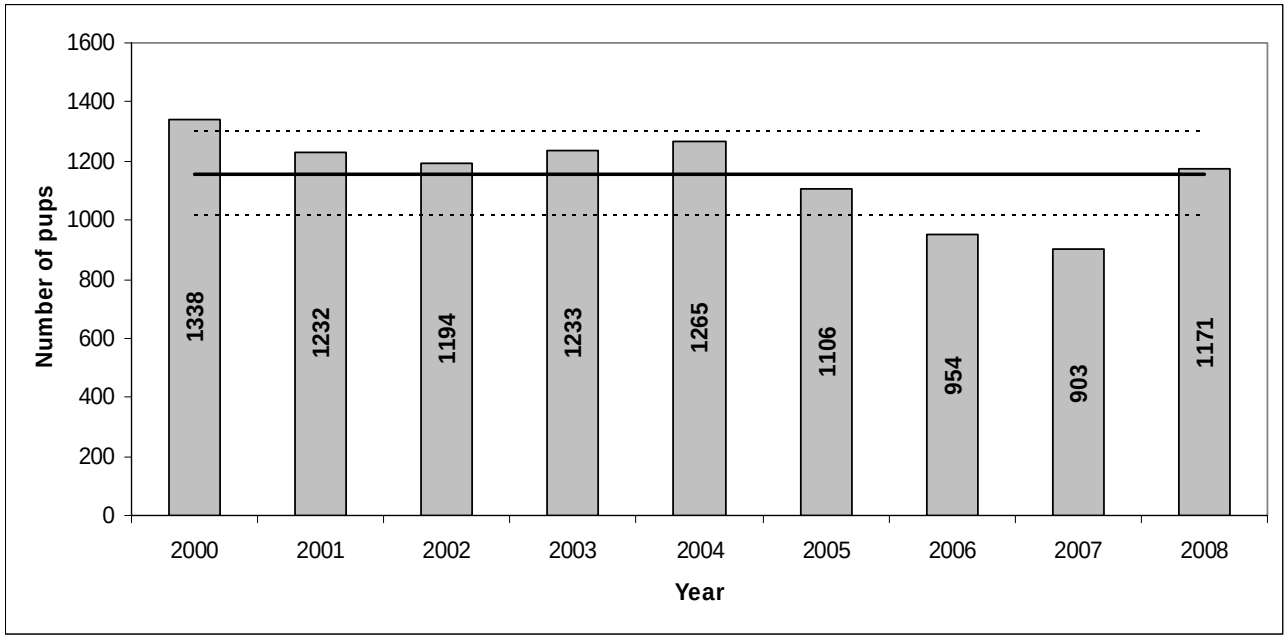

Figure 3. Maximum harbor seal pup counts for 2000–2008 at Marin County locations. The solid line on the graph represents the mean of the maximum pup counts from 2000–2008 (1155.1), and the dashed lines represent one standard deviation from the mean (143.9) (Flynn et al. 2009).

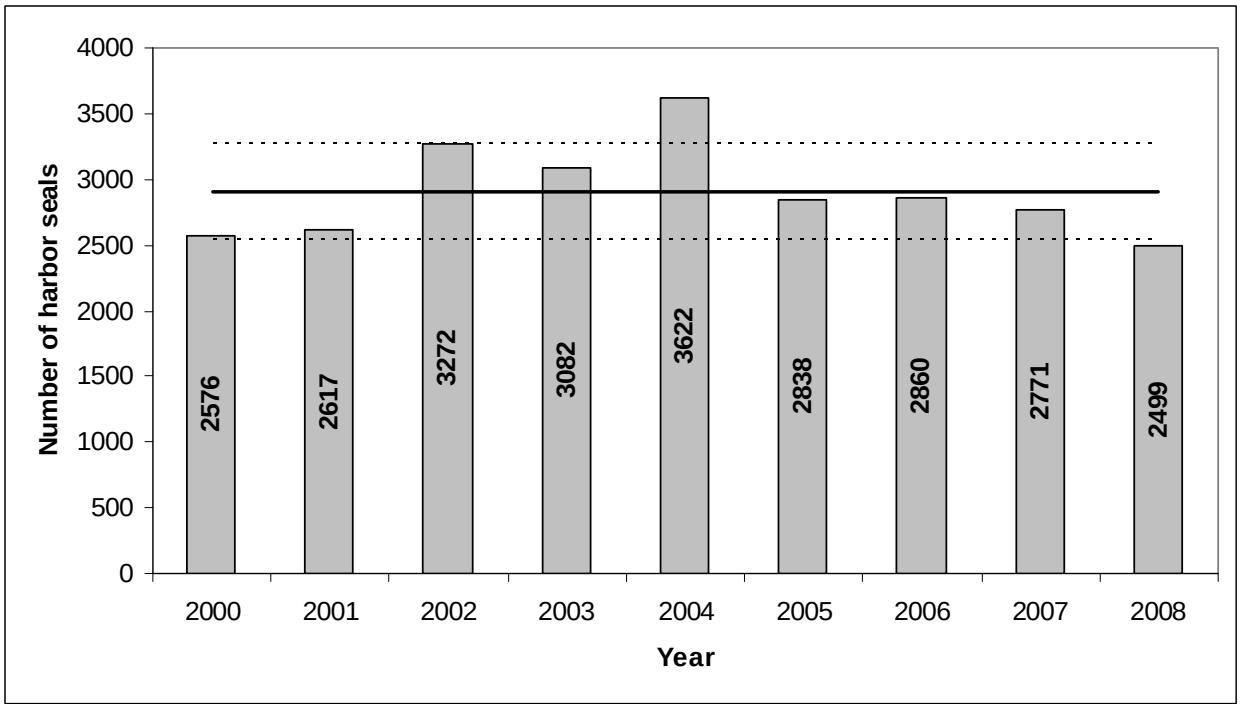

Figure 4. Maximum counts of harbor seal adults and immatures during the breeding season (March-May) at Marin County locations. The solid line on the graph represents the mean of the maximum adult counts from 2000–2008 (2904.1), and the dashed lines represent one standard deviation from the mean (364.1) (Flynn et al. 2009).

Regardless of year, most harbor seal disturbances have occurred at haul outs at Point Bonita, Bolinas Lagoon, Drakes Estero, and Tomales Bay (Allen et al. 2004; Flynn et al. 2009). Harbor seal response to disturbance ranged from a simple head alert to flush into the water. The highest number of disturbances per hour occurred at Point Bonita in 2000, during which time the area was heavily used for educational tide pooling. The haul out at Double Point also had elevated disturbances in 2001 related to an aggressive male northern elephant seal. Bolinas Lagoon seals experience elevated disturbance levels due to their proximity to Highway 1. During the 2008 pupping and molting season, 108 harbor seal disturbances resulting in a seal response were recorded at PORE.

The PORE northern elephant seal population grew by almost 29% from 2005 to 2007 (Table 1; Adams et al. 2007). Using a correction factor for animals at sea, the total population size was estimated at 1,771 and 2,285 seals at PORE in 2005 and 2007, respectively. Almost 50% more females were counted at North Drakes Beach (NDB) colony sites in 2006 (223) compared with 2005 (147). There also was a smaller increase of 20% at NDB in 2007 (272). The authors suggest that hazardous coastal weather and tide conditions coinciding with the initial arrival of females made NDB a more attractive colony site than the Point Reyes Headlands (PRH) colony in 2006. The other colony sites, PRH and South Beach (SB), showed much smaller increases in numbers of female seals (10% and 20% respectively) in 2006 and declines (-13% and -30%) in 2007, indicating the movement of seals from these sites to NDB.

Table 1. Point Reyes National Seashore northern elephant seal population and productivity counts for 2005–2007 breeding seasons at each colony site (adapted from Adams et al. 2007).

Season	Colony site[1]	Max # of females	Adjusted max # of females[2]	Max # of pups plus weaners	Breeding population size estimate[4]	Overall population estimate[5]	Productivity index[6]
2005	PRH	384	408	320	677	1120	0.78
	SB	29	30	28	73	98	0.93
	NDB	147	166	158	322	553	0.95
	Total	560	604	506	1072	1771	0.84
2006	PRH	413	447	352	768	1232.0	0.79
	SB	30	36	39	99	136.5	1.08
	NDB	223	245	209	463	731.5	0.85
	Total	666	711	600	1330	2100	0.82
2007	PRH	362	387	377	809	1319	0.97
	SB	24	25	24	70	84	0.96
	NDB	272	293	252	551	882	0.86
	Total	658	705	653	1430	2285	0.93

[1] PRH=Point Reyes Headlands; SB=South Beach; NDB=North Drakes Beach. Census includes all sub-sites.
[2] The adjusted maximum includes the number of females counted 33 days prior and after the maximum count.
[3] The maximum count of pups plus weaners on a single census for each colony site.
[4] The maximum survey count of all seals.
[5] Based on pup count multiplier of 3.5.
[6] Maximum number of young divided by the adjusted maximum number of females.

Beginning in 1988, weaned northern elephant seal pups at all PORE 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) were applied to sleeping or resting seals. These tags were chosen over the use of PIT (passive integrated transponder) tags for several reasons: the plastic tags are 6-12 times less expensive, there are no battery operated devices necessary, and the likelihood of northern elephant seals losing two flipper tags has been calculated to be 0.0031 for both males and females (Filippo et al. 2000). The NMFS coordinates the national northern elephant seal tagging program and assigned pink color tags for the PORE colony. NMFS assigns unique color tags for each of the colonies so that movement between colonies and source populations for new colonies can be identified. All marking of seals is conducted under a permit from the NMFS issued to PRBO Conservation Science; current permit is no. 373-1868-00.

Until 1998, the number of weaned northern elephant seal pups tagged each year roughly approximated the total number of pups surviving to weaning. Due to the high pup mortality and reduced colony access during the 1998 El Niño storm events, only about 27% of the pups produced were tagged. Between 1999 and 2004, approximately 55% to 94% of the pups produced were tagged. Since 2005, the number of pups surviving to weaning has far surpassed the number researchers were able to tag. The general goal, as outlined in the NMFS permit, is to tag 200-300 weaned northern elephant seal pups each year. Opportunistically, some sub-adult and adult male northern elephant seals are tagged and dye-marked to track movement of males between breeding sites and to identify the alpha and beta males. Tag resighting is done in conjunction with other research activities.

1.3 Pinniped Management

Managers at PORE and GOGA have developed an adaptive pinniped monitoring and management program. A key focus to any adaptive management program is monitoring to detect the effects of management actions. The monitoring program is structured to collect long-term pinniped population data and identify shifts in distribution and haul out use patterns to protect the species. Through disturbance monitoring, managers can determine if resource protection measures are effective.

With northern elephant seal populations increasing within the San Francisco Bay Area, the NPS has had to respond with increased monitoring and management. The northern elephant seal colony at PORE has grown rapidly since 1981, with seals now using multiple breeding sites. In response to the increase of seals and associated park visitor interactions, a northern elephant seal management plan was initiated in 1995 to set guidelines for research, interpretation, and resource protection measures and their enforcement (Allen 1995). The management plan outlines management actions and programs for issues such as disturbance, conflicts with other sensitive animals and plants, and safety for both the seals and the public. This plan replaces an earlier plan for PORE on marine mammal management that recommended inventories and research (Ainley et al. 1979).

PORE and GOGA have adaptively managed harbor seals based on the results of monitoring of population numbers and annual productivity at several seal colonies. Harbor seal numbers have changed at each site because of various stressors including predation by coyotes, human disturbance and climatic events. The NPS and the Gulf of the Farallones National Marine Sanctuary (GFNMS) have responded adaptively and collaboratively with different strategies for management specifically related to reducing human disturbance at haul outs ranging from no-action to seasonal closures.

Additional past and current management strategies have included:

1) The initiation of a baseline study of disease in harbor seals in conjunction with The Marine Mammal Center.
2) Annual restriction of kayaks and other watercraft in Drakes Estero during the breeding season March 15 – June 30.
3) A study of the dispersal of weaned pups and feeding habits of harbor seals at Point Reyes in collaboration with Moss Landing Marine Lab.
4) Proposed delineation of marine protected areas at Point Reyes to further protect seal colonies.
5) A year-round public access closure to the tide pools at Point Bonita.
6) Educational opportunities to inform the public about pinnipeds and their sensitivity to human activities, implemented in collaboration with the Marine Mammal Center and the Gulf of the Farallones National Marine Sanctuary.

1.4 Rationale for Selecting this Resource to Monitor

SFAN is one of eight networks in the Pacific West Region (PWR) and one of 32 throughout the 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 SFAN that encompass resources utilized by pinnipeds (seals and sea lions) include PORE and GOGA. One other park unit in the PWR has a pinniped monitoring protocol, Channel Islands National Park (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 1992).

Marine mammals, particularly pinnipeds, were selected by the SFAN to monitor and were ranked as the 10th priority vital sign. The ecosystem conceptual models developed for the SFAN include pinnipeds as an indicator of the marine ecosystem (Adams et al. 2006). 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, and to human disturbance (Allen et al. 1985; Trillmich and Ono 1991; Thompson et al. 1998; Sydeman and Allen 1999; Thompson and Miller 1990).

The pinniped assemblage 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),

2. Marine mammals and their habitat are specifically identified in the general management plan and management objectives of PORE.

3. The data collected under the pinniped monitoring program can be directly applied to key management decisions, particularly in regards to the protection of breeding pinnipeds (see 1.3 Pinniped Management).

4. Pinnipeds are good indicators of the condition of the marine ecosystem because they respond quickly to oceanic conditions, and

5. There is a long history of monitoring pinnipeds at PORE and GOGA in collaboration with other agencies and organizations.

Seals are also charismatic 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.

General pinniped conservation concerns include effects of 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.

1.4.1 Legal Mandates

The NPS shares a mandate with National Oceanic and Atmospheric Administration (NOAA) Fisheries 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 national 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 a congressional mandate for national parks to provide information on the long-term trends in the condition of their natural resources.

The ESA mandates the protection of all threatened, endangered, or candidate species as well as their critical habitats within park boundaries. The MMPA supplements the ESA, providing special protection for all marine mammals. MMPA states that it is unlawful to "harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill" marine mammals. 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. NMFS (1994) proposed guidelines on closest approach distances to avoid disturbing marine mammals.

1.4.2 Enabling Legislation

In 1972, GOGA was authorized by Congress as an NPS unit (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…"

In September 1962, PORE was authorized by Congress as a unit of the National Park Service (Public Law 87-657) and was officially established in October 1972 (Public Law 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 (Public Law 95-544) established 25,370 acres of Wilderness and 8,003 acres of potential wilderness in PORE, thereby adding special protection. The Wilderness Act also amended the PORE enabling legislation (Public Law 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 PORE General Management Plan (NPS 1980) is "to protect marine mammals...and other sensitive resources found within the Seashore. The revised PORE Statement of Management (NPS 1993) specified several natural resource 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 PORE Statement for Management, 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."

The 1999 GOGA Resources Management Plan identifies the need to monitor and protect natural resources and the ecosystems upon which they depend (NPS 1999). This plan highlights threats and challenges from GOGA's location at the urban interface of the San Francisco Bay Area, with a regional population of over eight million people. "This Natural Resources Management Plan identifies GOGA's natural resources and their condition. It describes a program to preserve, monitor, maintain, and restore, where necessary, the natural California habitats, and ecosystems on which they depend. The ever-growing metropolitan population adjacent to these natural areas exerts a great pressure to over-utilize the fragile natural systems that remain. This plan identifies these pressures and provides strategies for protecting the natural systems and resources (NPS 1999)."

1.4.3 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. 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.

Analysis of the monitoring data collected through this program will allow changes in pinniped abundance, species composition, distribution, and phenology to be detected. These changes may be influenced by a combination of variables such as changes in food supply, disease, pollution, 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 (Allen et al. 1985; Harvey 1990; Francis and Hare 1994; Pettee 1999; Sydeman and Allen 1999; Sholin et al. 2000; Dierauf and Gulland 2001; Edwards and Richardson 2004; Keiper et al. 2005; Neale et al. 2005; Womble and Sigler 2006; Laidre et al. 2008; Ragen et al. 2008). Additional research and data analysis involving data collected outside this monitoring program (e.g., climate data) will be needed to determine some of these effects.

Pinniped monitoring has applications and links to other monitoring programs conducted by SFAN, parks, and other agencies. Incorporating data and analyses from these other programs may help in the interpretation of changes in pinniped populations observed through the SFAN pinniped monitoring program. Many of these other monitoring programs target pinniped prey species, but also long-term trends in climate change and ocean conditions. SFAN supports a stream fish assemblage vital sign monitoring program, which includes collecting fish productivity data on salmonids (seal prey) at Lagunitas, Redwood, Pine Gulch, and Olema Creeks. Lagunitas Creek and Olema Creek flow into Tomales Bay, whereas Pine Gulch Creek flows into Bolinas Lagoon, both of which are estuaries monitored for harbor seals. CDFG conducts annual Pacific herring population assessment and manages herring stocks in Tomales Bay and San Francisco Bay. NMFS and CDFG, through the Nearshore Fishery Management Plan, collect productivity and stock assessments for rockfish and other nearshore groundfish. Through a multi-agency partnership, the Central and Northern California Ocean Observing System (CeNCOOS) collects and provides regional information on ocean conditions and water quality.

At a regional scale, long-term studies can also 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 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 (U.S. Environmental Protection Agency, administrative history).

1.5 Measurable Objectives

Based on past monitoring, pinniped breeding populations within the SFAN appear to be at a stable or increasing state in terms of abundance and productivity. While those two parameters are the easiest to monitor and have been selected as the primary metrics for monitoring objectives, other questions remain regarding the overall long-term viability of populations. In particular, managers need to understand the potential effects of natural and anthropogenic factors that range from loss of breeding and molting habitat due to sea level rise and global climate change, El

Niño events, increasing recreation and commercial activity around haul outs, and disease transmission.

1.5.1 Monitoring Questions

In the SFAN Vital Signs Monitoring Plan (Adams et al. 2006), specific monitoring questions were identified for pinnipeds. They include:

- What are the status and trends of the population size and distribution of pinniped assemblage?
- What is the natural level of variation in the pinniped population size and productivity?
- Are northern elephant seals and harbor seals reproducing successfully?
- How do natural and anthropogenic disturbances affect seal haul out use and productivity?
- Are there long-term trends in the phenology of pupping and molting by pinnipeds at SFAN?

The above monitoring questions are central to the SFAN Pinniped Monitoring Program, but as mentioned above, other questions exist related to pinnipeds such as prey availability, dispersal, effects of pollution, effects of disease and survivorship. Some of these other questions have been, or are being, pursued by university research projects regionally and at PORE and are investigated at larger spatial scales than is possible for the SFAN monitoring program.

1.5.2 Monitoring Objectives

Monitoring of pinnipeds will address the overall goals and objectives for vital signs monitoring as described in the SFAN Monitoring Plan (Adams et al. 2006). There are several critical sampling design criteria that will allow for the program to meet the monitoring objectives: 1) the survey frequency captures the normal range of variability during the season of importance (i.e., breeding and molt); 2) the survey frequency captures the population maximum during the season of importance (i.e., breeding and molt); 3) all primary survey sites are included in the analyses; 4) the survey frequency captures the potential effects of natural and anthropogenic stressors; and 5) observers receive consistent training to avoid observer biases in data collection and reporting (For more explanation, see Elzinga et al. 1998). These criteria are addressed in Section 2.0 Sampling Design of this protocol.

The specific monitoring objectives of the Pinniped Long-Term Monitoring Program are to:

1a. Determine the long-term trends in population size and seasonal distribution of harbor seal populations at primary sites in the SFAN parks during the breeding and molt seasons.

1b. Determine the long-term trends in population size and seasonal distribution of breeding northern elephant seal populations at SFAN parks as measured by counts of adult females.

1c. Determine the long-term trends in annual population size and seasonal distribution of other pinniped populations at SFAN parks.

Understanding the abundance and distribution of pinnipeds during different haul out periods (pupping/breeding, molting, juvenile haul out) is vital to managing SFAN

beaches and intertidal areas where pinniped haul out sites occur. This objective also supports the next two monitoring objectives, both of which focus on the critical pupping and breeding season. Changes in pinniped use (abundance and distribution) of SFAN haul outs can inform interpretation of long-term trends seen in reproductive success and disturbance levels.

2a. Determine long-term trends in reproductive success of harbor seals through annual estimates of pup production at PORE and GOGA.

2b. Determine long-term trends in reproductive success of northern elephant seals through annual estimates of pup production at PORE.

The long-term reproductive success of pinnipeds in the SFAN is a key metric to determining the overall status of each species within its SFAN habitat.

3. Determine the long-term trends in sources, frequency and level of effects of natural and anthropogenic disturbances on harbor seal haul out use and productivity.

Harbor seals are sensitive to disturbance. Disturbance at haul out sites can negatively affect reproductive success and reduce or eliminate harbor seal use of specific haul outs. Past monitoring has indicated problems with anthropogenic disturbances at harbor seal haul out areas, and management actions have been applied. The MMPA restricts harassment or disturbance of pinnipeds, therefore the monitoring plan involves observation and recording of incidental or intentional disturbance of pinnipeds.

1.5.3 Management Objectives

The overall management objectives, as defined in the SFAN Monitoring Plan (Adams et al. 2006), that relate to marine mammals:

Golden Gate National Recreation Area	• 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 National Seashore	• 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 CDFG.

Specific management objectives fall into two categories: threshold/target objectives and condition/trend objectives (Elzinga et al. 1998). These management objectives vary by species and meet certain assumptions regarding the inherent variability of the data.

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

- Detect any change in the number of primary colony sites of harbor seals between years.
- Detect any change in the number and distribution of breeding/molting sites of northern elephant seals between years.
- Detect any new breeding sites of Steller or California sea lions between years.
- Determine changes in the type (i.e. cause) and magnitude of harbor seal disturbances at haul out sites annually during the breeding and molting season.
- Detect mass stranding of any marine mammal species within a year (see NMFS website http://www.nmfs.noaa.gov/pr/health/ for details)

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

- Detect a 36% decline in harbor seal pup production at six sites over four years.
- Detect a 27% decline in harbor seal abundance at six sites over three years.
- Detect a 41% decline in northern elephant seal pup production over five years.
- Detect a 46% increase in northern elephant seal pup production over four years.
- Detect a 36% decline in the abundance of northern elephant seal cows over four years.
- Detect a 33% increase in the abundance of northern elephant seal cows over three years.

These trend thresholds for harbor seal and northern elephant seal monitoring reflect the results of power analyses of the long-term NPS pinniped data (see Section 2.5). The threshold levels represent the number of years to detect 10% compounded annual changes with greater than 80% power. A 10% annual decline over four years therefore represents a 35% cumulative decline. The power analyses indicate that our current monitoring design has the ability to detect significant population changes in short periods of time, thus allowing for timely, reactive management actions if warranted.

A management action might be initiated if any of the above threshold/target or condition/trend objectives are realized. For example, if a new northern 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. Monitoring the type and magnitude of northern elephant seal expansion into recreation areas such as Limantour Beach or endangered species habitat such as western snowy plover (*Charadrius alexandrinus nivosus*) critical habitat, will provide early warning to managers that these situations are occurring and allow for more informed management decisions. In many cases, the management response to declines that are greater than the threshold levels would be to initiate further research to better understand the factors involved. High levels of disturbance at any site might trigger management actions to reduce the disturbance levels, where appropriate. In the past, these management actions have included increased outreach, and seasonal or permanent closure of sites.

1.5.4 Currently Funded Monitoring Objectives

In 2007, the SFAN Board of Directors, with guidance from the SFAN Technical Steering Committee, approved funding for the pinniped monitoring program that would not allow the program to meet all the monitoring objectives. Based on these funding limitations, a decision was made to focus the SFAN pinniped monitoring on harbor seals. As such, funding is currently limited to only meet the following monitoring objectives related to harbor seals:

1a. Determine the long-term trends in population size and seasonal distribution of harbor seal populations at primary sites in the SFAN parks during the breeding and molt seasons.

2a. Determine long-term trends in reproductive success of harbor seals through annual estimates of pup production at PORE and GOGA.

3. Determine the long-term trends in sources, frequency and level of effects of natural and anthropogenic disturbances on harbor seal haul out use and productivity.

PORE will continue the northern elephant seal monitoring program to the greatest extent possible using volunteers under the direction of the PORE Science Advisor. The SFAN I&M program will continue to offer data management support for the program and may be able to re-instate funding for the program in the future. For these reasons, sample design, field methods, and data management specifications for northern elephant seal monitoring are described within this protocol and associated SOPs in full detail.

2.0 Sampling Design

2.1 Rationale for Selecting this Sampling Design

The primary focal species of the monitoring program are harbor seals and northern elephant seals, during their respective breeding seasons. Ancillary data on other pinniped species are collected concurrently, but are not the primary targets of this monitoring protocol.

Due to the regional and national interest in the health and protection of marine mammals, many pinniped monitoring programs exist along the Pacific Coast. The sample design and methods for this program were developed so that the data could be integrated with other regional surveys, allowing for the results to be interpreted in a regional context. PORE and GOGA participate in regional harbor seal breeding season surveys in collaboration with several other agencies and groups, with the PORE Science Advisor as the coordinator for the surveys. PORE also annually exchanges northern elephant seal breeding season data with other northern elephant seal researchers in California and with NOAA Fisheries.

Harbor seals do not make extensive migrations, are susceptible to disturbance, and regularly use haul out areas throughout the year. Disturbances can affect harbor seal use of SFAN parks, so disturbance levels have been a key metric to monitor for park managers. The parks have engaged volunteers in monitoring activities, particularly with harbor seals, because the methods are relatively easy, there is strong local interest in marine mammals, and there is cost efficiency. The harbor seal monitoring program is a long-standing program and has the added benefit of visitor education and enhanced park stewardship through volunteer appreciation and participation.

Northern elephant seals are a wide-ranging species, migrating twice a year annually to pelagic and continental shelf feeding grounds in Alaska and north of Hawaii, and only spending breeding and molting seasons, and the fall onshore. Given the broad spatial component to the northern elephant seal life history and limited monitoring resources, it is important for any monitoring program to monitor at the spatial and temporal scale at which management actions can have an effect. Seasonal visitor and beach management of current and potential northern elephant seal breeding and molting beaches is dependent on data gathered through the long-term monitoring program.

The current population size and distribution of the harbor seal and northern elephant seal breeding populations are at a level allowing surveyors to complete timely censuses of all breeding sites. Thus, spatial stratification or other sampling techniques were not needed to decide which haul outs to include for monitoring. Survey frequencies and timing capture the beginning of the breeding season, the peak of the breeding and molting seasons, and have been shown to have sufficient ability to detect meaningful population changes over time (see Section 2.5).

The sampling design is outlined below and presented in greater detail in the standard operating procedures (SOPs). If the pinniped populations expand in number and space beyond the current capacity to census all the animals, the sample design will be reviewed and revised.

2.1.1 Parameters Monitored

Reproductive Success: The productivity or reproductive success of a population can be measured and defined in several ways. At SFAN 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 applied to counts of female seals and pups, an index of reproductive success can be calculated annually by site for harbor seals and northern elephant seals (Eberhardt et al. 1979; Le Boeuf and Laws 1994; Sydeman and Allen 1999; Harvey and Goley 2005; Carretta et al. 2007). Data are also collected on the week of first pup, the week of the peak pup count, pup mortality, survivorship to weaning, and lifetime pup production of marked females (Eberhardt et al. 1979; Huber et al.1985; DeMaster et al. 1988; Sydeman and Allen 1999). Measuring reproductive success provides important demographic information on understanding pinniped populations. Reproductive success is strongly associated with population size. In addition, reproductive success provides additional information above and beyond population counts. For example, human disturbance at a haul out may be at a level that does not cause the seals to abandon the site, but may be causing the seals at the site to have reduced reproductive success.

Population Size: Population size is an important parameter to measure, as it shows whether the population is growing, stable or declining. Assessing the total 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 sometimes impossible. NMFS develops regional correction factors to account for this problem in assessing population size. Common methods for censusing pinnipeds include direct counts of a population subsample (e.g., during the breeding season) 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), PORE (Allen and Huber 1983; Allen et al.1989; Allen Miller 1988; Sydeman and Allen 1999), and SFAN.

An index of regional population status at PORE and GOGA based upon 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 SFAN habitats can then be evaluated, and management and program resource allocation wisely directed (DeMaster et al. 1988; Barlow et al. 1993; Lowry et al. 2005).

Distribution: Due to inaccessibility of many coastal sites for pinnipeds, shifts in breeding and non-breeding habitats can go undocumented without regular surveys (Carretta et al. 2007). 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 change or disturbance. Haul out sites are documented annually, and mapped periodically, to assist in assessing shifts in distribution. Shifts to new areas within or adjacent to primary monitoring sites are easily detected by observers through regular monitoring. SFAN is reliant upon other monitoring, for example GFNMS Beach Watch program or CDFG aerial surveys, and reports from park visitors, including boaters, kayakers and an avid birding community, to locate new haul outs in remote areas of the parks.

Phenology: Tracking the changes in the timing of seasonal activities of plant and animal species can provide information on species' responses to seasonal and climatic changes in the environment (Visser and Both 2005; Moore 2008). In marine mammals, cyclic events such as the first arrival and departure dates during the breeding and molt seasons, the birth of the first pup, and the date of peak pup numbers can be related to seasonal and climatic changes seen and measured on a broader scale (Laidre et al. 2008). The frequency and timing of our pinniped censuses is designed to track seasonal arrival, departure, molt, birth of first pup, and peak pup numbers at each study site.

Disturbance Data: Disturbance data are collected for both natural and anthropogenic disturbances at haul outs. Observers note potential and actual disturbance sources (e.g., human, dog, cattle, other) to pinniped colonies or haul out sites. The data recorded include the disturbance source, time, and effect. The effect is noted as the behavioral response of the seals and the number of seals that are disturbed. As mandated by NMFS under permit number 373-1868, the NPS is required to record disturbance events caused by researchers during the course of monitoring pinnipeds. These data are currently collected routinely during all surveys and submitted with the annual report to the NMFS.

2.2 Study Area and Site Selection

The coastal topography of PORE is diverse and complex, including long stretches of sandy beaches, offshore islands, rocky intertidal areas, steep cliff-backed pocket beaches, and bays and estuaries. Significant and extensive sandy beaches include RCA Beach, Wildcat Beach, Drakes Beach, the sandspit of Limantour Estero, and Point Reyes Beach. Point Reyes Headlands encompasses a series of pocket beaches, as does the shoreline extending from Palomarin to Bear Valley. Pinnipeds use both terrestrial and marine habitats of PORE. Haul out and pupping sites occur throughout the park, but are limited mostly to remote beaches, estuaries, or rocky shorelines.

GOGA also has complex topography and is a long, narrow, fragmented park surrounding the mouth of one of the largest estuaries and ports in the United States. Pinnipeds at GOGA are limited to haul out sites on islands within San Francisco Bay, including Alcatraz Island, and at rocky intertidal habitats around Point Bonita, Muir Beach and Seal Rock near the mouth of the Bay. GOGA is in the process of acquiring additional coastal properties in San Mateo County that include pinniped haul out sites. Once these properties are acquired, SFAN and GOGA will determine how to incorporate these sites into the monitoring program.

Primary monitoring sites include the dominant harbor seal and northern elephant seal pupping and breeding sites within PORE and GOGA. Secondary sites do not have a large and consistent occurrence of seals during the breeding season, due to habitat availability or other characteristics, such as high recreation levels (e.g., Ocean Beach at GOGA, Bolinas Point at PORE). Secondary sites, for example, include the rocky coastline of GOGA between Stinson Beach and Muir Beach where a handful of harbor seals occur at any given time of the year. For northern elephant seals, secondary sites include the beaches distant from the Point Reyes Headlands where sub-adult males may come ashore to temporarily rest during the breeding season. Northern elephant seal females and pups do not occur at secondary sites. The pinniped monitoring is focused on and

designed in regards to primary sites, although data and information from secondary sites may be collected opportunistically or in regards to management considerations.

2.3 Sampling Frequency

2.3.1 Harbor Seal Monitoring

Shore-based harbor seal surveys are conducted a minimum of twice per week at each site during the breeding and molting seasons, which run from March 1 to June 1 and June 1 to July 31, respectively. Volunteers and park biologists survey each site, weather and logistics permitting. Each survey lasts two hours, if possible, with seal counts occurring every half-hour. Each subsite is surveyed separately, comprising a grand total for the site on each half-hour count. Regional surveys are coordinated with other monitoring organizations outside of the study area and occur bi-weekly during a five day window (Thursday - Monday) between March 1 and July 31. See SOP 1: Harbor Seal Surveys for additional information.

Factors that might cause variation in the number of seals counted are time of day, tide height, time of year and number of seals that are in the water at the time of the count (Harvey 1990; Frost et al. 1999; Ver Hoef and Frost 2003). Therefore, in an effort to rule out some of these covariates, regardless of season, surveys target low to medium tides (ideally +2.0ft tide or less) between 10:00 and 16:00; the time when the maximum number of seals haul out in the San Francisco Bay region (Risebrough et al. 1978; Fancher 1979; Allen and Huber 1984; Stewart and Yochem 1984; Allen et al. 1989; Grigg et al. 2002).

The survey frequency described above and used in the past are sufficient to capture the peak pup and total population counts necessary to estimate the population size and productivity at each site. The surveys begin prior to the start of the pupping season to capture the date of first pup to track phenology and to begin disturbance monitoring during this critical period. Disturbance monitoring is done concurrently with the seal population monitoring. All disturbances and potential disturbances that occur during the survey period are recorded.

2.3.2 Northern Elephant Seal Monitoring

The survey period for the breeding season extends from December 1 to March 31. Surveys for population size, distribution, productivity, and phenology are conducted a minimum of two times weekly at all sites during the peak breeding season. This frequency is warranted to capture the maximum counts and changes in phenology. One count is conducted per survey, with surveys typically done on the same days each week (i.e., Tuesday and Friday), but that schedule is weather dependent.

In addition, during the breeding season, since adult females remain in the same location for at least one month, tags are resighted at each site once every two weeks at minimum. While a more frequent tag resighting effort would be desirable to assure that the surveyors are capturing the majority of the tagged animals, factors such as beach access, weather, safety, and limited personnel availability, must be considered.

2.4 Number and Location of Sample Sites

All sites where seal breeding occurs within SFAN parks are included in the current study design. If seal populations increase in size or distribution, the sample design may need to be reviewed and number of sites modified.

2.4.1 Harbor Seal 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 areas, offshore tidal ledges, and sandy beaches.

There are eight primary monitoring sites: Double Point, Drakes Estero, Tomales Point, Tomales Bay, Point Reyes Headlands, Bolinas Lagoon, Point Bonita, and Duxbury Reef (Figure 5). Most sites are in PORE, while Bolinas Lagoon and Point Bonita are in GOGA. Duxbury Reef is located within Agate Beach (Marin) County Park and adjacent to PORE. These sites are surveyed during the pupping/breeding and molting season. Additional harbor seal data is collected during northern elephant seal surveys and park-based "all species" surveys of the Point Reyes Headlands (see Section 4.2). Counts of harbor seals at Alcatraz Island (GOGA) by park staff and volunteers have an irregular history. In recent years, however, the data has been consistent enough to include in regional summaries of harbor seal data.

2.4.2 Northern Elephant Seal Study Sites

There are three main survey sites (Figure 6), all at PORE: Point Reyes Headlands (PRH), North Drakes Beach (NDB), and South Beach (SB). There are seven subsites at PRH (see SOP 2: Northern Elephant Seal Surveys): Cove 1, Cove 2, Cove 3, Cove 4, Tip, Loser Beach, and Dead Seal Beach. There are four subsites at NDB: North Drakes Beach, Lifeboat Station, Gus' Cove, and Chimney Rock Cove. At South Beach, there are three subsites: Lighthouse Beach, Nunes Beach, and Mendoza Beach. Incidental observations occur at other sites including Double Point, Abbott's Lagoon, and Point Bonita.

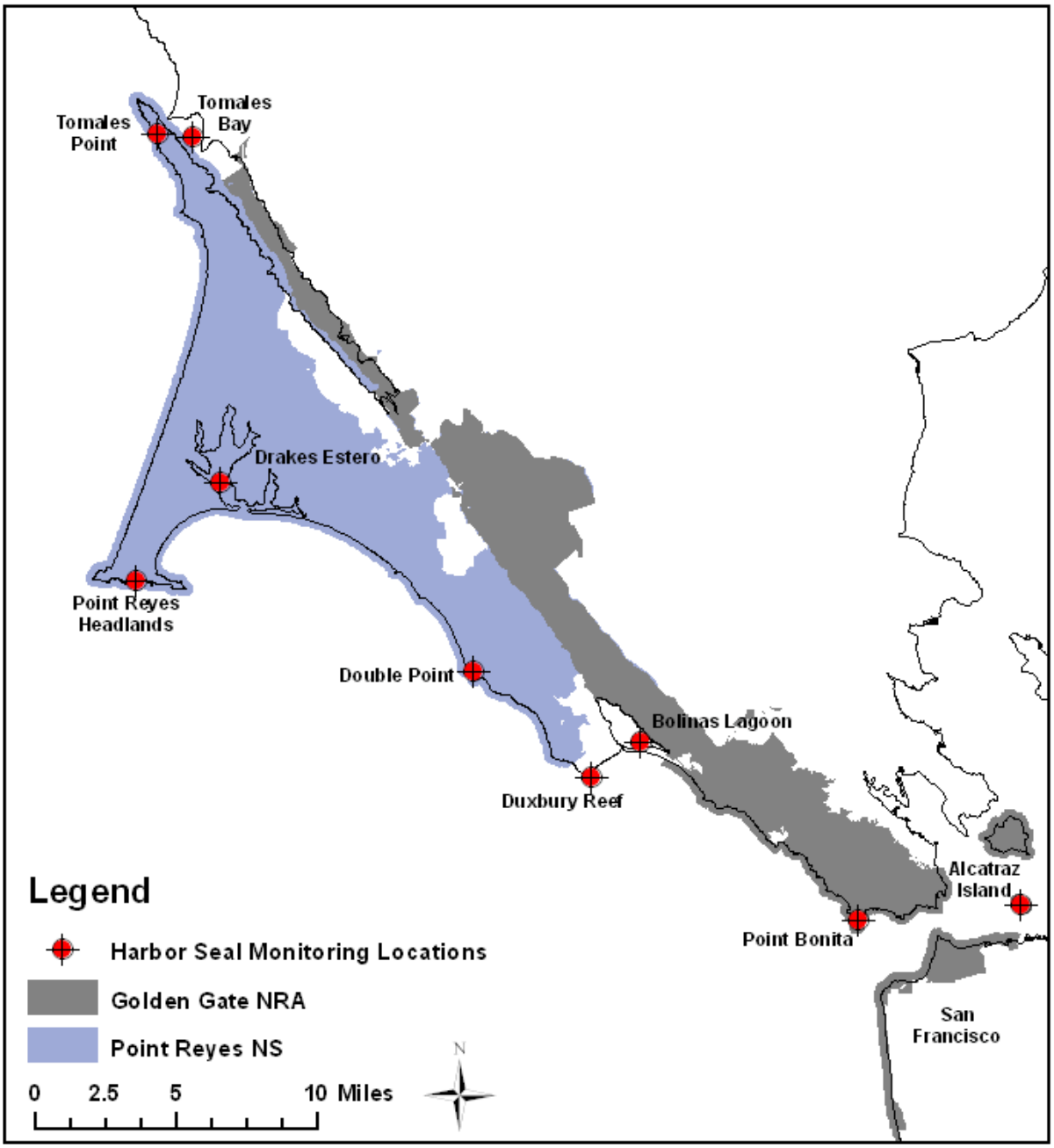

Figure 5. Harbor seal haul out monitoring locations within Point Reyes National Seashore and Golden Gate National Recreation Area.

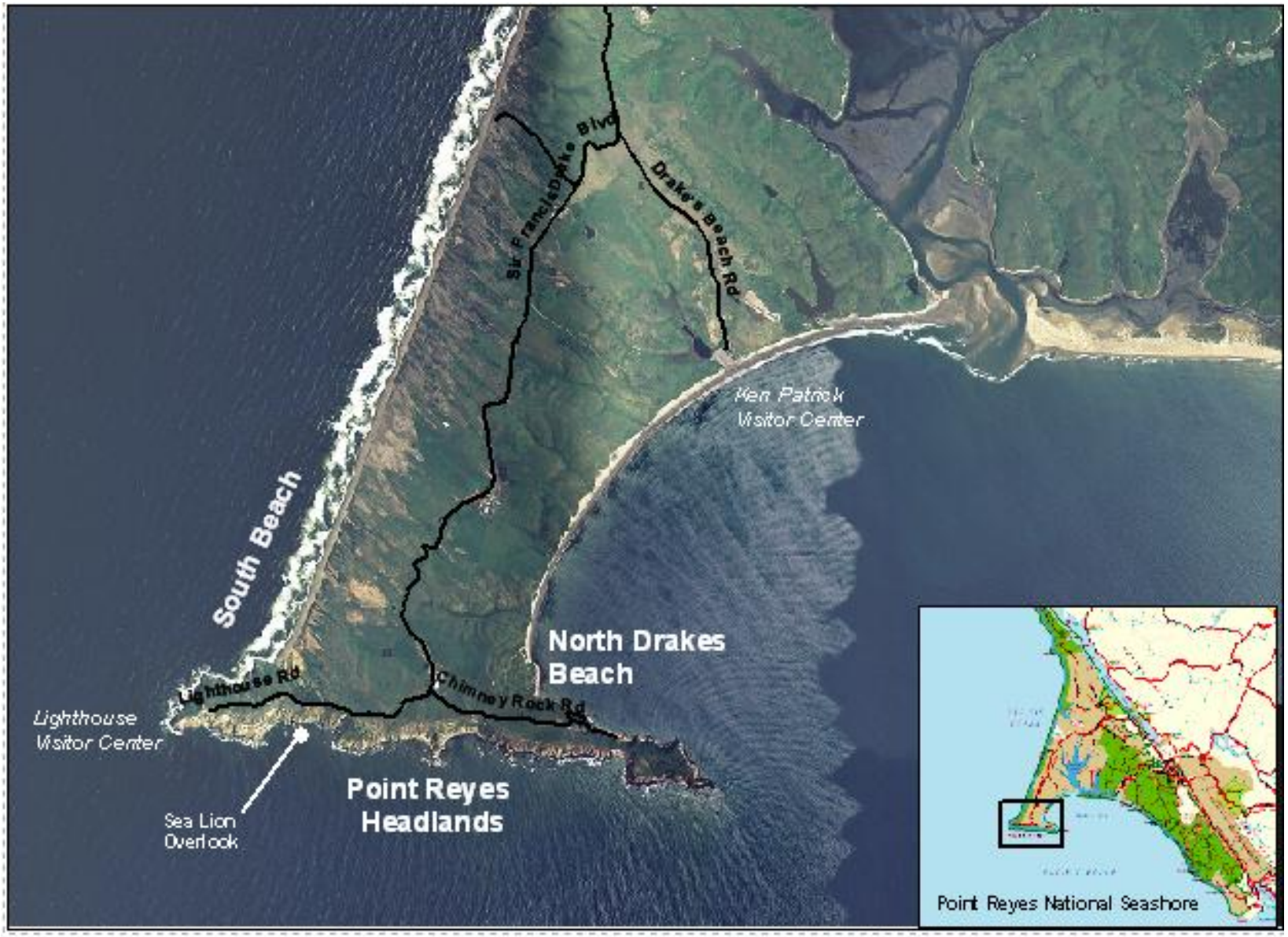

Figure 6. Northern elephant seal monitoring locations at Point Reyes National Seashore.

2.5 Level of Change That Can Be Detected

2.5.1 Harbor Seal Population Monitoring

A power analysis was completed for the harbor seal monitoring program based on data collected from 2000 to 2008 (Appendix A). The analysis was designed to estimate the likelihood that the existing monitoring program will detect a 25% or 50% decline at individual colonies, and the number of years it would take to detect a 10% annual compounded decline for the six major colonies as a group, excluding Duxbury Reef and Point Bonita. The analysis used maximum counts for adults and pups from surveys during the pupping season for 8 colonies from north to south: Tomales Bay, Tomales Point, Point Reyes Headlands, Drakes Estero, Double Point, Duxbury Reef, Bolinas Lagoon, and Point Bonita. Because Duxbury Reef and Point Bonita are mainly molting sites with few pups, molting season maximum count data was used for this analysis.

All of the six pupping sites had an 80% chance of detecting a 50% decline in adults at any one colony within 2-5 years, not including the base year. Detecting an overall 25% decline in adults would always take at least 14 years, not including base year. 50% declines of pups at each of the six pupping sites could be detected in 2-7 years, and 25% declines for pups would always take at least 14 years, except for at Bolinas Lagoon, which would only take 4 years. Tomales Bay and Bolinas Lagoon had the lowest coefficient of variation.

Power was generally higher for both adults and pups for the six major SFAN pupping sites pooled (excluding Duxbury Reef and Point Bonita). Current monitoring effort had a 90% chance of detecting a 27% decline in overall population counts over 3 years. For pups, an 88% chance of detecting a 36% decline would be realized after 4 years. Thus, after only three years of monitoring (not including the baseline year) the current program is very likely to detect ~25% declines in both adults and pups.

Based on these results, the harbor seal monitoring program will focus on detecting a 10% annual decline (total 27%) of adults in the six major SFAN pupping sites pooled over a period of 3 years. For pups, the focus will be on a 10% annul decline (total 36%) over 4 years. Power for detecting these trends is 90% for adults and 88% for pups. Colony-specific declines, which take longer to detect, will be explored at intervals consistent with the results of the power analysis. The sites not included in the pooled analysis, Duxbury Reef and Point Bonita (low number of pups each year, with less intercount variance during the molting season), will continue to be surveyed because of the high disturbance levels at these sites and the need to acquire information for management even if trend analyses are not possible.

2.5.2 Northern Elephant Seal Population Monitoring

A power analysis was completed for the elephant seal monitoring program based on data collected from 1998 to 2009 (Appendix B). The analysis was designed to estimate the likelihood that the existing monitoring program will detect a 25 or 50% decline at individual colonies, and the number of years it would take to detect a 10% annual compounded decline *or* increase for total maximum count. The analysis used maximum counts for adult cows and pups+weaners from surveys during the breeding season were compiled from 1998 – 2009 for Point Reyes Headlands, South Beach, and North Drakes Beach, as well as the maximum count day for all colonies.

For cows, Point Reyes Headlands had an 80% chance of detecting a 50% decline in only 2 years, as well as the population as a whole. However, North Drakes Beach and South Beach would take 8-9 years to detect a 50% decline. Detecting an overall 25% decline in adults would always take at least 7 years for the population pooled. 50% declines in pups pooled could be detected in 2 years, and 25% declines for pups would take at least 12 years to detect.

For all sites combined, monitoring effort had an 86% chance of detecting a 36% decline in cows over 4 years. For pups, an 83% chance of detecting a 41% decline would be realized after 5 years. Increases were easier to detect, generally having 0.1 - 0.2 higher power. Thus, after only 4-5 years of monitoring (not including the baseline year) the current program is very likely to detect 36-41% declines or increases in both adult cows and pups.

3.0 Field Methods

3.1 Site Access

Most sites are accessed via trails from park roads. Counting locations are typically off trail and not in public access areas or in view of the public. The exceptions are North Drakes Beach, Duxbury Reef, Point Bonita, and Bolinas Lagoon, which are in public access areas. When observers are in closed areas, such as seal pupping beaches, the park dispatch is notified via radio of their presence and likely duration of activities. When possible, temporary signs are posted to alert the public to the official research activities occurring within closed areas. See SOP 1: Harbor Seal Surveys and SOP 2: Northern Elephant Seal Surveys for maps of sub-sites and counting locations.

3.2 Harbor Seal Monitoring

3.2.1 Field Season Preparation and Equipment Setup

The field season preparations for the harbor seal monitoring program focus on volunteer recruitment, training, and coordination. Each year, volunteer recruitment is started in the fall with advertisements on NPS websites, in local Bay Area newspapers, and in environmental organization newsletters. Training sessions are scheduled in October for February and March, and include two-half day classroom sessions, typically in the PORE Red Barn classroom, and field visits to each survey site. In 2006, a mentor program was established for beginner surveyors to work on survey skills with long-term volunteers. See SOP 1: Harbor Seal Surveys, for more details.

3.2.2 Details of Taking Measurements

Population data: Shore-based surveys are conducted from standardized observation points using binoculars and/or spotting scope. Direct counts of all harbor seals present at sub-sites within a monitoring location occur from March 1 to July 31. Pups may be identified and are counted separately from March 1 to May 31. 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 and surveys coordinated by a volunteer coordinator. See SOP 1 for training documentation, data forms and monitoring field methods.

Tagging: Tagging of harbor seals is not a primary task of the monitoring program. However, on occasion, project staff do assist with tagging efforts by researchers affiliated with universities and other agencies.

Resighting Tags: The monitoring project does not actively tag or track tagged harbor seals. However, tagged harbor seals that are incidentally observed during surveys are recorded and the appropriate research program is notified.

Disturbance data: These data involve the number of potential and actual disturbance sources (e.g., human, dog, cattle, other) and include both natural and anthropogenic disturbances. For each potential or actual disturbance, observers record the source, time, and effect of activity, including the behavioral response of the seals and the number of seals affected. Harbor seals are

very reactive to human activities and will flush into the water when disturbed (Allen et al. 1985). 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 is collected during surveys to provide information on visibility (fog), precipitation, and wind speed. These three parameters can affect the presence or visibility of seals. Climate data include ENSO events, La Niña events, North Atlantic Decadal Oscillation, and Pacific Decadal Oscillation and can help interpret the reproductive results of the season (DeLong et al. 1999; Sydeman and Allen 1999).

3.3 Northern Elephant Seal Monitoring

3.3.1 Field Season Preparation and Equipment Setup

In October and November, surveyors assemble and inventory equipment needed during the breeding season and replace or repair any missing or damaged equipment. Flipper tags are drilled and checked for flaws prior to the start of the season. Temporary beach closure signs are made. Surveyors follow a signage plan to erect signs to alert the public to beach and cliff closures during the breeding season. See SOP 2: Northern Elephant Seal Surveys for more details.

3.3.2 Details of Taking Measurements

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 classes 1-4, other sub-adult male, cow, pup, dead pup, weaned pup, immature of unknown sex, yearling. Other species noted include number of harbor seals, California sea lions, and other pinnipeds. See SOP 2 for more detailed information on northern elephant seal monitoring field methods and data forms.

Tagging: The goal outlined in the NMFS permit is to tag between 200-300 weaned pups at PORE each year. 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 tagged and/or dye-marked 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. Dye-marking reduces the effort of resighting the same tagged animal multiple times throughout a season, and aids in identification of important male seals by park docents and interpreters.

Resighting Tags: Surveys to re-sight tagged individuals occur once every two weeks at a minimum on the easily accessible beaches (NDB, SB). Re-sight surveys to PRH sites typically occur only in December, early January and March because of concerns for human safety. The PRH sites have difficult access, a higher density of seals, and increased seal movement on the beach. Tag information recorded from animals during re-sight surveys includes location of seal, flipper tag number, color, side (left or right), and position among the inter-digit webs (round or square). Also, the presence or absence of tags on the other flipper is recorded. Animals with freeze brand marks (applied at other breeding colonies) and distinctive scars such as shark bites

are recorded in the notes field. Nursing activities and pup size class (P1-4) are recorded if the animal is an adult-sized female. Dominancy on the beach (alpha, beta, not associated) is recorded if the animal is a sub-adult 4 or bull male.

Disturbance data: Disturbance data are collected on source (e.g., human, dog, cattle, other) and on effect to seals including potential versus actual disturbances. Northern elephant seals are not as reactive to human disturbance as harbor seals; however, females are more sensitive and the presence of humans can deter colony formation. Additionally, responses of seals to humans can have indirect effects on productivity due to disruption of nursing or causing males to interact. Harbor seal disturbances that occur during northern elephant seal surveys are recorded as well.

Environmental data: Weather data is collected during surveys to provide information on visibility (fog), precipitation, and wind speed. These three parameters can affect the presence or visibility of seals. Climate data include ENSO events, La Niña events, and Pacific Decadal Oscillation and can help interpret the reproductive results of the season (DeLong et al. 1999; Sydeman and Allen 1999).

3.4 End of Season Procedures

General end of season procedures are briefly described here, but more detailed descriptions of data management, reporting, equipment maintenance, and data and report archive procedures are outlined in the SOPs.

Following the data entry, proofing, and analysis (described in Section 5.0 and SOPs 3 and 4), program and park staff produce a brief annual monitoring report with basic data summaries and any natural history items of note using the NPS Natural Resource Technical Report template. The report provides pertinent updates to the park program managers and I&M Coordinator for inclusion in other reporting requirements (e.g., Annual Administrative Report and Workplan or for website updates) as outlined in SOP 4: Data Analysis and Reporting.

The number of volunteers and the total volunteer hours spent on the pinniped program is summed by program staff and provided to volunteer coordinators at GOGA and PORE for use in annual volunteers in parks reporting.

All monitoring equipment is cleaned and stored at either PORE or GOGA. At PORE, storage of monitoring supplies is in the wildlife garage, basement of the Resource Management building or Science office. At GOGA, equipment is stored in the Resource Management Building (Fort Cronkhite Building 1061) or in the SFAN I&M Building (Fort Cronkhite Building 1063).

All digital photographs taken during the field season will be labeled with site name and date and organized on the PORE server within the appropriate directory. High quality photographs (300 dpi) should be submitted to the Network I&M Coordinator for use with the annual reporting along with a caption or explanation of the photograph.

4.0 Cooperation with Other Monitoring and Research

During surveys associated with this monitoring protocol, additional activities may occur in support of regional or national long-term ecological monitoring programs. These activities are not represented as part of the protocol but are included to document the activities currently supported. The information collected contributes to the understanding of the SFAN pinniped populations in a regional context and may inform the SFAN monitoring program.

Understanding the pattern of relationships between organisms and their environment (abiotic and biotic, environmental and anthropogenic) is a necessary goal for adaptive management. These relationships are complex for pinnipeds and patterns vary by species and season. The effort expended to collect ecological and anthropological data at SFAN sites varies and is often the outcome of collaborations with other researchers and resource agencies.

The following partners, collaborators, agencies and institutions have expertise and complementary programs that contribute to the NPS program goals and give a broader context to the data collected by the NPS.

- 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
- The Marine Mammal Center
- Moss Landing Marine Lab
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration
- National Marine Sanctuary Program
- California Oiled Wildlife Care Network
- PRBO 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

4.1 Dye-Marking, Tagging and Resighting Tags

Northern elephant seal tag information is collected during scheduled surveys and opportunistically. Between 200 and 300 weaned northern elephant seal pups are tagged each year. Data on tagging and tag resighting are submitted as a component of the annual report to the NMFS.

Tag resight data within and across seasons may be used to understand mechanisms of dispersal, colony expansion, and movements between PORE breeding sites. During a single season,

temporary dye marks may be applied to tagged and/or dominant males to aid in tracking individual movements.

Northern elephant seal tag resighting data are shared among researchers from other colonies including Piedras Blancas, San Miguel Island, Southeast Farallon Islands, and Año Nuevo. Resight data of northern elephant seal pups tagged at PORE have been provided by other researchers from Russia, Alaska, Oregon, and Washington. Additionally, The Marine Mammal Center (TMMC) shares resight data of all rehabilitated seals. Reporting resighted tags aids in understanding recruitment, seasonal distribution, survivorship, reproductive success, and success of rehabilitation efforts.

Tagging and tag resighting have been core components of the NPS northern elephant seal monitoring program for several years due to the minimal effort required to collect the data and high value to the broader research community. The SFAN I&M program has provided support for these efforts, and would likely continue to do so should it be able to again fund northern elephant seal monitoring in the future. As such, tagging and tag resighting are written into this protocol as core field activities and are addressed both in field methods and data management sections.

Harbor seals are tagged by various researchers in the region and the data are shared among researchers. Resight data of tagged harbor seals observed during surveys is recorded and shared with researchers.

4.2 All Species Pinniped Monitoring – Point Reyes Headlands

Point Reyes staff and volunteers, under direction of the PORE Science Advisor, conduct year-round counts of all pinniped species at all locations at the Point Reyes Headlands every other week. Winter surveys overlap with and are coordinated with counts of northern elephant seal breeding sites. The park's all species monitoring program compliments the harbor seal and northern elephant seal monitoring programs by documenting the northern elephant seal molts, harbor seal pupping, and harbor seal molt at the Point Reyes Headlands. The program additionally collects data on California sea lions, Steller sea lions, and northern fur seals. The monitoring program contributes to a long-term data set for the Point Reyes Headlands dating back to 1980. The SFAN I&M program provides data management support for the all species monitoring program. All data collected at the Point Reyes Headlands are entered into the pinniped monitoring database. I&M data management staff assists PORE with data entry, data maintenance, and data summaries.

4.3 Scat Collection

Although scat collection is not a component of the current protocol, some relationships, such as diet and trophic interactions, are extremely valuable and information in this area would enhance the monitoring program and pinniped management. To this end, through the pinniped program, SFAN will examine pinniped diets by opportunistically collecting scat to identify the prey seals are utilizing. Information on diet also will be obtained by assisting in analyzing carcasses of dead seals. Standardized protocols for fecal collections and measuring diet may prove valuable for long-term assessments, but samples are currently collected only opportunistically (Harvey 1987). Some species, such as harbor seals forage locally, while northern elephant seals, feed mainly in the north Pacific.

4.4 Statewide Surveys

The CDFG and NMFS conduct statewide aerial surveys of harbor seal sites during peak molting season. Surveys are conducted on an annual basis during June, weather permitting (Hanan 1996; Lowry et al. 2005). The NMFS annually collects data on northern elephant seal demography which is used for stock assessments on the number of total seals and the number of pups produced and pups weaned. SFAN shares survey data from monitoring at PORE with NMFS for the stock assessments (Carretta et al. 2007).

The year round sea lion survey data are also shared with the NMFS for stock assessments. These data are also relevant for ground-truthing aerial surveys during the Steller sea lion pupping season, May through July. Although Steller sea lions no longer breed at PORE, large male sea lions do appear during May through July, and individuals are present year round. Observations of marked California sea lions are shared with NMFS and are used to estimate survival for the population. California sea lions were branded at San Miguel Island to study survival of the population.

Additionally, data are shared with PRBO for comparison with Southeast Farallon Island colonies (Sydeman and Allen 1999). The NMFS requires an annual report from the park as part of the permit authorization. S. Allen and D. Lee of PRBO are co-primary investigators for the NMFS permit number 373-1868.

4.5 Volunteer and Docent Programs

As needed, the NPS has assisted the GFNMS volunteer stewardship program, SEALS. However, the SEALS program is no longer active in Tomales Bay or Bolinas Lagoon. The GFNMS participates in the breeding and molt season region-wide surveys, and provides the results in their annual reports (Tezak et al. 2004).

PORE has a northern elephant seal docent program with volunteer docents who educate visitors about northern elephant seals to protect the easily accessible haul out sites from disturbance. The focus is on interpretive efforts. I&M monitoring data is shared with the docent program to provide the public with current seasonal breeding summaries.

4.6 Stranding Network Program

The SFAN 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/mmhsrp.html website). Stranding frequency data at SFAN sites is captured from several sources including 1) NPS survey data from breeding and haul out monitoring for northern elephant seals, harbor seals and Point Reyes Headlands “all species” (see Section 4.2), 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.

Regional Stranding Network partners include California Academy of Sciences (CAS), University of California - Museum of Vertebrate Zoology (MVZ), and TMMC. GFNMS conducts a monthly regional beach-monitoring program (Beach Watch), and 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).

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.

4.7 Disease Monitoring

Disease can have large impacts on pinniped populations. As such, SFAN will continue to work with partners to monitor the presence and effects of disease on pinniped individuals and populations by documenting affected animals and coordinating investigations with TMMC, other researchers, and the National Marine Mammal 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).

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. GOGA and PORE are members of the NMFS, Southwest Region Marine Mammal Stranding Network (see NOAA website http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/mmhsrp.html for details). The Stranding Network is linked to the Marine Mammal Health and Stranding Response Program, which tracks various health parameters across the nation, and PORE contributes to the National Marine Mammal Tissue bank. Additionally, PORE banks tissue with the TMMC 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. TMMC, UC Davis, NMFS and the National Marine Mammal 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). Opportunistically, the parks collect blood, tissue and other tissue from stranded or captured (tagged) seals to be used as reference data on health (Gulland et al. 1997; Neale et al. 2002). Necropsies are performed on most dead marine mammals, including pinnipeds, found on SFAN beaches by the stranding network personnel to determine cause of death.

4.8 University Research

The wealth of monitoring data and knowledge about the SFAN pinniped populations have spurred many university researchers and graduate students to address specific questions related to pinnipeds, such as disease transmission, dispersal, reproductive success relative to habitat differences, and El Niño effects. Some of these research areas fall outside the objectives and scope of the long-term pinniped monitoring program. However, these research projects provide critical information in effectively managing pinniped populations. The SFAN Network will continue to support research to address questions that promote a better understanding of pinniped populations in the region.

4.9 Collaborative Products

NPS staff members contribute regularly to products developed by other agencies. The following section lists examples of contributions made by assisting with data analyses or reviewing documents.

State (CDFG): Ground-truth data for annual CDFG/NMFS harbor seal aerial surveys.

Federal (NMFS/NOAA): Under the 1994 amendments to the MMPA, the NMFS is 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. Stock assessments are required for all marine mammals, and the NPS reports for northern elephant seals, harbor seals and sea lions.

Federal (National Marine Sanctuaries): Data from the NPS harbor seal monitoring program are included in the annual harbor seal reports of the GFNMS (1998-2002).

International: Collaboration with researchers in other countries occurs on a sporadic basis regarding resight data from tagged northern elephant seals.

5.0 Data Management, Analysis, and Reporting

This section briefly describes the data management, data analysis and reporting aspects of the SFAN pinniped monitoring program. Two SOPs provide further details:

SOP 3 (Data Management) describes in more detail how the SFAN pinniped monitoring protocol meets data management objectives through data entry specifications, database design, quality assurance and control measures, metadata development, data maintenance, data storage and archiving, and data distribution. Data management procedures are explained for all the components of the protocol.

SOP 4 (Data Analysis and Reporting) describes in more detail annual data analysis and reporting procedures.

5.1 Overview of Database Design

The pinniped protocol encompasses two monitoring programs (harbor seal and northern elephant seal). The pinniped database contains data collected by both programs. There are separate data entry and editing procedures for the harbor seal and northern elephant seal programs. The northern elephant seal data entry and editing forms are also used for pinniped surveys at Point Reyes Headlands conducted by PORE outside of the breeding seasons. While separate data entry and editing forms are used, data are stored in common tables to facilitate reporting and analysis across the monitoring programs.

The SFAN staff has developed a relational Microsoft (MS) Access XP database modeled after the Natural Resource Database Template (NRDT), an application developed by the NPS I&M Program. The database consists of two separate MS Access .MDB files. The 'front end' (Pinniped.mdb) contains forms, linked tables, reports, queries, macros and Visual Basic code while the 'back end' (Pinniped_BE.mdb) houses the data tables. This organization of the database allows new development and edits of forms and reports (housed in the front end) to proceed without hindering use of the data (housed in the back end). The two .MDB files are linked using the 'Linked Table Manager' utility of MS Access.

The data organization is based on the concept of surveys (sampling events occurring at a specified time) recorded in an event table which are conducted at specified locations, that are geo-spatially described in a locations table. EventID and LocationID codes provide the unique keys for databases built on the NRDT model. Besides actual counts of pinnipeds, the database is used to record effects of natural and anthropogenic disturbances to harbor seals and track the fate of tagged northern elephant seals.

As described above, there are two different data collection protocols, one for harbor seals and the other for northern elephant seals. The primary information collected by both programs is the number of pinnipeds observed at a specific time and location. The same tables are used to house the primary information from both programs, namely, *tblEvents*, *tblLocations*, *tblObservers* and *tblSealCoun*t. Events are linked to counts by an EventID which is automatically generated by Visual Basic code housed in the data entry forms. EventIDs are the concatenation of the

following values: park, project, year, month, day and starting time (i.e., PORE_Pinniped_2005-Jan-03_12:30:00).

5.2 Data Entry, Verification, and Editing

Data entry is done by field staff within a week of collecting the data. The data entry forms resemble the field data sheets as closely as possible. Data entry and editing are discrete operations which cannot be combined. Separate entry and editing forms are provided for each pinniped program.

Satellite databases are distributed to PORE and GOGA, which enters data just for the Point Bonita harbor seals. Satellite databases should begin with data collected after Aug 1 and continue through to the following July 31. This time frame captures the entire northern elephant seal breeding season (approximately Nov-March), the harbor seal breeding season (March-May), and the harbor seal molting season (June-July). Field staff must cross check the northern elephant seal census and northern elephant seal resight data in the database against the paper datasheets completed in the field. In addition, after the field staff has completed its review, the Network Data Manager should independently check a random 10% of the records for accuracy.

The harbor seal monitoring program undergoes a higher level of data scrutiny because it is primarily collected by volunteers and is more subject to difficult field conditions, such as fog and high winds, that may compromise the accuracy of the data. In addition, data collected by volunteers are given data reliability ratings based on the amount of experience and evaluation by project staff. During the course of the season, and again at the end of the season, each survey should be evaluated and assigned a yes/no for high quality rating, based on factors such as poor visibility, incomplete survey, and poor observer quality. Following these procedures, data checking continues as described for the northern elephant seal monitoring program.

The Database Manager incorporates all the satellite databases into a single annual database and completes additional error-checking queries.

Prior to any major changes to the database design, a back-up copy of the database should be made. Once the database design changes are complete, the database should be assigned the next incremental version number. The final copy of the previous database version should be archived with the version closing date incorporated into the database title. Version numbers should increase incrementally by hundredths (e.g., version 1_01, version 1_02, … etc.) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2_0, 3_0, 4_0, …). The front-end and back-end databases should be titled with the same version number, regardless of in which database file modifications are made. Significant database re-design may require approval by the project manager, review by other data management staff, and revisions to this data management SOP.

5.3 Data Archival Procedures

Before the annual data is uploaded into the master database, a copy of the master is made and archived with the date incorporated into the file name. The satellite databases are archived after the data has been uploaded. PORE database archives will be stored at PORE, while GOGA files will be archived at GOGA. In addition, when changing the database to a new version, the final

copy of the previous database version is archived with the version closing date incorporated into the database title. Both GOGA and PORE servers have regular back-ups that are maintained by park staff.

At the end of each field season, after error-checking, proofing, and uploading the seasonal data, all of the field datasheets are organized into a binder for that year. Also included in the binder are a hardcopy of the annual report, once completed, and a CD containing a copy of the complete master database and an electronic copy of the annual report. With the exception of the Point Bonita datasheets, which are stored at GOGA in the Marin Headlands I&M office, all data binders are stored in the PORE Science office.

5.4 Metadata Procedures

The NPS GIS Committee requires all NPS GIS data layers be described with the NPS Metadata Profile, which combines the FDGC standard, elements of the ESRI metadata profile, the Biological Data Profile, and NPS-specific elements. Although no standard has been applied to natural resource databases and spreadsheets, the SFAN will complete the NPS Metadata Profile to the greatest extent possible to document the annual and master pinniped back-end databases. Because the annual Point Bonita harbor seal data is uploaded into the master Point Bonita database without alteration, it is not necessary to create metadata records for the annual Point Bonita back-end databases.

Complete metadata records for the SFAN pinniped databases will be generated in compliance with current NPS standards by the SFAN Data Manager. Because the location data for this project is stored as UTM coordinates within the MS Access databases, there are no spatial data products associated with this protocol that require metadata records.

When completed, metadata records, but not the data, will be posted to the NPS Data Store for public discovery and consumption. Contact information within the metadata records will direct interested parties to the SFAN Data Manager for further inquiries. Master database metadata records posted to the NPS Data Store will be updated annually after the annual data has been uploaded or following database revision to a new version whole number (i.e., v1_3 to v2_0, but not v2_0 to v2_1).

5.5 Data Distribution

In order for the pinniped monitoring program to inform park management and to share its information with other organizations and the general public, guidance documents, reports, and data must be easily discoverable and obtainable. The main mechanism for distribution of the pinniped monitoring documents and data will be the Internet. The pinniped monitoring protocol, accompanying SOPs, and all annual reports will be made available for download at the SFAN website:

http://science.nature.nps.gov/im/units/sfan/

Although the pinniped monitoring database will not be posted for public download, as previously mentioned, metadata records for the master database will be maintained at the NPS Data Store.

The metadata records will direct interested parties to the SFAN Data Manager for further inquiries.

In addition to the NPS Data Store, the NPS I&M Program maintains an on-line natural resource bibliographic database known as NatureBib. NatureBib records will be created for all of the pinniped monitoring documents, including the protocol, annual reports, and any resulting publications.

5.6 Data Analysis

Each year an annual report is produced that is largely based on the presentation of summary statistics for the season. Both site specific and aggregate data are presented. Comprehensive trend analyses will be prepared every five years. Details for the annual and five-year reports are presented in SOP 4: Data Analysis and Reporting.

5.6.1 Harbor Seal Monitoring Program

Several harbor data summaries are developed each year for each location and for all sites combined, including:

- breeding season maximum count of adults and immatures combined
- breeding season maximum count of pups
- molting season maximum count of adults, immatures, and pups combined
- summary of disturbance sources (e.g., motorboat, human, vehicle, aircraft, etc.), presented by reporting, for each source, the number recorded and the percent of the total number of disturbances for the season
- rate of disturbances (number of disturbances per hour of survey) for each monitoring location

As an index of the total population size, the maximum counts for each location are summed and reported separately for the breeding and molting seasons. Graphs of the maximum total count of pups and adults for each year are developed for the breeding and molting seasons to compare the data across years (Figures 3 and 4).

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. The current population estimator is 1.65 times the maximum onshore number of adults/immatures, pups, and individuals during molting (Lowry et al. 2005; Carretta et al. 2007). SFAN synthesis and trend reports will apply the appropriate correction factor for long-term harbor seal population trends.

To determine long-term trends in population size and productivity, the maximum count from each colony, multiplied by the 1.65 correction factor, is evaluated by regression (linear or non-linear) analyses (versus year) as described in Sydeman and Allen (1999) and . This results in one data point per colony per year for the analyses. As recommended in Appendix A, the harbor seal monitoring program will focus on detecting a SFAN-wide decline over a period of three years (90% likelihood of detecting a 27% decline) using six of the primary sites (Tomales Bay, Tomales Point, Point Reyes Headlands, Drakes Estero, Double Point, and Bolinas Lagoon).

Both population and productivity trends are analyzed to report the rate of change and whether it is significantly different from zero (Caughley and Birch 1971; Zar 1984). In addition to the colony specific regressions, route regressions (Elzinga et al. 1998) will be used to evaluate the population trend for the entire SFAN harbor seal population. This consists of individual regressions from each colony being combined to report a mean slope, standard error, and statistical significance for all the colonies. A report of the statistical power of the regression will also be presented with the regression results.

Disturbance data are summarized every year using the following measures:

- source of disturbance: annual tally of sources of disturbance (e.g., motorboat, human, vehicle, aircraft, etc.) for each location and for all locations combined
- rate of disturbance: number of disturbances per hour of survey for each location

Rate of disturbance will be explored for changes through time using binomial tests on human disturbance sources versus total disturbance sources. In addition, ANOVA or Generalized Linear Models (GLM) will be applied to test for differences in disturbance rates between years (pooling all sites and at each individual site), differences in weekday and weekend disturbance rates, and differences in disturbance between sites.

The effects of disturbance on population size and pup production can be tested using GLMs following methods developed by Becker et al. (2009). GLMs will be run using factors that may affect population size and productivity, such as year since the most recent El Niño event, and density-dependence due to total counts in the region in order to test the relative influence of disturbances to the harbor seal population.

5.6.2 Northern Elephant Seal Monitoring Program

In 2007, a two-year northern elephant seal report was produced using the NPS Natural Resource Report Template (Table 1; Adams et al. 2007). Annual and long-term trend reports will likely remain consistent with this report format, which emphasized northern elephant seal population and productivity estimates.

Annual and long-term trends of northern elephant seal population size are reported by age and sex class using direct counts. Breeding population estimates are based on maximum survey counts for northern elephant seals by sex, age group, and colony (Adams et al. 2007). During the breeding season, not all age classes are present on the beaches so accurate total population size counts are not possible. In addition, during surveys, some northern elephant seals, especially sub-adult males, are in the water and cannot be counted. Consequently, 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 NMFS estimates the elephant seal population size by using raw pup counts multiplied by the inverse of expected ratio of pups to total animals (McCann 1985). Boveng (1988) and Barlow et al. (1993) recommend using 3.5 as an appropriate multiplier for a rapidly growing population such as the California stock of northern northern elephant seals. The PORE population estimates

are based on the pup count multiplier (3.5) used with the maximum total of pup and weaned pup counts by colony or sub-site. NMFS is currently reviewing this multiplier and may provide new guidelines in the future. SFAN contributes data to NMFS for an annual national population estimate (Barlow et al. 1993; Carretta et al. 2002; Carretta et al. 2007).

Annual productivity is reported as an index of annual reproductive success using direct counts of females, pups, and applying correction factors. An example of productivity summary data for the northern elephant seal monitoring program is in the protocol narrative, Table 1. The productivity index is calculated from the following formula (Lee 2006):

$\frac{\text{Maximum count of weaned pups and pups}}{\text{Adjusted maximum count of females}}$	= Productivity Index

The index is calculated for colony sites and the entire PORE population. The total number of breeding females is estimated using the maximum count of adult females during peak pupping adjusted to include the adult female counts 33 days prior to and 33 days after the peak count for each colony site (Adams 1994; Le Boeuf and Laws 1994; Table 1). 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 prior to pupping + 27 days nursing period; LeBoeuf and Laws 1994). The assumptions of this method to determine productivity are that observers are able to capture the high count of pups plus weaners and adult females during the bi-weekly surveys and that female natality is unknown but relatively stable across years. The index reflects productivity only and not mortality (dead pups are included in the total) that occur at the breeding site.

Rates of change in the northern elephant seal population will focus on adult female counts and pup production. Cow adults will be used as a proxy for total breeding population size because northern elephant seal males, particularly sub-adults, are highly mobile during the breeding season, which can result in them being double-counted. The maximum count of pups plus weaners for each colony provides an estimate of actual pup production.

A power analysis (Appendix B) indicates that for all sites combined, monitoring effort has an 86% chance of detecting a 36% decline in cows over 4 years. For pups, an 83% chance of detecting a 41% decline can be realized after 5 years. Increases are easier to detect, generally having 0.1 - 0.2 higher power. Site specific trends will take longer to detect, but will be explored for Point Reyes Headlands, North Drakes Beach, and South Beach separately. Methods for exploring long term trends in the northern elephant seal population will be similar to those already described for harbor seals.

5.7 Reporting Schedule and Formats

Reporting is an essential component of the pinniped monitoring process. The effectiveness of pinniped monitoring at GOGA and PORE lies not only in the field work and data management, but also in how the information gathered is shared throughout the season and how it is summarized at the end of the season. Reporting within-season allows for the information gathered to be transferred to managers for the most effective internal support of the program; it also allows visitors to understand what it is that Resource Management does in a NPS unit; and

how resources are protected while providing for visitor enjoyment of those resources. Reporting at the end of the season allows for consistent scientific thoroughness to be applied to the pinniped monitoring program, and allows resource managers to identify population and productivity trends and triggers for management actions and resource protections.

A summary of reports that will be developed is provided in Table 2.

One of the most critical components of updating park staff about ongoing activities is the Weekly Updates. These reports include updates on maximum numbers documented and any unique or noteworthy observations (e.g., arrival dates, shifts in beach use). The Weekly Updates are distributed to all employees via e-mail and are posted to the SFAN website.

The post-season or annual report follows the national guidelines established for NPS Natural Resource Publications (http://nature.nps.gov/publications/NRPM). The annual report format includes an abstract, introduction, study area and methods, results, discussion and conclusion. Recommendations including management, research, and changes in the protocol (changing monitoring intervals and timing, moving/adding sites, etc.) will also be included in the discussion. The annual report enables readers to determine if the goals of the project are being met and provides an administrative and scientific record of monitoring activities. These annual reports will also be distributed to the SFAN parks, and can be used to report on park management goals. Portions may be included in the network's Annual Administrative Report and Workplan.

A comprehensive data analysis and synthesis will be written every 5 years to summarize general trends within a context of the park ecosystem. The longer time period for comprehensive analyses allows for more thorough data analysis and review of protocols and may give greater opportunity for adaptive management. Details for the annual and five-year reports are presented in SOP 4: Data Analysis and Reporting.

Table 2. Summary of reporting and communication products.

Communication Product	Lead	Audience	Schedule	Summary
Annual Report	Biological Technician	Park Resource Managers	Annually	- Document monitoring activities -Describe current condition of the resources -Document changes in the monitoring protocol -Increase communication within the park and network
Analysis and Synthesis Report	Project Lead and possibly contractors	Park Resource Managers	5 years	-Determine patterns and trends -Discover correlations among resources being monitored -Analyze data to determine the level of change that can be detected using the existing sampling scheme -Provide context, interpret data for the park within a multi-park, regional, or national context -Recommend changes to management practices -Review of protocol design and product to determine if changes are needed
Executive Briefing	Biological Technician	Program Managers, Superintendents, Interpretation staff	Annually	Two-page summary that lists monitoring objectives and questions, discusses annual results, and provides a regional context.
NMFS Report	Project Lead	NMFS + Partners	Annual report and permit renewal due every 5 years.	The NMFS reports include information on number and species of seals tagged (tag number, location of tag, location of tagging event, date, and age-sex of individual), resighting records of tags from non-PORE sites, and the number and species of seals and sea lions disturbed during research activities. Other health data that might be collected is also provided.
Stranding Network Report	Project Lead	NMFS + Partners	Annually	Stranding data (species, date, location, condition) is shared with NMFS through the stranding network.
Web Site Internet	Data Manager	Park Staff, General Public	Annually or as needed	Post all Executive Briefings, Report Cards,
Park Presentations	Biological Technician/ Project Lead	Park Staff	Annually	Provide a presentation to park staff during senior staff, all employee, or division meetings at each park upon request. Gives staff an opportunity to ask questions about the program.
Weekly Update	Biological Technician	Park Staff	Weekly during the field season.	Brief update listing maximum numbers and pertinent natural history notes. Highlights areas where pupping occurs.
Photos	Biological Technician/ Volunteers	For all reports and publication	Continuous	High quality publication quality photos are needed to support all communication products. For digital photos that means 300 pixels per inch resolution in a plain or compressed TIF format. Specialist should make every effort to document ongoing work, special incidents, site visits for communication purposes.
Press Releases	PIO	Public, park staff	Annually	Submit to local news media before the breeding season for northern elephant seals and harbor seals to remind the public not to disturb seals and to highlight the monitoring program.

6.0 Personnel Requirements and Training

6.1 Roles and Responsibilities

6.1.1 Project Manager

The Project Manager oversees the monitoring program, trains technicians and volunteers, conducts field surveys, oversees data management, and submits annual reports. The project manager responsibilities are currently shared by the PORE Science Advisor (Sarah Allen) and SFAN Data Manager (David Press).

6.1.2 Biological Technicians

Presently, a full-time Conservation Corps North Bay/AmeriCorps member coordinates volunteers, conducts field surveys, and enters data for harbor seal program.

Although not currently funded, traditionally a full-time, seasonal GS-7 biological technician has organized the monitoring schedule, conducted population surveys, and completed data entry during the northern elephant seal breeding season. In addition, the AmeriCorps member has provided significant field and office assistance to the program.

6.1.3 Data Manager

The data manager maintains the database, oversees data entry, and generates data summaries for the project manager.

6.1.4 Volunteers

Volunteers contribute significant amounts of time each year and are considered the backbone of this monitoring program. Over 30 volunteers per year participate in the harbor seal monitoring. A few, highly trained volunteers assist in the northern 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.

6.2 Qualifications

Observers (both volunteers and program staff) must have an ability to use binoculars and a spotting scope; ability to record data into a field form; be in excellent physical shape to hike several miles in rugged terrain and off trail; and carry a backpack with up to 30 lbs. Project staff and experienced volunteers will mentor new volunteers. Program staff requirements include either one season of experience doing surveys, including field data collection, or training in seal survey techniques.

6.3 Training Procedures

The project manager and biological technicians 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. Harbor seal volunteers are trained in two in-class sessions and five field sessions. New volunteers are asked 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. See SOP 1: Harbor Seal Surveys for the summary of volunteer training and an overview of the volunteer training guide. Training documentation includes background information, papers, tide charts, safety information and contact information.

7.0 Operational Requirements

7.1 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 March 1 until July 30. A full-time AmeriCorps member has traditionally overseen the program, scheduling, and coordinating volunteers with direct oversight by the two program leads. The AmeriCorps position lasts for one year, with new members beginning in October.

The northern elephant seal monitoring study requires an average of 70 visits per year. When funded, this is accomplished with one full-time, seasonal GS-7 biologist, the AmeriCorps member (part-time), 3-4 volunteers, and the two program leads as needed. The volunteers assist with field surveys only. The biologists oversee the program, scheduling, coordinating volunteers, data entry and weekly reporting, and conduct surveys.

7.2 Annual Field Schedule

The annual schedule is presented separately for harbor seals (Table 3) and northern elephant seals (Table 4). Taken together, however, pinniped monitoring is divided into three major periods: 1) northern elephant seal breeding season (December 1- March 31), 2) harbor seal breeding season (March 1-July 30); and 3) data processing and reporting (August 1-November 30). Within each of these periods, there are several tasks both specific to the season and general to all seasons.

7.3 Facility and Equipment Needs

Program staff members use office space and computers at PORE. Field equipment used by field staff and volunteers is shared for harbor seal and northern elephant seal monitoring. This equipment includes binoculars (8x40), spotting scopes with tripods, hand counters, clipboards, digital camera, and backpacks. Some specialized equipment is also used for tagging northern elephant seal pups. See SOP 1 and 2 for equipment details. All of the equipment is stored in the Science office at PORE.

Two vehicles based at PORE are available for use for travel from Bear Valley Headquarters to the pinniped monitoring sites. The SFAN I&M program pays for one vehicle, while the Pacific Coast Science and Learning Center (PCSLC) pays for the other. The PCSLC, PORE Science Advisor, pinniped monitoring programs, and the northern spotted owl program share these two vehicles on a first-come, first-served basis.

Table 3. Annual SFAN harbor seal monitoring field schedule.

Activity	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug
Harbor Seal Technician Starts											
Volunteer Recruitment											
Equipment Prep											
Signs posted											
Train Volunteers											
Press release by PIO											
Breeding Season Surveys											
Molt Season Surveys											
QA/QC and Data Analysis		*	*								
Annual Report Completed			*								

* Data analysis and completion of the annual report occurs during the fall months following the field season.

Table 4. Annual SFAN northern elephant seal monitoring field schedule.

Activity	Oct	Nov	Dec	Jan	Feb	March	Aug	Sept
Northern Elephant Seal Bio-Technician Starts								
Pre-season meeting with park managers								
Equipment Preparation								
Contact Volunteers								
Train Volunteers								
Beach Signs								
Adult Dye Marking								
Census								
Field Work (1x weekly)								
Census Field Work (2x weekly)								
Re-Sight Survey (2x weekly)								
Flipper Tag Preparation								
Weaned Pup Flipper Tagging								
Annual Report Completed								

7.4 Budget

The annual budgets for harbor seal monitoring (Table 5) and northern elephant seal monitoring (Table 6) include costs for personnel, vehicle, travel, equipment, and housing. Every five years, long-term trend analyses will be developed by park and network staff or through cooperative agreements with partnering agencies such as PRBO or the California Cooperative Ecosystems Study Unit (CESU). These reports will incur additional costs.

Harbor seal monitoring is funded primarily through SFAN. Contributions are also made by PORE and by the Point Reyes National Seashore Association (PRNSA) to cover costs for equipment replacement and miscellaneous supplies.

The northern elephant seal monitoring was funded by SFAN through FY07. Contributions after that date were reduced and phased out. Future monitoring will occur with volunteers under the direction of the PORE Science Advisor.

The SFAN I&M data management staff supports both monitoring projects. Data management needs include database modifications, training staff and volunteers on data entry, error-checking, and producing annual data summaries and other data requests.

Volunteers also make significant annual contributions. From 2007 to 2009, for example, volunteers donated over 1,300 hours to harbor seal monitoring resulting in an in-kind contribution of $26,325 at a rate of $20.25/hour. Partners contribute additional hours of in-kind funds in personnel time and supplies by conducting various tasks ranging from tagging seals to collecting tissue sample.

7.5 Permitting and Compliance

SFAN conducts harbor seal and northern elephant seal monitoring under NMFS permit 373-1868, in cooperation with PRBO Conservation Science, who conducts research on pinnipeds on the Farallon Islands National Wildlife Refuge. A permit is required due to northern elephant seal tagging activities and because both monitoring programs have the potential to disturb seals, even during censuses. Additional research on harbor seals, such as harbor seals tagged in San Francisco Bay and at PORE for a study by TMMC, also occurs under this permit. To meet permitting requirements, this project provides an annual report to NMFS with certain required information. The permit was reissued in 2007 and is valid for another five years, until 2012.

Table 5. Annual budget for the SFAN harbor seal monitoring program.

Category	Item	Annual Expenses
Project Income		
	SFAN I&M Program	$34,650
	PORE Contribution	$8,000
	Volunteer Support (in-kind contribution)	$26,325
Total Income		**$68,975**
Project Expense		
Personnel	Project Manager GS-13 (2 pp)	$8,000
	Data Manager GS-11 (2 pp)	$7,770
	Data Manager GS-9 (2 pp)	$6,180
	AmeriCorps/CCNB Volunteer	$18,000
	Volunteer Support (in-kind contribution)	$26,325
Cooperative Agreements	Data Analyses	
Equipment	Repair/replacement	$500
Supplies	Miscellaneous	$200
Travel	Vehicle	$2,000
Total Expense		**$68,975**
Balance		**-0-**

Table 6. Annual budget for the SFAN northern elephant seal monitoring program.

Category	Item	Annual Expenses
Project Income		
	SFAN I&M Program	$3,090
	PORE Contribution	$8,000
	Volunteer Support (in-kind contribution)	$610
Total Income		**$11,700**
Project Expense		
Personnel	Project Manager GS-13 (2 pp)	$8,000
	Data Manager GS-9 (1 pp)	$3,090
	Bio-Tech GS-6/7 (7 pp)	$18,550
	AmeriCorps/CCNB Volunteer	$4,000
	Volunteer Support (in-kind contribution)	$610
Cooperative Agreements	Data Analyses	
Equipment	Repair/replacement	$500
Supplies	Miscellaneous	$200
Travel	Vehicle	$2,000
Total Expense		**$36,950**
Balance		**-$25,250**

Note: The only I&M contribution to this monitoring program will be limited data management assistance.

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SOP 1. Harbor Seal Surveys
Version 1.5

Revision History Log

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	March 2008	Marcus Koenen, D. Press, Erin Flynn	General editing. Add revision history log. Combined SOP 1, 2, and 3 to reduce redundancy.	Update.	1.1
1.1	May 2008	Dawn Adams, Sarah Allen	Fix layout, minor edits General editing	Prep for review	1.2
1.2	September 2009	D. Press, M. Koenen, S. Allen	Added directions to survey sites. Minor editing.	Peer review comments.	1.3
1.3	November 2009	K. Freeman, D. Press	Changed tables and figures to a modular numbering system, added a literature cited section, additional minor edits.	Formatting requirements.	1.4
1.4	December 2009	D. Press	Minor grammatical edits. Added definition of red-pelaged seals.	Comments from Penny Latham.	1.5

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This SOP details field preparation and field methods for monitoring harbor seals at Golden Gate National Recreation Area and at Point Reyes National Seashore. Data sheets and maps to observation sites are attached.

1.0 Field Schedule

The field season for harbor seal monitoring begins in March and continues to the end of July (Table SOP 1.1). Field preparation begins in January and February. Field surveys for the breeding and molting seasons are conducted March 1 through July 31. Scheduling surveys and volunteers is coordinated by the lead field biologist or volunteer coordinator for the project.

Each harbor seal colony is surveyed a minimum of two times per week during the season. Weather can be unpredictable and surveys are occasionally cancelled or rescheduled at the last minute due to rain or fog. The weekly updated schedule is maintained by the volunteer coordinator on a website accessible to the volunteers. For each scheduled survey day, the calendar has the location and observer initials. Project staff and some volunteers continue monitoring during the non-breeding season and provide survey forms throughout the year. Although these surveys occur outside of the breeding and molting season and are not included in the annual summaries and reporting, they do provide important information on colony sites during the rest of the year.

Signs are placed at the access points to several of the seal colonies to advise park visitors to avoid disturbing seals before the breeding season begins. The sign template is located on the PORE server inppore05\Resources\Science\Phoca\Harbor Seal Signs. A press release is also distributed to the local press before the season begins through the public information officer (PIO) at PORE.

Table SOP 1.1. Annual SFAN harbor seal monitoring field schedule.

Activity	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug
Harbor Seal Technician Starts											
Volunteer Recruitment											
Equipment Prep											
Signs posted											
Train Volunteers											
Press release by PIO											
Breeding Season Surveys											
Molt Season Surveys											
QA/QC and Data Analysis	*	*	*								
Annual Report Completed			*								

*Data analysis and completion of the annual report occurs during the fall months following the field season.

2.0 Volunteers

Each year in December, the park schedules training dates for new volunteers and returning volunteers. A minimum of 20 volunteers is required to run the program. Typically around 15 volunteers return each year and so 5-10 new volunteers are needed annually.

2.1 Observer Requirements

Observers must have an ability to use binoculars and a 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 up to 30 lbs; and to hike off trail. Experienced volunteers will mentor new volunteers. See also personnel section of protocol.

2.2 Recruitment

The first step is to advertise in 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 inppore05\Resources\Science\Phoca08\Volunteer recruit\2008 volunteer ad. This ad should be placed in the Yodeler by December.

Each year in January, a press release recruiting volunteers is sent by the Park Information Officer (PIO) to be distributed to local media (Point Reyes Light, West Marin Citizen, etc…). A digital copy of the release is located at inppore05\Resources\Science\Phoca\Phoca08\Volunteer recruit\harbor seal monitoring press release-08.

Additionally, the Park VIP coordinator posts applications on volunteer.gov/gov, nps.gov/pore, and other regional volunteer websites. Signs are posted at the Palomarin, Tomales Point, and Five Brooks trailheads. A digital sign is located at inppore05\Resources\Science\Phoca\Phoca08\Volunteer recruit\flyer. Other recruitment options include the Park Wavelength volunteer email, local outdoor recreation businesses, The Marine Mammal Center, and the Gulf of the Farallones National Marine Sanctuary.

2.3 Training Sessions

Training includes two half-day sessions in the classroom and five field trips. Dates are selected for mid-late February and March that coincide with medium to low tide levels to maximize the number of seals onshore at the haul outs. Field trips include one trip to each of the primary seal haul out sites (Tomales 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 asked 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. All of the training materials are located on the PORE server under inppore\Resources\Science\Phoca\Training.

2.3.1 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 Cordell Bank Marine Sanctuary and/or the Pacific Coast Science and Learning Center

- General information on marine mammals and pinnipeds
  -Speaker from The Marine Mammal Center
  -Speaker from the NPS or AmeriCorps (inppore05\Resources\Science\Phoca\Training Materials\Presentations\ phocamarinemammals08 ppt files a and b)
- Specific information on long-term monitoring of harbor seals at Point Reyes (inppore05\Resources\Science\Phoca\Presentations\Training Materials\Presentations\ phocaclass08b.ppt)
- Specific information on long-term monitoring of northern elephant seals at Point Reyes (inppore05\Resources\Science\Phoca\presentations\Training Materials\ phocaeseal08.ppt)
- Data collection and volunteer information (inppore05\Resources\Science\Phoca\Training Materials\Presentations\Volunteer Information and Data Collection 2008.ppt)
- Specific information on safety in the field including
  -Poison oak identification and avoidance
  -What to do if you get bitten by a tick
  -Facts on West Nile Virus, Avian Flu, and other relevant diseases
  -Interactions with park visitors, presented by Park Law Enforcement

All of the presentations are updated each year with new information.

New volunteers are also trained in the field at each of the survey sites and a mentor program pairs up new volunteers with older volunteers to continue training (see below).

Each year, returning volunteers are provided with a refresher on the survey methods and their ability to count seals is evaluated to determine if more practice is needed.

2.3.2 Training Guide

A full packet of information for new volunteers is updated each year and is located at inppore\Resources\Science\Phoca\Training Materials\Training Manual\Harbor Seal Training Manual 08.doc. The training manual is organized in a binder and includes the following:

- Volunteer service agreement for Natural Resources Agencies
- Natural history of Marine Mammals
- Working in the field at PORE
- Harbor seal survey protocol
- Published articles with background information
- Maps of each location and observation sites
- Data forms
- Examples of field data forms filled out
- Equipment list (see below)
- Equipment care and maintenance
- Tide book (available from visitor center bookstore; for new and returning volunteers)
- Park brochure

- Safety issues (Lyme disease, poison oak, West Nile virus)
- Contacts (update annually)

2.3.3 Mentor Program

New volunteers are encouraged to participate in a mentoring program and are paired up with long-term volunteers that are familiar with the locations and the survey methods. In so doing, new volunteers are not only trained in the methods but their abilities are evaluated by the mentor and more intensive training is provided if needed. We recommend that new volunteers accompany a mentor at least 3 times and at least once to each survey site.

3.0 Field Equipment and Preparation

In January, the equipment needs are reviewed, and missing or damaged items are replaced. Equipment for observers is housed in the three separate boxes for survey convenience. The boxes are located at Bear Valley Headquarters, the PRBO Palomarin Field Station, and Fort Cronkhite. Individual box content may vary by location.

Equipment includes:

- Binoculars (8x40 Eagle Optics or equivalent; 3 available)
- Spotting scopes and tripods (Bushnell Spacemaster or equivalent; 5 available)
- Hand counters (10 available)
- Clipboards (metal to hold forms and maps; 5 available)
- Backpacks (4 available)

Data sheets include:

- Survey form
- Disturbance form
- Map of location being surveyed

Recommended personal equipment:

- Water and snacks
- Sunblock
- Warm clothing
- Sturdy hiking boots
- cellphone

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.

4.0 Field Methods

Field methods include surveys that are conducted March 1 through July 31 to cover the breeding season (March 1-May 30) and the molt season (June 1-July 31). Some volunteers continue monitoring during the non-breeding season and do provide survey forms throughout the year. Although these surveys occur outside of the breeding and molting season and are not included in the annual summaries and reporting, they do provide important information on colony sites during the rest of the year.

4.1 Survey Sites

There are eight distinct survey sites located within the SFAN parks (see Protocol Narrative Section 2.4.1 and Figure 5). Each survey site is further subdivided into subsites based on habitat features.

ESRI ArcMap and Arcview files for reproducing or updating maps are located at inppore07\GIS\vector1\wildlife\marine\pinnipeds. Seal haul out sites and observer positions are represented as point locations in the maps. In addition, the project MS Access database stores UTM locations of pinniped haul-out and colony sites within the locations table (see SOP 3. Data Management).

Maps of each of the study sites are presented in Appendix SOP 1 A. To produce quick maps with no changes, files are located at inppore05\Resources\Science\Phoca\Fieldmaps. Maps for Point Reyes Headlands are located in SOP 2 Northern Elephant Seal Surveys.

4.1.1 Bolinas Lagoon

Subsites: HWY1, Kent Island (KI), Pickle Weed Island (PWI).

From San Francisco, take 101N, exit at Mill Valley/Stinson Beach/Hwy1. Follow signs for Stinson Beach via Hwy1/Shoreline Hwy. Pass through Stinson Beach on Hwy1. Calle Del Arroyo Rd. will be on your left, 1.6 miles further north, park on the right hand side of the road in a small dirt parking lot to survey for HWY1 and PWI sites (see below).

From Bear Valley, start from the intersection of Sir Francis Drake Blvd, and Rt. 1, in Olema. Traveling south on Hwy1, the Hwy1 site is 12 miles from this intersection. It is 1.3mi. past the sign for the Audubon Canyon Ranch. There will be a small dirt parking lot on your left. At the back of the lot is a brown sign that says no camping/overnight parking. Park your car here. The best vantage spot is approximately 100 yards north on Rt. 1 (in the direction that you came from). Here you are at least a little bit above the seals, and it is easier to count them. There is very little room on the side of the road, however, so please watch out for cars! The group of seals right in front of you is the Hwy1 subsite. The group of seals off to the left is PWI.

1.6 miles further south down Rt.1, turn right onto Calle Del Arroyo Rd., at the end of the road you will come to a guard shack for Sea Drift, a gated community. Tell them you are with Point Reyes and are here to survey the harbor seals. If no one is at the gate, back up, park, and go across the road to the Assoc. office and they will open the gate for you. Immediately after the guard shack, turn right onto Dipsea Rd. Across from house #197, right before the grey/blue

boathouse, there is a small pullout. Park your car here. At low tide, a sandbar will be visible from here (KI). Kent Island is the sandbar across the channel.

4.1.2 Duxbury Reef
Subsites: None

From San Francisco, take 101N, exit at Mill Valley/Stinson Beach/Hwy1. Follow signs for Stinson Beach via Hwy1/Shoreline Hwy. Pass through Stinson Beach on Hwy1. Go about 3 miles, take a left onto Olema/Bolinas Rd. (this road is not labeled), right at the end of the bay. At the end of this road, take a left onto Horseshoe Hill Rd, then follow the directions below.

From Bear Valley, start at the intersection of Sir Francis Drake Blvd, and Rt. 1, in Olema.
Go 9.6 miles south on Rt.1, and then turn right onto Horseshoe Hill Rd.
After approximately 3 or 4 miles, at your second stop sign, take a right onto Mesa Rd for 0.6mi.
Take a left onto Overlook Dr for 0.5mi.
Take a right onto Elm Rd for 0.6mi.
Take a left onto Maple Ave (across from BCPUD, Bolinas Community Center)
Drive to the end of the road and park in the small dirt parking lot.
Set up at the bench. The reef is right across the way. The seals tend to haul out at the end beyond where the tidepoolers can get to, but make sure to check the entire length.

4.1.3 Double Point
Subsites: North Beach (NB), North Beach Rocks (NBR), and Stormy Stack (SS), South Beach (SB), Tide Pools (TP) and South Point (SP).

Start at the intersection of Sir Francis Drake Blvd, and Rt. 1, in Olema.
Go 9.6 miles south on Rt.1, and then turn right onto Horseshoe Hill Rd.
After approximately 3 or 4 miles, at your second stop sign, take a right onto Mesa Rd.
Continue down the dirt road (Mesa Rd.) to the end and park in the Palomarin parking lot.
Take the Coast Trail to Bass Lake, which is about 2.6 mi. or 3.l (info varies on mileage) from the start of the Coast Trail.

About a ½ mile after Bass Lake, on the right side of the trail is a small sign for Crystal Lake, and a separate trail closed sign, with a minor trail next to the sign. This trail is right before the main trail starts to descend. Backtrack a few yards and on the left side of the trail is a "trail -opening in the trees." This is the off-trail route to Double Point.

4.1.4 Drakes Estero
Subsites: Drakes Beach (DB), Drake’s Mouth Sandbars (DEM), Limantour Spit (L), Main Colony (A), Sandbar to the Right of A (A1), Upper Estero Near (UEN), Oyster Bar (OB), Upper Estero Far (UEF).

Park at Drakes Beach at the Ken Patrick Visitor Center. Walk down the beach to the left. The beach is bordered to your left by steep cliffs. Watch out for rock debris. Soon after you climb over a rock formation, the cliff ends temporarily. This is where Horseshoe Pond exchanges water with the ocean. Walk across the beach to the end of the pond, and head up the hill using an old

abandoned ranch road. Continue on the road until it begins to slope down the other side of the hill. You will see some cypress tress with a rookery below you. Then leave the road and hike away from the ocean and towards the Estero and find a spot with good visibility.

If the tide is too high to walk the beach, at the visitor center go left but instead of walking on the beach, climb the bluff and walk parallel to the beach. Please beware of erosion issues and do not hike near the cliff edge. You will descend just before Horseshoe Pond. Cross the beach and follow the directions above. Alternatively, you can park at the abandoned D Ranch, the last ranch on your left before Drakes Beach, and hike across the field and down to Horseshoe Pond. It is about equivalent distance to the suggested route above. If you do park at D Ranch, you much notify dispatch and leave a note in the windshield explaining you are a harbor seal volunteer.

4.1.5 Tomales Point

Subsites: Two Rock Beach (TRB), Rope Beach (RB), Bird Rock (BR)

Follow Sir Francis Drake towards the lighthouse. Turn right onto Pierce Point Rd. towards Tomales Bay State Park. Follow the road into the Tule Elk reserve and park at the Upper Pierce Ranch parking lot and take the Tomales Point Trail.

Two Rock Beach: Two Rock Beach is the first subsite you will survey. You will begin to hike up a large hill about 15-20 minutes into the hike. About three-quarters the way up the hill, you will pass a fenced enclosure on your right. About 2-3 minutes past this enclosure you will pass the first rock outcroppings. At this point the path is still uphill. 8-10 minutes after passing the enclosure you will reach the crest of the hill. About 2-minutes after you have passed the crest of the hill you will arrive at a large rock outcropping, located about twenty feet from the left side of the trail. This rock out cropping is an important landmark. It is on your left, twenty feet from the trail. Forty feet past the rock outcropping is a water bar on the right that points towards Tomales Bay.

Stand on the trail facing the pile of rocks and pretend that the pile of rocks is at 12 o'clock. Then hold your right arm out so that it is pointing towards an imaginary 2 o'clock. Walk in this direction. You will cross a long gully. Keep going towards the coast until you reach the observation point. From the observation point look back south towards the lighthouse or McClures Beach, you should be able to see the beach as well as a variety of flat rocks along the shore. It is on these flat rocks where the harbor seals usually haul out. Two Rock Beach is so named because each side of the beach has two large rocks, approximately 100m from shore. Make a count and then return to Tomales Point trail.

The alternative way to get to the observation site for TRB is to walk past the main rock outcropping landmark. To your left are grasses. After a 4-5 minute walk past the rock outcropping you will come to several coyote brush bushes that are touching the trail. Turn left at the second coyote bush on your left and walk directly towards the coast. The rocks should be directly below you and the beach, south of you.

Rope Beach: After returning to the Tomales Point trail, continue north. You will go down a long gradual hill. Near the bottom of the hill, on your right will be a pond and ahead will be a line of

tall trees. This is Lower Pierce Point ranch. Go around the west side, or ocean side, of the trees and head for the coast. Walk north along the coast counting as you go. Continue to walk north along the coast until Bird Rock is easy to survey. Seals can be hauled out on any of the many rocks and beaches along this segment of the coast, so remember to look down over the cliffs often to makes sure you are not missing any of them. During breeding season you will need to hike until you are directly across from Bird Rock, then look back at the beach across from Bird Rock, in order to see all of the seals.

Bird Rock: Bird Rock is north of Rope Beach. Bird Rock is a large white rock about 400 yards from shore, where shorebirds nest and seals haul out. Hike north until you are confident in your ability to count the seals on Bird Rock. Count here twice, then survey RB and TRB on your way back.

4.1.6 Tomales Bay

Subsites: Seal Island (SI), Clam Island (CI) Hog Island (HI).

Follow Sir Francis Drake towards the lighthouse. Turn right onto Pierce Point Rd. towards Tomales Bay State Park. Follow the road into the Tule Elk reserve and park at the Upper Pierce Ranch parking lot and take the Tomales Point Trail.

You will begin to hike up a large hill about 15-20 minutes into the hike. About three-quarters the way up the hill, you will pass a fenced enclosure on your right. About 2-3 minutes past this enclosure you will pass the first rock outcroppings. At this point the path is still uphill. 8-10 minutes after passing the enclosure you will reach the crest of the hill. About 2-minutes after you have passed the crest of the hill you will arrive at a large rock outcropping, located about twenty feet from the left side of the trail. This rock out cropping is an important landmark. It is on your left, twenty feet from the trail. Forty feet past the rock outcropping is a water bar on the right that points towards Tomales Bay. Continue walking 50-100 yards past the rock outcropping then turn right and cut across the field towards the bay. Hike down towards the bay until you have a good view of the sandbars down below in the bay. It may take some experimentation to find the best spot to count from. Seal Island and Clam Island, which are both sandbars, should be in front of you while Hog Island will be way off to the right. Seal Island is the sandbar closer to you, while Clam Island is the sandbar further away from you.

4.1.7 Point Bointa

Subsites: # 1–20.

From Hwy 101 take the Alexander Avenue/Marin County exit. Turn right at the stop sign on to Alexander Avenue. After approximately 100-200 yards, turn left towards the tunnel on Bunker Road (look for Marin Headlands Visitor Center sign). You will drive through a one-way traffic tunnel. There may be up to a five minute wait to enter the tunnel. Continue on Bunker Road to its intersection with Field Road. Turn left onto Field Road. You will pass the Headlands Visitor Center and the historic Nike Missile Site. Follow signs to the Point Bonita Lighthouse. This site involves a very short walk and looks down upon a group of rocks on which the harbor seals haul out.

4.2 Field Visit Schedule

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 once per week, but ideally twice per week with one survey during a weekday and one on the weekend. During the peak of the breeding season (mid-April to mid-May) extra effort is made to ensure that sites are surveyed twice per week, and surveys are promptly re-scheduled if canceled due to weather. The weekly updated schedule is emailed to the volunteers weekly.

All surveys are scheduled through an online calendar that is private to the public. This allows the volunteers to check available survey dates and to notify the volunteer coordinator when they are available to survey. Most recently, an online Google calendar has been used in which editing privileges are limited to volunteer coordinators at PORE and GOGA.

At the beginning of the field season, the project managers develop a list of regional survey dates. The dates occur every other Saturday beginning in early March until the end of July, but occur every Saturday during the peak breeding season. The volunteer coordinator ensures that all sites are monitored at least once during the regional surveys. Any survey that occurs within two days of the selected regional survey date, or Thursday through Monday, is accepted as a regional survey. The regional survey dates are also distributed to harbor seal researchers and volunteer groups working in San Francisco Bay, on the Sonoma County coast, and along the San Mateo County coast. The project managers compile data from outside the NPS study area and manage this data separately from the I&M program.

4.3 Field Forms

Three field survey forms are presented in Appendix SOP 1 B, including:

- Harbor seal census form
- Harbor seal disturbance form

Digital copies of forms are located at inppore05\Resources\Science\Phoca\Form\PhocaForm.doc Maps are located at inppore05\Resources\Science\Phoca\Fieldmaps. A separate census form is designed for Point Bonita with an inset map depicting the numbered sub-sites at the bottom of the form.

4.4 Surveys

Surveys include collecting census data and recording disturbance events. For each site visit, volunteers retrieve equipment and survey forms from outside storage containers distributed in the parks and then go to their assigned survey location. For each survey, volunteers should collect the needed equipment (listed above) from the storage containers or provide their own. Each survey site has a specific field map with marked locations for observation site and where the seals haul-out (Appendix SOP 1A).

4.4.1 Census Data

Observers count all harbor seals onshore at each site by subsite where seals are hauled out and separate out age class into two categories (adults/immatures and pups). Pups may be documented as early as mid-February, but after May 31, all seal age classes are combined because pups cannot be easily distinguished from immature seals. Other data collected include number of red-

pelaged seals, number of fresh shark attacked seals, and number of dead pups. Red pelage is easily identified and results from the deposition of iron oxide precipitates on the hair shaft; it usually extends from the head down to the shoulder and is of interest due to its rarity outside of the San Francisco Bay Area (Allen et al. 1993). In the comments section, observers can add information on 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 (Allen et al. 1985; Grigg et al. 2002). The tide time and tide level is standardized to San Francisco, Pacific Standard Time, as documented in local tide books. During weeks with early morning low tides, survey times should be adjusted accordingly. For example, if low tide of –1.0 is at 7am, a survey should be conducted between 8–11 am.

To help plan accordingly, the following tide time adjustments should be taken into account for each site.

Tomales Bay	+30 min
Tomales Point	-30 min
Point Reyes Headlands	-25 min
Drakes Estero	+45 min
Double Point	-30 min
Duxbury Reef	-25 min
Bolinas Lagoon	+37 min
Point Bonita	no correction

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 Bolinas Lagoon, where the subsites are a considerable distance from each other, and are usually counted twice during a survey event (instead of four times at other sites).

The survey start and end times are intended to capture the time spent on site with the harbor seals within view. The start time should represent the time that the observer arrives on site and begins preparing for the survey. The end time should be the time that the observer physically leaves the survey site.

All harbor seal counts are recorded by subsite, and all subsites with seals must be recorded during each count. For ease of data entry in the database, only the start time of each count needs to be recorded on the datasheet and not the exact time that each subsite is counted. In addition, only subsites where seals are present need to be recorded on the datasheet.

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, which can cause seals to haul out in lower numbers (Jemison and Pendleton 2001). 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. Observers should count the number of pelicans roosting within view on rocks or sandbars following the first harbor seal count.

Finally, the observer must note whether or not all of the subsites were surveyed, yes or no. This notation is intended to capture whether or not more seals may have been present during the survey but were not counted, perhaps due to poor visibility. If subsites are underwater during the survey due to tide height or swell conditions, this does not mean that all of the subsites were not surveyed.

4.4.2 Disturbance Events

Disturbance data include any potential or actual disturbance of the seals while they are resting onshore causing them to alter their behavior. Tracking disturbances allows us to monitor the amount of activity, especially human activity, in an area. By recording the seals' reactions to these events we will also be able to observe trends or changes in their reactions or use of haul-out sites. An example of a trend is chronic flushing, which may lead to the desertion of a site. Information collected includes source for disturbance (various anthropogenic or non-anthropogenic sources) and seal response (a gradient from no response to flush into water). Disturbance data is collected as needed during harbor seal surveys.

Actual disturbance events occur when at least one of three harbor seal behaviors are observed:

- Head-Alert (HA): when a resting seal raises its head and clearly looks around. The seal's eyes are open, and the seal is not scratching itself. Note Head-Alerts only if > 5 seals exhibit this behavior.
- Flush (F): seal movement towards the water but not completely in the water. Rising tides do not constitute approaching the water.
- Flush Water (FW): when, in one continuous movement, seals stampede from their haul-out site and completely enter the water.

When a disturbance event occurs, the observer notes the time of the disturbance, identifies the source of the disturbance, and records the seal response at each affected subsite. Data columns relating to the number of seals before the disturbance, the number of seals that remain on site, etc., only relate to FW disturbance events.

One disturbance source may affect multiple subsites with varying responses, all of which should be recorded on the datasheet. In addition multiple seal responses may be observed for one subsite; however, only the strongest reaction per subsite is recorded on the datasheet and entered in the database. For example, if some seals at a subsite head-alert and some flush as the result of a disturbance, the disturbance should be recorded as "flush" on the datasheet for that subsite.

Single disturbance sources, such as a kayaker, may result in more than one disturbance event. However, separate disturbance events for the same source should only be recorded if the source departs from the haulout area of influence, if the seals are observed to return to state of rest, or if

a period of greater than 20 minutes passes. For example, a kayaker traveling south through Drakes Estero may disturb several subsites along the way. These disturbances should be recorded as one event, even though several minutes may pass from the time the first subsite is disturbed until the last. If the kayaker returns north later in the day and again disturbs subsites, then this would be counted as a new disturbance event. It is helpful to note in the comments that this is the same disturbance source. Following these guidelines will prevent the error of counting single disturbances events/sources multiple times when summarizing the data.

Table SOP 1.2 lists the specific sources of disturbances collected by the harbor seal monitoring program from 2000-2007. Observers should reference this table in order to correctly categorize disturbance source observed in the field. The table follows data entry specifications designed in the project database, which allows for the disturbance data to be more easily and more correctly summarized.

In addition, the harbor seal observers record potential disturbances to harbor seal haul-out areas. Potential disturbances are recorded when a disturbance source is observed that does not appear to elicit a response from the harbor seals. Examples might include a low-flying aircraft or a nearby coyote.

Table SOP 1.2. Harbor seal disturbance source groups and specific sources collected in the field. Categories are standardized to facilitate data entry and summarization.

Vehicular Type Disturbance Sources	
Source	**Source Specific**
vehicle	car
vehicle	truck
vehicle	motorcycle
vehicle	bus
vehicle	ambulance
aircraft	small plane
aircraft	jumbo jet
aircraft	helicopter
aircraft	hang glider
aircraft	ultralite
non-motor boat	kayak
non-motor boat	canoe
non-motor boat	sailboat
non-motor boat	row boat
non-motor boat	wind surfer
motor boat	fishing boat
motor boat	tug boat
motor boat	sailboat w/engine
motor boat	jet skis
motor boat	park ranger boat
motor boat	oyster boat
motor boat	clam boat

Human Type Disturbance Sources	
Source	**Source Specific**
fisherman	
clammer	
human	hikers
human	visitors / tourists
human	photographers
human	divers
human	surfers
human	oyster workers
human	horse riders
human	joggers
human	bicyclists
human	other workers
researcher	
school group	
Other Disturbance Source Types	
Source	**Source Specific**
dog	
coyote	
bobcat	
bird	sea gull, etc.
other	rock slide, etc

5.0 Literature Cited

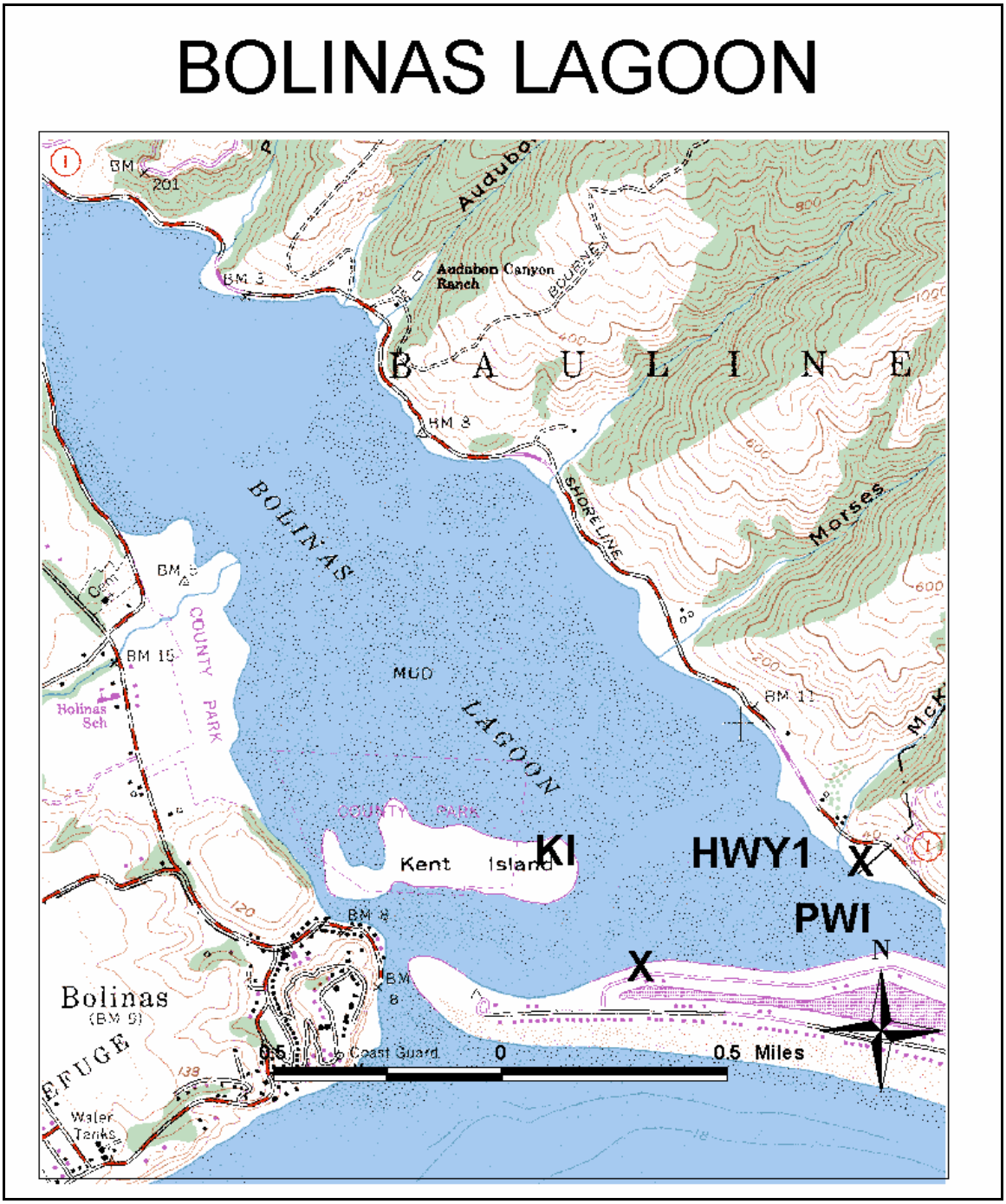
Allen, S. G., D. G. Ainley, G. W. Page, and C. A. Ribic. 1985. The effect of disturbance on harbor seal haul out patterns at Bolinas Lagoon, California, 1978–1979. U. S. Fishery Bulletin 82:493-500.

Allen, S. G., M. Stephenson, R. W. Risebrough, L. Fancher, A. Shiller, and D. Smith. 1993. Red-pelaged harbor seals of the San Francisco Bay Region. Journal of Mammology. 74(3):588–593.

Grigg, E. K., D. E. Green, S. G. Allen, and H. Markowitz. 2002. Diurnal and nocturnal haul out patterns of harbor seals (*Phoca vitulina richardsi*) at Castro Rocks, San Francisco Bay, California. California Fish and Game 88 (1).

Jemison, L.A. and G.W. Pendleton. 2001. Harbor seal population trends and factors influencing counts on Tugidak Island, Alaska. Pages 31–52 in: Harbor Seal Investigations in Alaska. Annual Report for NOAA Award NA87FX0300. Alaska Department of Fish and Game. Division of Wildlife Conservation, Anchorage, AK. 356 pp.

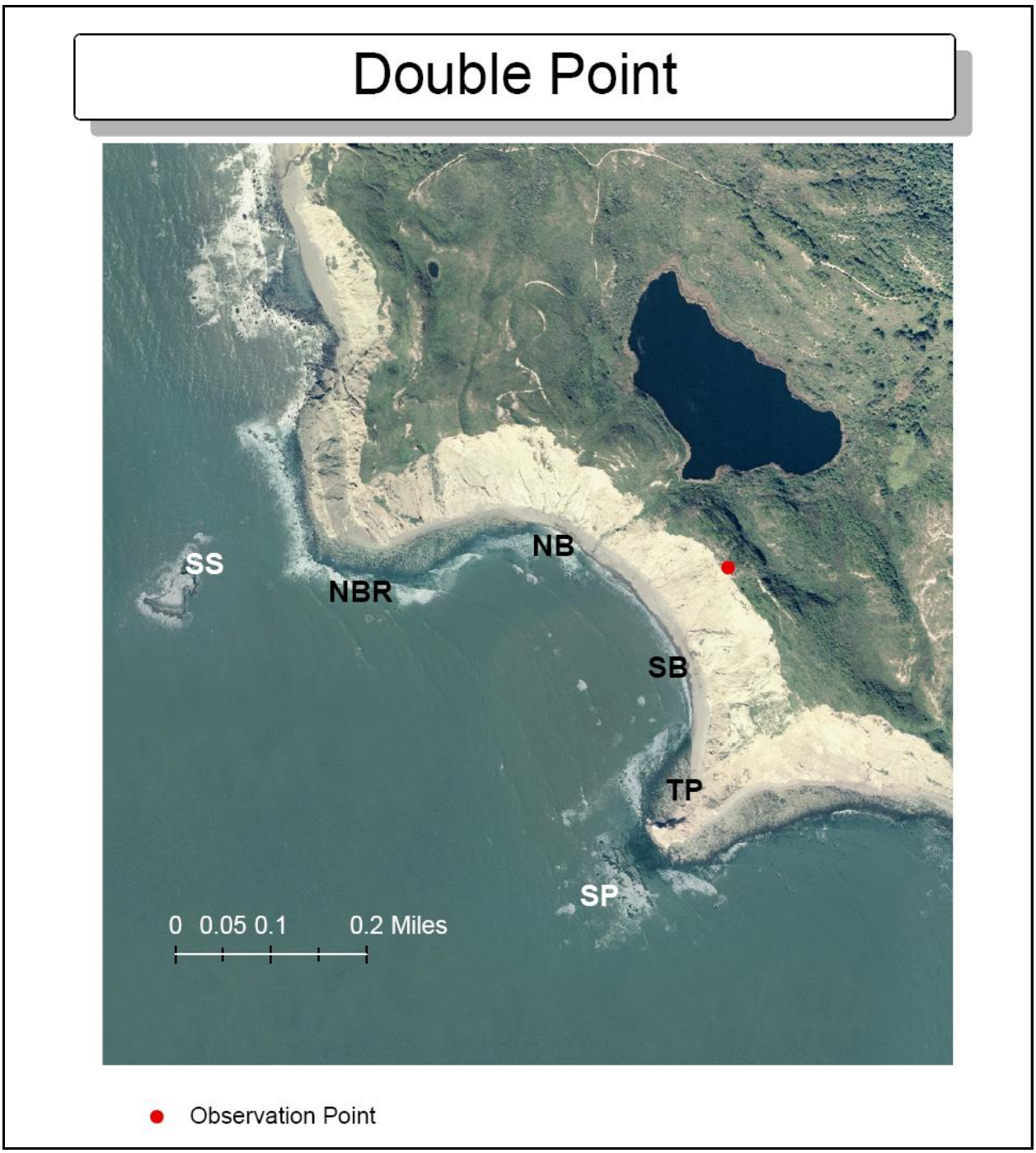
Appendix SOP 1A. Harbor Seal Site Maps.



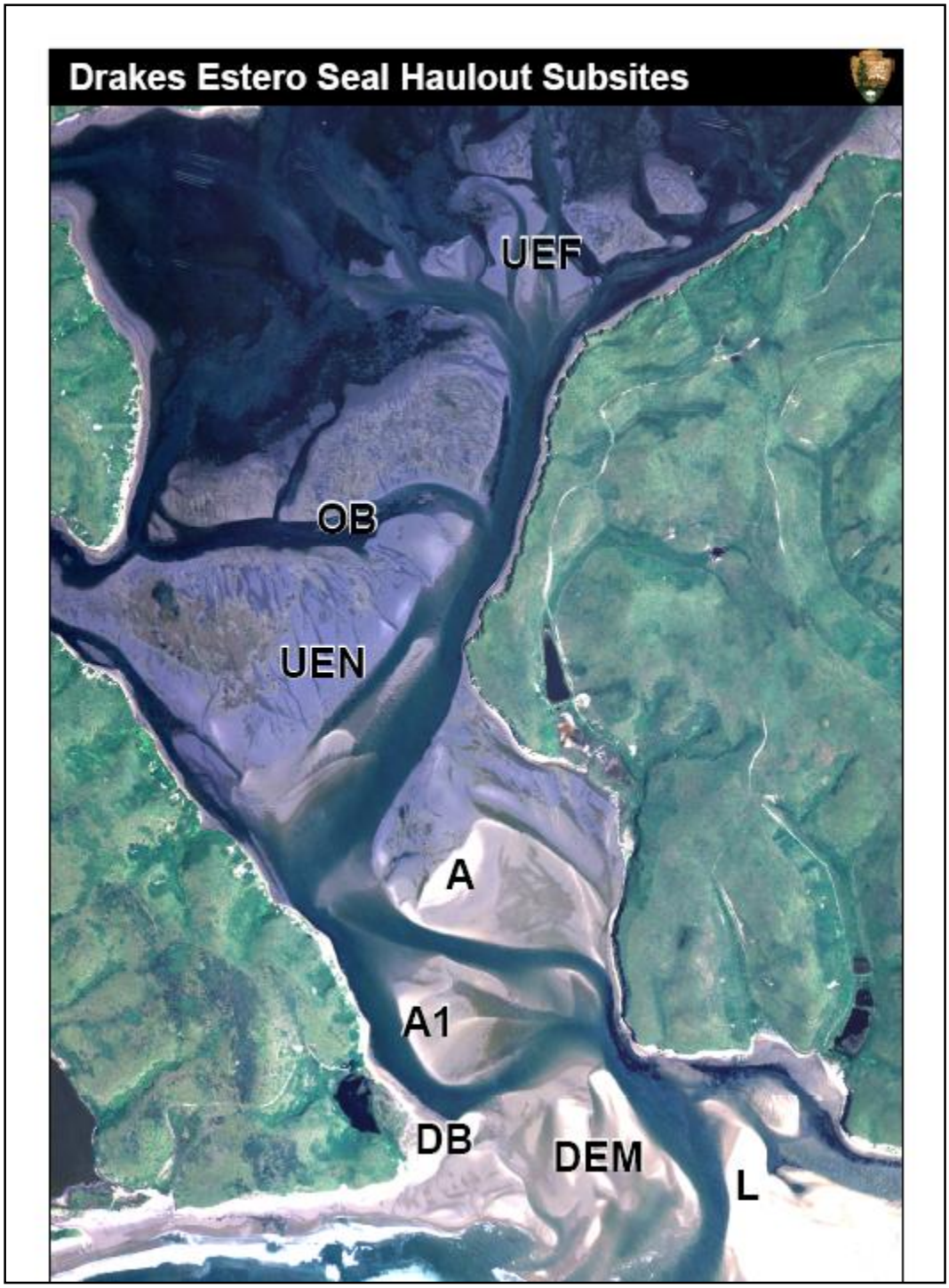
Map of Bolinas Lagoon haulout sites. Subsites include: KI = Kent Island, HWY1 = Highway 1 sand bars, PWI = Pickle Weed Island. X = Observation Points.

DUXBURY REEF

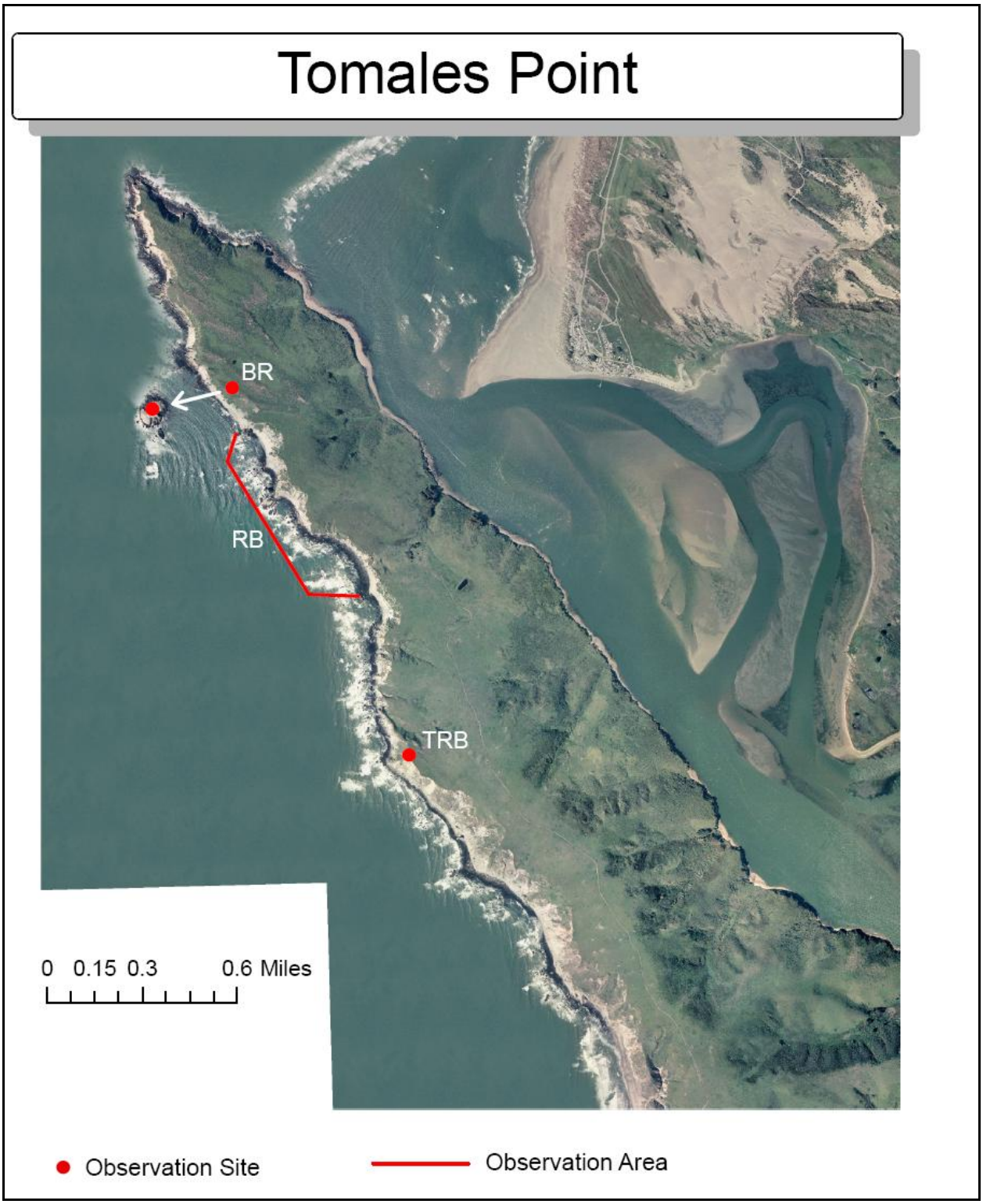
Map of Duxbury Reef haulout site. Subsite DUX notes location of haul out site. X = Observation Point.



Map of Double Point haulout sites. Subsites include: SS = Stormy Stack, NBR = North Beach Rocks, NB = North Beach, SB = South Beach, TP = Tide Pools, SP = South Point.



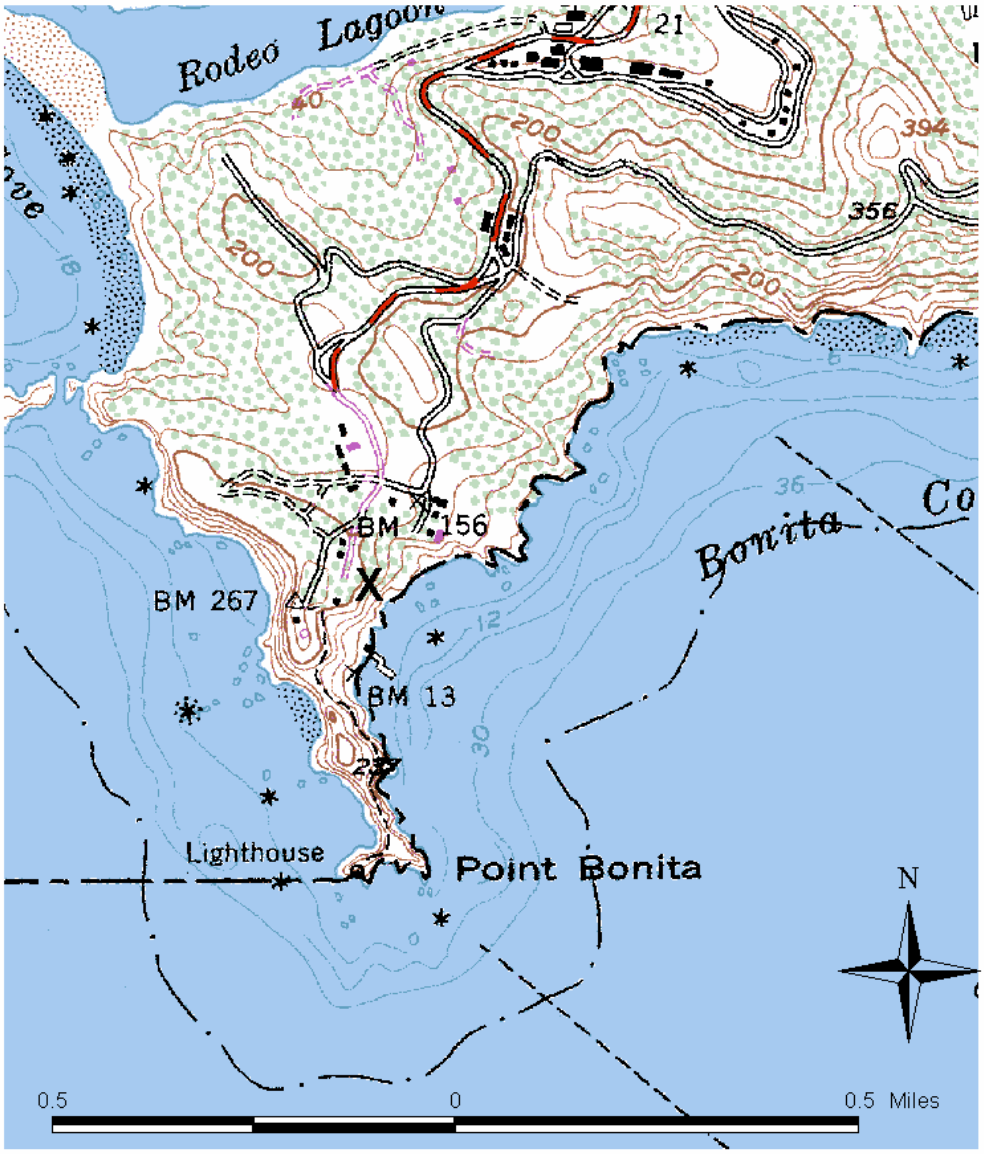
Map of Drakes Estero haulout sites. Subsites include: UEF = Upper Estero Far, OB = Oyster Bar, UEN = Upper Estero Near, A = A Sandbar, A1 = A1 Sandbar, DB = Drakes Beach, DEM = Drakes Estero Mouth, L = Limantour Spit.



Map of Tomales Point haulout sites. Subsites include: BR = Bird Rock, RB = Rope Beach, TRB = Two Rock Beach.

Map of Tomales Bay haulout sites. Subsites include: SI = Seal Island, CI = Clam Island, HI = Hog Island.

POINT BONITA



Map of Point Bonita haulout site. X = Observation Point. Dotted black line denotes area of harbor seal haulout. Refer to Point Bonita data sheet (Appendix SOP 1 A) for a diagram of subsites, which for Point Bonita are predominantly numbered rocks.

Appendix SOP 1B. Harbor Seal Field Datasheets.

POINT REYES NATIONAL SEASHORE HARBOR SEAL SURVEY Page ___of ____

Date:_____ Day of Week_____Year_____ Location: _____

Start Time:_____End Time _____ Observers:_____

Weather: Visibility (1,2 or 3)_____ Rain (Y/N)____ Low Tide Level closest to survey time _____

# of White Pelicans:_____ # of Brown Pelicans:_____ All subsites surveyed? (Y or N) _____

Time (Survey every ½ hr)	Sub-Site*	# of Adults & Imm	# of Live and Dead Pups	Subsite Total	# of Dead Pups	# of Red Seals	# of Shark Bite	Disturb-ance Sources Y/N	Survey Total All subsites Each ½ hour	Comments

Visibility: 1=clear, 2=slightly obscured but still able to count, 3=unable to conduct an accurate or full count.

***SUBSITES: Drakes Estero** (**A**=A sandbar, **A1**=A1 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** (**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, other) **Duxbury Reef** (**DUX**=Duxbury Reef)

Harbor seal census data form.

Page ___of___

POINT REYES NATIONAL SEASHORE HARBOR SEAL DISTURBANCE SURVEY

Date:_____Year_____ Location: _____Observers: _____

Time	Source *	Number	Sub-Site	Seal Behavior **	No. Before Disturbance (Total Seals)	No. Adult Immature Seals Remain On site	No. pups Remain On site	No. Seals Flush Into Water	Seals Rehaul (Y/N) Time	Comments (vessel/aircraft identification)

*SUBSITES: **Drakes Estero** (**A**=A sandbar, **A1**=A1 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 (**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, other) **Duxbury Reef** (**DUX**=Duxbury Reef)
SEAL BEHAVIOR: NR=no response; HA=head alert; F=flush; FW=flush into water. (Record Strongest Reaction)

Harbor seal disturbance data form.

GGNRA POINT BONITA HARBOR SEAL SURVEY

Page ___ of ___

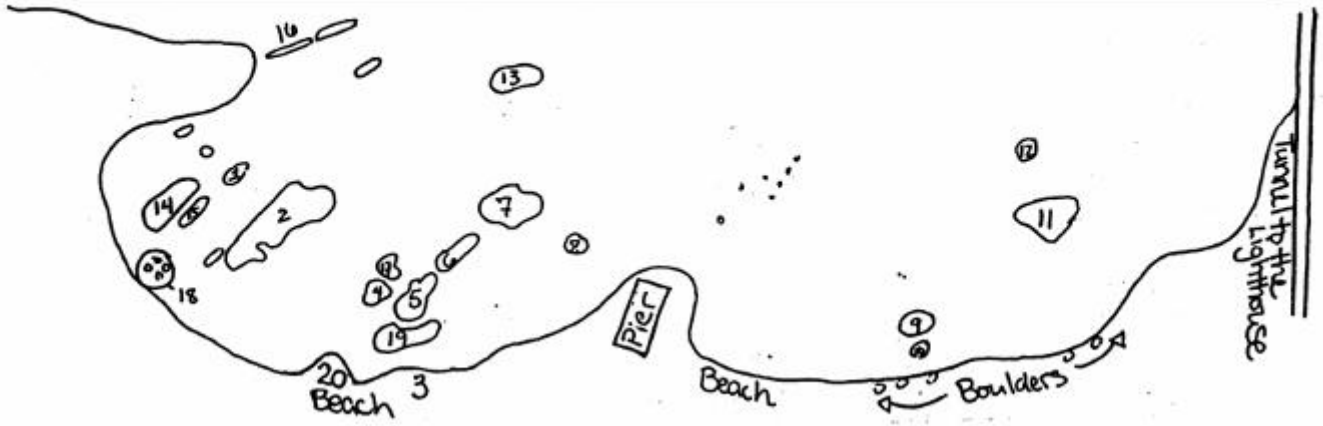
Date:_____ Day of Week_____ Year_____ Location: _____

Start Time:_____ End Time_____ Observers:_____

Weather: Visibility (1=clear, 2=slightly obscured, or 3=very poor) _____ Rain (Y/N)____ Low Tide Level closest to survey time _____

# of White Pelicans:_____ # of Brown Pelicans:_____ All subsites surveyed? (Y or N) _____

Time Survey every ½ hr	Sub-Site	No. Adults & Imm	No. Live/ Dead Pups	Subsite Total	No. Dead Pups	No. Red Seals	No. Shark Bite	Seals Disturb Y/N	Survey Total All subsites Each ½ hour	Comments



Point Bonita harbor seal census data form.

SOP 2. Northern Elephant Seal Surveys
Version 1.5

Revision History Log

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	March 2008	Marcus Koenen, Dave Press, Heather Jensen	General editing. Combine with SOP 4 and 6. Added Appendixes A and B.	Update.	1.1
1.1	June 2008	Dawn Adams, Sarah Allen	Additional methods information, format and layout.	update	1.2
1.2	September 2009	D. Press, M. Koenen, S. Allen	Edits to SOP format and layout.	Preparation for final protocol submission.	1.3
1.3	November 2009	K. Freeman, D. Press	Changed tables and figures to a modular numbering system, added a literature cited section, additional minor edits.	Formatting requirements.	1.4
1.4	December 2009	D. Press	Minor grammatical edits.	Comments from Penny Latham.	1.5

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Appendix SOP 2B. Northern Elephant Seal Survey Maps 106

This SOP details field preparation and field methods for monitoring northern elephant seals at Point Reyes National Seashore. Data sheets and maps to observation sites are attached.

1.0 Field Schedule

The field season for northern elephant seal monitoring begins in November and continues to the end of March (Table SOP 2.1). Field preparation begins in November and December. Field surveys for the breeding season are conducted December 1 through March 31. Scheduling surveys and volunteers is coordinated by the lead field biologist or volunteer coordinator for the northern elephant seal project. The proposed survey dates for each month are distributed to volunteers via e-mail usually a month in advance. Weather can be unpredictable and surveys occasionally get cancelled or rescheduled at the last minute due to rain or fog. The weekly updated schedule is maintained on a wall-calendar in the Science office. For each scheduled survey day, the type of survey, observer initials, and low tide time and height are written on the calendar.

Table SOP 2.1 Annual SFAN northern elephant seal monitoring field schedule.

Activity	Oct	Nov	Dec	Jan	Feb	March	Aug	Sept
Northern elephant Seal Bio-Technician Starts								
Pre-season meeting with park managers								
Equipment Preparation								
Contact Volunteers								
Train Volunteers								
Beach Signs								
Adult Dye Marking								
Census								
Field Work (1x weekly)								
Census Field Work (2x weekly)								
Re-Sight Survey (2x weekly)								
Flipper Tag Preparation								
Weaned Pup Flipper Tagging								
Annual Report Completed								

2.0 Volunteers

Volunteers assist the field biologist by independently collecting field data. Volunteers receive hands on training and must meet all of the observer requirements.

2.1 Observer Requirements

Observers should be physically fit, and have experience 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 30 lbs; and to hike off trail and orient using a topographic map. Training for new observers includes intensive one-on-one field training over one breeding season with the program manager or someone who has extensive experience studying northern elephant seals (i.e. lead biological technician). Observers who are volunteers are asked to commit to one survey every other week. Observers are expected to follow the same rules and signage as visitors to Point Reyes National Seashore unless accompanied by a uniformed NPS employee or given permission by NPS administration. An exception to this rule is that the split rail fence at Chimney Rock must be crossed in order to get a clear view of the colony at Gus' Cove. Before new volunteers participate in fieldwork, a volunteer form should be completed.

3.0 Field Equipment and Preparation

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- donation)

Rope ladder and 50 feet of climbing rope
5" x 8" field binders with data forms
Field vest for carrying gear and identification as NPS biologist (2)
Laminate and laminator for signage

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

3.1 Beach Signs

Beach restrictions go into effect in late November and early December when adult male northern elephant seals arrive on the colony beaches. A total of 14 laminated signs are posted at prominent beach access points in the Point Reyes Headlands and on the edges of the northern elephant seal colonies where northern elephant seals breed. The purpose of the signs is to warn park visitors of the temporary beach closures to prevent visitors from entering or walking above the colonies. All signage should be in place by December 15th. Facilities Management and Visitor Services staff assist in the placement of signs.

Signage should be strategically placed in highly visible locations. In some locations, the area may need to be roped off (i.e., Lifeboat Station and north end of North Drakes Beach). Each sign requires: a sign post, a 9x12" plywood sign board, 8x11 ½" laminated sign or map based on location, 2 bolts, 2 nuts, and 2 washers. A post pounder will be needed for installation of the signs.

Several templates and guidance documents have been prepared and stored on the PORE server to streamline sign creation and placement, including:

Signage maps:	inppore07\GIS\vector1\wildlife\marine\pinnipeds\arcview
Signage templates without map:	inppore05\Resources\Science\ESeal\SealSigns
Signage placement images:	inppore05\Resources\Science\ESeal\SealSigns\Sign Location Images.ppt
Signage placement guidance:	inppore05\Resources\Science\ESeal\SealSigns\ ESsignplan.doc

3.2 Plastic Flipper Tag Preparation

Annually, approximately 250 northern elephant seals are flipper tagged, the majority of which are weaned pups. Tags are prepared at the beginning of each season. Each flipper tag is drilled with a dremel tool using an established drill pattern (Figure SOP 2.1) for letters (P, R, H, J, and K) and the numbers (0-9). The letter "M" does not have a drill pattern.

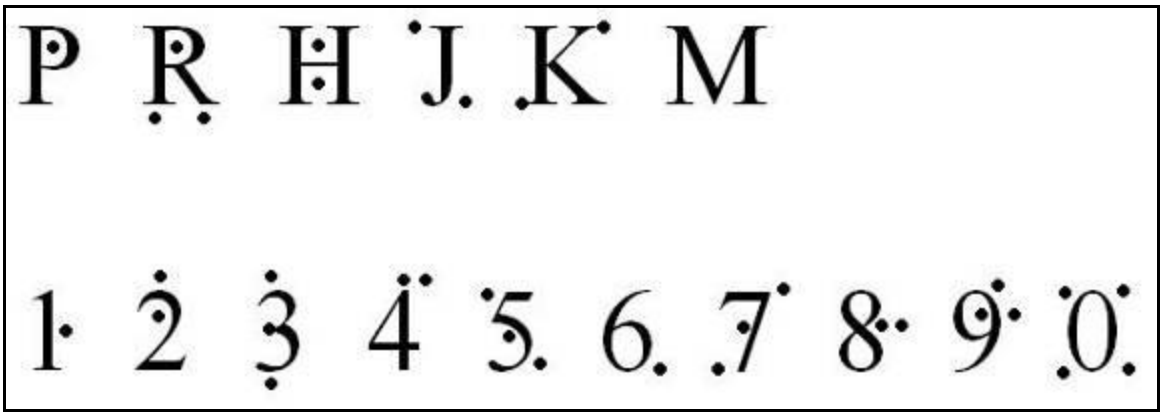


Figure SOP 2.1. Drill code for flipper tag letters and numbers.

Tags ready to be drilled should be placed on a small wooden board with a layer of cardboard on the top to avoid the premature wearing of the drill bits. Safety glasses should be worn during drilling.

As a result of the drilling process, plastic will need to be scraped from the tag using a pocket knife so that the surface of the tag is relatively smooth. The final step of tag preparation is to match the corresponding male and female ends of each individual tag and then string and label the tag sets numerically in groups of ten using masking tape. If any tags are destroyed during the drilling process include them with the other tags on the string, but place a large “X” on either side of the masking tape to indicate it is unusable. When a tag with an “X” is encountered in the field while tagging, the data recorder should record the tag letter/number sequence in the left or right tag number box and place a “9” in the code box on the resight data form.

By January, the drilling and stringing of flipper tags should be completed and ready for the tagging of weaned pups. Equipment used for tag drilling includes:

Dremel tool (extra bits)
Three prong extension cord
Safety glasses
Key to drill patterns
Pocket knife
Masking Tape and sharpie
Small wooden board with cardboard on top

4.0 Field Methods

Field methods include full count surveys and re-sight surveys, which may include all or some of the following activities: flipper tagging, dye-marking, and tag re-sighting. All field work is conducted during the breeding season (December through March). Early northern elephant seal arrivals are captured in the all pinniped species monitoring surveys. A complete census of northern elephant seals is conducted a minimum of once per week at all breeding sites and subsites within Point Reyes National Seashore (PORE) beginning in December. Surveys to re-sight tagged individuals occur once every two weeks at a minimum on the easily accessible beaches (NDB, SB). Re-sight surveys to Point Reyes Headlands (PRH) sites typically occur only in December, early January and March because of concerns for human safety. The PRH sites have difficult access, a higher density of seals, and increased seal movement on the beach.

4.1 Field Forms

There are three survey forms, one for Full Count (Census) Surveys and two for Resight Surveys (Appendix SOP 2A). Digital copies of forms are located at inppore05\Resources\Science\Eseal\ Forms and SOPs\Data_Forms.

Northern elephant seal survey form (Full Count/Census)
Northern elephant seal resight form (Resight)
Northern elephant seal mark form (Scar Card)

Always use one of the three standardized data forms to ensure all essential information has been collected. Observational data that should be collected during census and resight surveys include number of seals with fresh shark bites, number of dead seals, and any marked seals (dye mark, brand, radio, or flipper tags).

4.2 Survey Sites

Northern elephant seals breed at three sites in PORE including North Drake's Beach (NDB), Point Reyes Headland (PRH), and South Beach (SB) (Protocol Narrative, Figure 6). To facilitate a more accurate census, the three main breeding sites are further subdivided based on proximity to one another. There are four sub-sites within NDB: North Drakes Beach (NDB), Lifeboat Station (LBS), Gus's Cove (GUS), and Chimney Rock Cove (CRC). There are seven sub-sites at PRH: Cove 1 (C1), Cove 2 (C2), Cove 3 (C3), Cove 4 (C4), Tip Beach (TIP), Loser Beach (LB), and Dead Seal Beach (DSB). At SB, there are three sub-sites: Lighthouse Beach (LTH), Nunes Ranch Beach (NUN), and Mendoza Ranch Beach (MEN). Maps of the northern elephant seal breeding sites are in Appendix SOP 2B.

Appendix SOP 2B consists of one general map of all survey locations with positional information on the northern elephant seal haul out sites, and specific location maps with the observation points. Additional maps will be provided as new locations are established.

ESRI ArcMap and Arcview files for reproducing or updating maps are located at inppore07\GIS\vector1\wildlife\marine\pinnipeds. Seal haul out sites and observer positions are represented as point locations in the maps. In addition, the project MS Access database stores UTM locations of pinniped haul-out and colony sites within the locations table (see SOP 3: Data Management).

To produce quick maps with no changes, files are located at inppore05\Resources\Science\Eseal\ Forms and SOPs\Maps.

4.3 Field Visit Schedule

In December and March, full counts are conducted once per week on Tuesdays with Wednesdays as a back-up day in case of inclement weather conditions. During January and February, during the height of the season, counts are conducted twice per week on a Monday and Thursday schedule. Tuesdays and Fridays are used as back-up survey days in case of rain or fog.

Resight surveys depend on safe access to the northern elephant seal colonies and the timing of resight surveys coincides with low tide. Allow enough time to exit the beach safely. Resight surveys can be completed on the same day the full count is completed.

If very large storms with large ocean swell are predicted during any given week, extra effort should be made to conduct a survey immediately before and immediately after the storm in order to document any losses due to wash out by storm waves. Documenting storm effects on the colony during a large storm is also important to determining the extent of mortality and the movement of females to new colony sites.

4.4 Surveys

4.4.1 Full Count Surveys

During December to March of each breeding season, full count (census) surveys of northern elephant seals are conducted a minimum of once per week at all breeding sites and associated subsites within PORE. From mid-January to the end of February, two censuses per week are conducted to try to capture the peak female and pup/weaned pup counts. Full pinniped surveys, which include SLO in addition to the northern elephant seal sites and subsites, are completed once per week.

Seals are counted from fixed vantage points on cliffs with the aid of a 40X spotting scope and 8-10X binoculars. Counts are completed from pre-determined observation locations to maintain consistency between observers and data collection (Appendix SOP 2B).

Sex and age groups are tallied within each sub-site; adult female (Cow), bull male (Bull), sub-adult male classes 1-4 (SA1-4), immature (IMM), yearling (YRLNG), pup, dead pup, and weaned pup (WNR). Male age classes are distinguished by the extent of the chest shield, the length of the proboscis, and overall body length (Figure SOP 2.2; Le Boeuf and Laws 1994). Immature and SA1 age groups are not identified on the aging chart. Immature, SA1, and cow (female) northern elephant seals are indistinguishable unless a ventral (belly) view is obtained to positively identify sex. When present, harbor seals and pups, California Sea Lions, and any other pinniped species are also recorded on the survey data sheet.

At the onset of the breeding season (November-December), large numbers of young northern elephant seals are hauled out on the breeding beaches and it is not time efficient or realistic to identify the sex of all animals. A concerted effort is made to identify adult females early in the breeding season, but the immature classification encompasses both male and female sexes and is used when sexes can not be determined. SA1 can be used when a young male lacking any sign of a proboscis can be positively sexed, but a large amount of effort should not be placed in making this determination. Overall, SA1 is used infrequently for age classification.

Seals in the water are not counted as a part of the census surveys; however, any unusual activities in the nearshore waters should be added to the comments section. 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 northern elephant seals are hauled out all day long.

Time commitment for each survey is a minimum of four hours. Full count surveys should be completed in a single day. It is acceptable (although not ideal) to stretch the survey out over two day and finish the full count within 24 hours or by the close of the subsequent survey day only if weather prohibits survey completion within a single day.

To avoid disturbance of roosting or nesting Common Murres (*Uria aalge*), the TIP subsite of PRH should not be accessed when murres are present on the offshore rocks. A rough count of murres should be completed and added to the comments section of the data form.

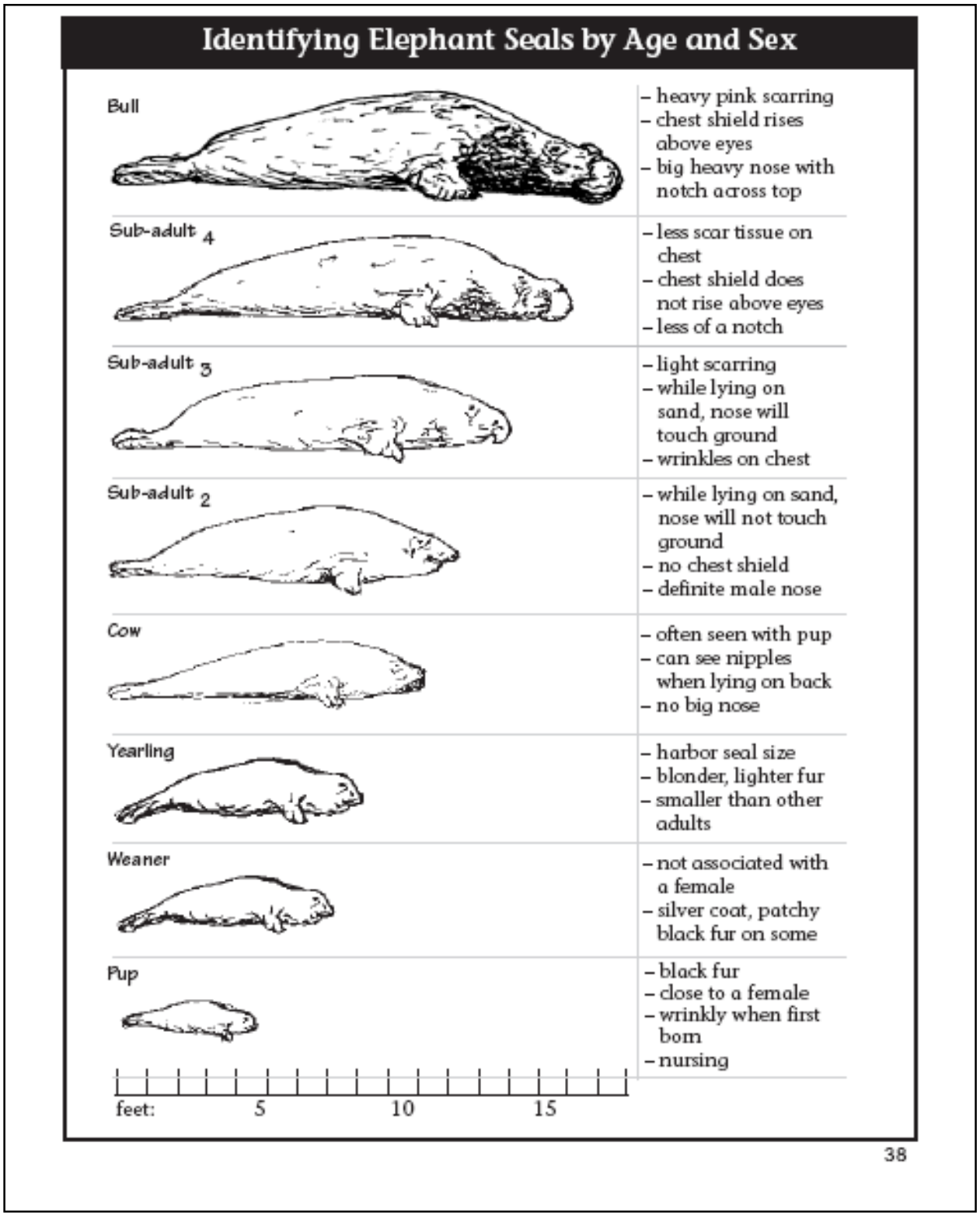


Figure SOP 2.2. Northern elephant seal aging and sexing chart (Le Boeuf and Laws 1994).

4.4.2 Resight Surveys

Dye Marking: Temporary dye-marking is used in some years to identify individual breeding adults, and to document adult and sub-adult male movement. Alpha and Beta bulls are the primary target for marking, and if the animal does not have a tag, they are also flipper tagged along with the dye mark. Dye marking occurs early in the breeding season (November-December). Dye marks allow individual identification without needing to read the tags each visit during a season. Dyes are applied with "Lady Clairol, Natural Blue-Black" human hair dye using the applicator bottle and using a series of individual alpha-numeric codes. Each dye mark includes the first letter of the name of the breeding site (i.e.: "M"= Main Colony, "S"= South Beach, "D"= Drakes Beach, etc.) where the animal was dye marked and is followed by a unique number based on a consecutive numbering system. Finally, the dye mark is underlined to avoid number confusion (i.e. 6 vs 9). For example, the first animal dye marked at South Beach would be S1 and the second individual dye marked would be S2 and so on. If possible, marks are placed on the back and side of the animal to insure good visibility of the mark from a distance. Any flipper tags present on the animal should be recorded when dye marking occurs. The orientation and shape of the dye-mark is recorded on a "scar card" to help field staff identify difficult to read dye marks during subsequent observations. The hair dye is innocuous to the seals and the mark goes away after the annual fur molt. In addition, marked males increase the ability of volunteer northern elephant seal docents to track individuals from the Northern Elephant Seal Overlook above the North Drakes Beach population and educate park visitors about the monitoring study.

Flipper Tagging: Individually marking animals allows researchers to estimate survivorship, site fidelity, and emigration rates. Colony-specific tag color and serial numbers allow researchers to track individuals over many years, with the potential to also study individual animal productivity. Similar to the procedures at other northern elephant seal colonies, we apply individually numbered plastic tags (Dalton brand) to the hind flipper of weaned pups born at PORE under National Marine Fisheries Service (NMFS) permits 373-1868-00.

Beginning in 1988, weaned pups have been tagged at PORE and each year the number tagged ranged between 150-300, as the colony grew. Until 1998, the number of weaned pups tagged each year roughly approximated the total number of pups surviving to weaning. Due to the high pup mortality and reduced colony access during the 1998 El Niño storm events, only about 27% of the pups produced were tagged. Between 1999 and 2004, approximately 55% to 94% of the pups produced were tagged. Since 2005, the number of pups surviving to weaning has far surpassed the number researchers were able to tag. Since 2000, the general goal as outlined in the NMFS permit is to tag 200-300 weaned pups each year. Double-tagging (tagging both hind flippers) is done to estimate tag loss and to increase the chance of resighting an animal, since both flippers are not always visible. At PORE, double-tagging is done opportunistically only because we do not restrain the seals when tagging as occurs at other colony sites. When possible, we also tag a few adult males to track inter-site movement.

Ideally, tags are applied when seals are sleeping and done using a Dalton brand tag and tag applicator in the fleshy, inter-digit webbing of the hind flippers. Two researchers are required during any tagging event, with one tagging and one as a safety lookout for other seals. The resight survey form is used to record data (Appendix SOP 2A). Location of seal, flipper tag number, color, side (left or right), and position among the inter-digit webs (round or square) are recorded for each tagged animal. Nursing activities and pup size class (P1-4) are recorded if the

animal is an adult-sized female. Dominancy on the beach (alpha, beta, not associated) is recorded if the animal is a sub-adult 4 or bull male.

Tag Resighting: Surveys to resight tagged seals are not currently part of the monitoring objectives for the pinniped monitoring program, but continue as part of the Seashore commitment to NMFS and other researchers that tag weaned northern elephant seals. SFAN is not analyzing the tag resight data collected yearly, but PORE is participating in a range-wide tag resight analysis with researchers working at other northern elephant seal monitoring sites through the University of California, Santa Cruz.

The resight surveys occur one to two times per week during the breeding season. The first resight survey of the breeding season usually occurs in mid-December with the purpose of dye marking large, dominant males and reading flipper tags. Due to ease of access, weekly resight surveys can occur at GUS, NDB, DSB, or SB. If biweekly resight surveys are completed, resight efforts are spread out between the breeding locations although NDB takes more effort due to the high density of animals and can be covered twice in one week. Resight surveys at PRH are restricted to early and late in the breeding season due to safety concerns (i.e., high seal density and access issues).

Resight surveys require a minimum of two persons for efficient and accurate data collection and for safety reasons. Observers can usually 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 2-4 hours to complete. Researchers should radio into dispatch indicating their location and number of observers prior to and upon completion of each survey.

Resight Data Form: The resight survey form is used for all flipper tagging, dye marking, and tag resighting activities. Observers record all seals with flipper tags or dye markings applied or identified at each site surveyed. When possible, the unique letter and/or number sequence of each flipper tag and/or dye mark should be confirmed with a second view of the tag/dye mark or by another observer. The mark (dye or tag number) should be recorded, along with the sex, age class and the reproductive status of the seal. Categories include Bull, Male Sub-adult 4, Male Sub-adult 3, Male Sub-adult 2, Male Sub-adult 1, Other Sub-adult Male, Cow, Pup, Dead Pup, Weaned Pup, Immature of unknown sex, Yearling. Only record what is “positively” seen on resight surveys. Leave sex unknown for immatures, yearlings, and weaned pups unless the sex can be positively determined with ventral view of animal. Tag/dye determinations should be checked for quality and accuracy by comparing hardcopy field data with historical database information. All corrections to hardcopy data should be completed in red pencil or ink.

For each northern elephant seal resight survey, the minimum amount of information must be recorded including, but not limited to Date, Time (beginning and ending), Observers, and Visibility. For each resight observation during the survey, record the Site, Sub-site, Size (age class), Sex, Dye mark (if present), L (Left) Tag Number, and R (Right) Tag Number (Figure SOP 2.3).

Left and right tag number information should always be recorded and may include an actual tag number/letter sequence or other information such as NR (tag present, but not read), NS (no tag seen, but may be present), or NT (no tag). If an observer is only able to positively determine a

portion of the tag, the partial tag read can be recorded to the level of information known and an underscore (_) can be placed under unknown or uncertain tag information. It may be possible to determine the individual's identity based on partial information with a search of the database.

For example (Figure SOP 2.3, line 1), an observer applied a dye mark of S6 to an SA4 male on the lower right side of body and determined there was a green tag present in the left square flipper position (Figure SOP 2.4), but was unable to read the tag. The observer also recorded a partial tag read of a green tag in the right round flipper position (Figure SOP 2.4) with an L in the first position, possibly a 1 in the 2nd position (not confirmed), a 2 in the 3rd position, and 3 in the 4th position. A dye code of "2" indicates that the dye mark was newly applied. A tag code of "1" indicates a questionable or incomplete tag read. All codes used on the resight form are noted on the bottom of the datasheet (Appendix SOP 2A)

						Dye		L Tag				R Tag				Reprod. Status		
Line	Site	Sub-site	Size	Sex	Condition	Number	Code	Color	Number	Pos	Code	Color	Number	Pos	Code	Bull/Cow Status	P Size	Notes
1	SB	LTH	SA4	M		S6	2	GR	NR	LS		GR	L_23	RR	1			H
2	SB	LTH	A	F				PK	K154	LR			NS			NU	P1	

NOTES: 1) Dye mark of S6 on right flank; second number of right tag could be a 1, but could not confirm.

Figure SOP 2.3. Example of northern elephant seal resight observation data.

A second example (Figure SOP 2.3, line 2) is of a female with a pink flipper tag of K145 on the left round flipper position (Figure SOP 2.4) and no view of a tag on the right flipper, but there could be an unseen tag present. The female (cow) was associated with a newborn pup who was nursing at the time of the observation.

Seal mark data form (Scar Card): Some individual seals are tracked throughout the breeding season and for multiple years based on flipper tags, scars, and dye marks. Individual data forms track the histories of these individuals (Appendix SOP 2A). A scar card should accompany each dye marked animal to aid in resight efforts. These cards are especially useful with hard to read dye marks. A scar card identifies where the animal was dye marked and records a realistic sketch of the dye mark. The scar cards are used for reference only during the breeding season and are not entered into the project database.

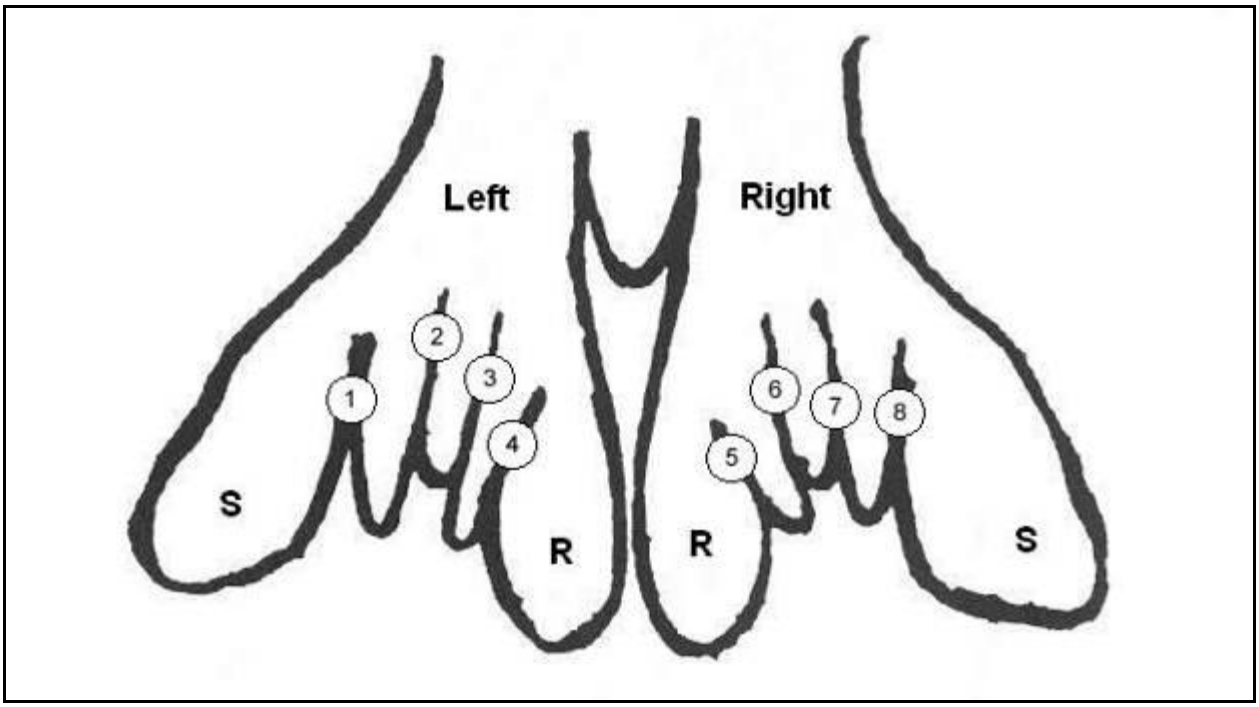


Figure SOP 2.4. Dorsal view diagram of northern elephant seal rear flippers. Square (S) and round (R) lobes of flippers are noted. Flipper tag locations are (1) Left Square – LS (2) Left Square Bar – LSB (3) Left Round Bar – LRB (4) Left Round - LR (5) Right Round - RR (6) Right Round Bar - RRB (7) Right Square Bar - RSB (8) Right Square - RS.

5.0 Literature Cited

Le Boeuf, B. and R.M. Laws (eds.). 1994. Elephant seals: population ecology, behavior, and physiology. University of California Press, Berkeley. 414 pp.

Appendix SOP 2A. Northern Elephant Seal Census, Resight Survey Forms, and Scar Cards.

POINT REYES NATIONAL SEASHORE NORTHERN 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 ☐

PORE Mirounga 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.

						Dye		L Tag				R Tag				Reprod. Status		
Line	Site	Sub-site	Size	Sex	Condition	Number	Code	Color	Number	Pos	Code	Color	Number	Pos	Code	Bull/Cow Status	P Size	Notes
1																		
2																		
3																		
4																		
5																		

Site		Sub-Site/Harem		Site		Sub-Site/Harem		
PRII	Point Reyes Headlands / Main Colony	C1- C4	Coves 1- 4	NDB	North Drake's Beach	NDB	North Drake's Beach colony	
		TIP	Tip beach			LBS	Lifeboat Station (includes areas between LBS and CUS)	
		LB	Lobar Beach			GUS	Gus' Cove	
		DSB	Dead Seal Beach					
				OTR	Other	CRC	Chimney Rock Cove	
SB	South Beach	LTH	Lighthouse Beach			SLO	Sea Lion Overlook	Weather Data from NOAA Radio Ch. 13/14
		NRR	Nunes Ranch Beach					
		MDR	Mendoza Ranch Beach					

Size: Female:		Male:		Pup Age		Sex	
A	Adult	A	Bull/Adult	P1	wrinkles	F	Female
IM	Immature	SA1-4	Sub-Adult class 1-4	P2	no wrinkles	M	Male
W	Weaner	IM	Immature	P3	bump like, black	U	Unknown
U	Unknown/Data not taken	W	Weaner	P4	molting		
Y	Yearling	U	Unknown/Data not taken	P5	molted		
		Y	Yearling				

Condition				Dye Brand	Number Code Column	Number as read, use '*' for place holder
S	sick, lethargic; describe in notes	SB	Sharkbite			
I	Injured, describe in notes	CC	Cooker Outer Bite	0		Brand Number, if Zalophus add '2' to condition column.
F	Fat or "super-weaning" for pups	C	Collected (by MMC, etc.)	1		Dye mark partially read or questionable
M	Medium/ Normal	Z	Zalophus (Use for resights, etc.)	2		Newly applied dye mark, use first time animal is marked
T	Thin or emaciated	P	Photo (use for tag resights, injury, etc.)	4		Data changed using info. from another source (i.e. database, dye record, etc.)
D	Dead					

L/R Tag

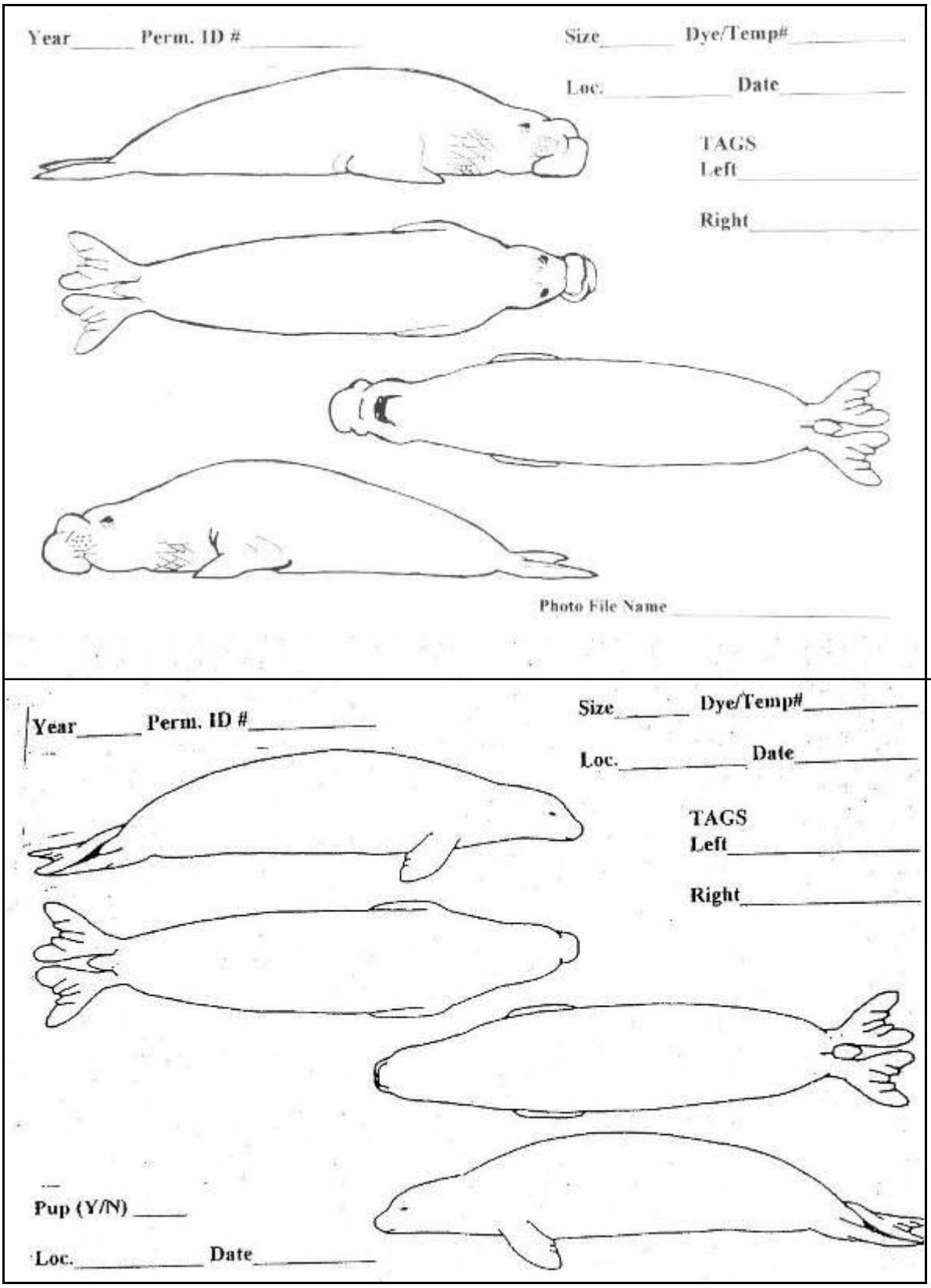
Color			Position		Number	Number as read, use '*' for place holder	Code Column	
	GR	Green	LR	RR	NR	Tag present but Not Read	1	Tag number partially read or questionable
	OR	Orange	L	R	NS	Tag Not Seen, maybe present	2	Newly applied tag number, recorded by tagger
	PK	Pink			NT	No tag	4	Data changed using info. from another source (i.e. Star card, dye record, etc.)
	RE	Red	LRB	RRB	DT	Broken Tag	8	Tag recovered from dead seal or found on beach.
	WH	White	LS	RS			9	Tag destroyed
	YE	Yellow	LSB	RSB				
	PU	Purple						

Reproductive Status

Status			Males				Pup Size/Sex	
	PG	Pregnant or possibly so		A	Alpha Bull / Beta	Center or guarding edge of harem		Size Above
	B	Birth of pup observed		B	Bull	2nd ranked male, in or at edge of harem	P1-P4	
	NU	Nursing pup or associated with pup		P	Peripheral	Within 5 to 50 m of harem edge.	M, F, U	
	NP	No Pup		NA	Not Associated	Non-breeding area or > 50 m away from harem edge.		

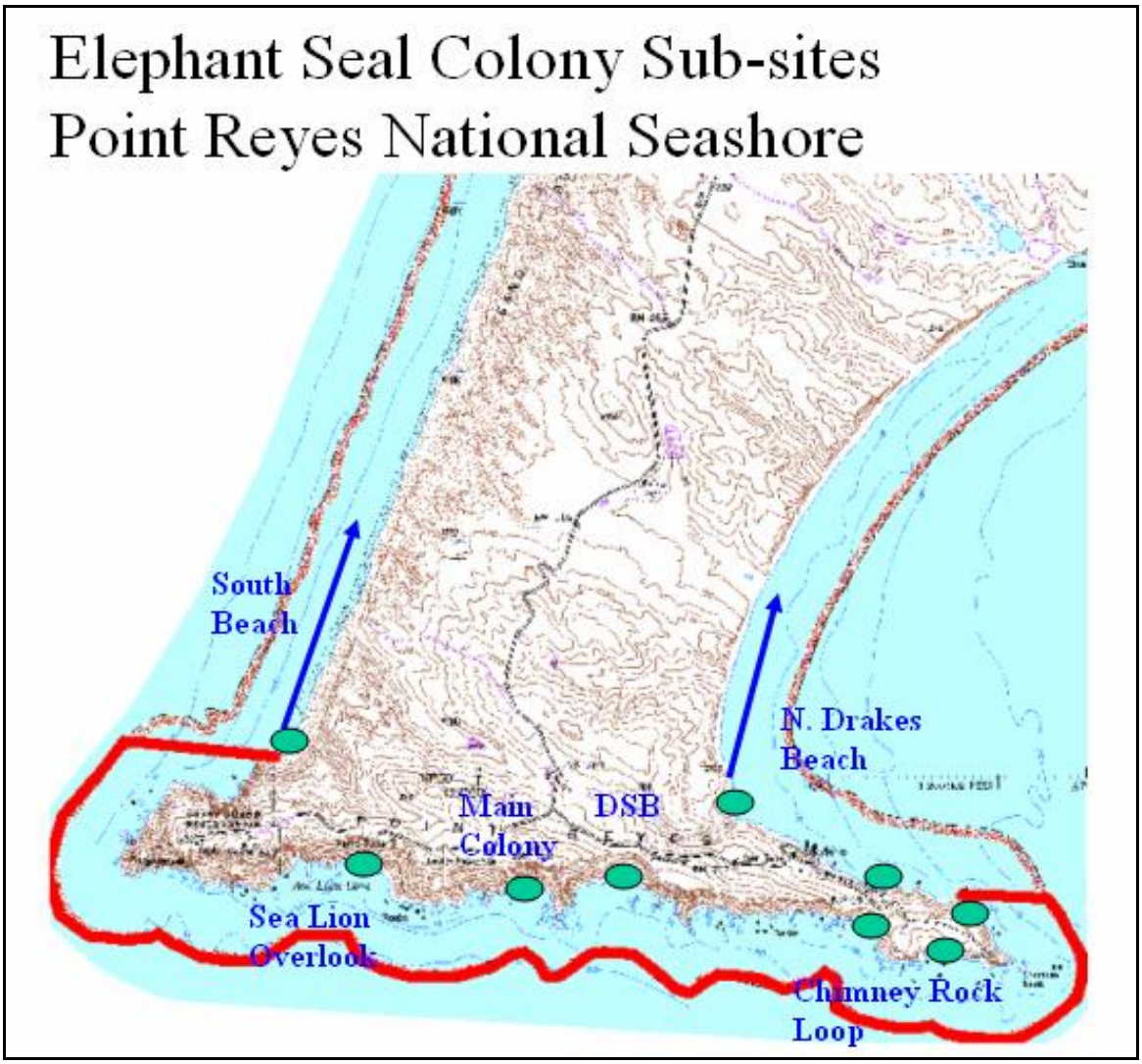
Notes	N	Handwritten notes at bottom of the page, referenced with the line number.	Revised March 2003

*Actual resight data form contains 20 rows per page.



Male and female northern elephant seal scar cards.

Appendix SOP 2B. Northern Elephant Seal Survey Maps



Elephant seal breeding sites: South Beach

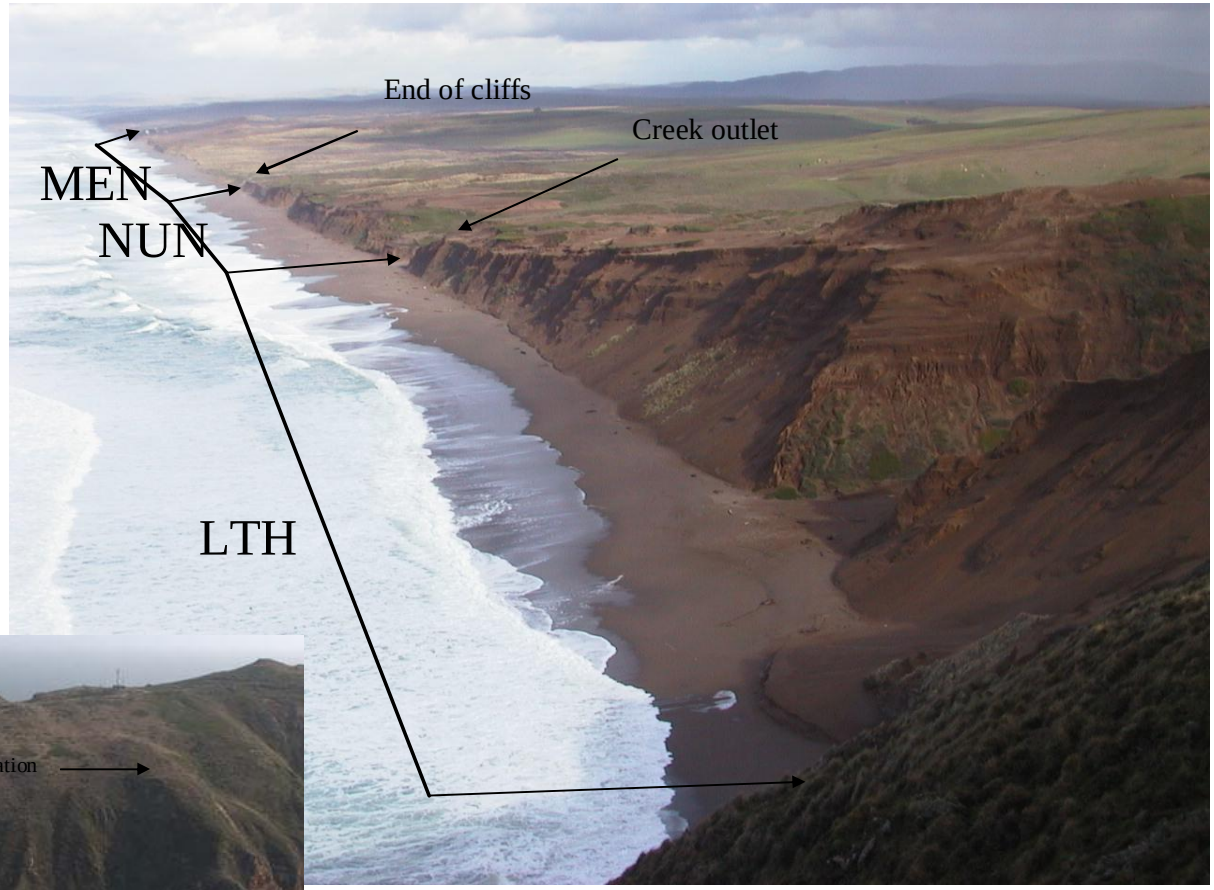


Photo taken from counting location near benchmark and cement block below lower overlook accessed from lighthouse parking lot.

March 2008

Elephant seal breeding sites: Point Reyes Headlands

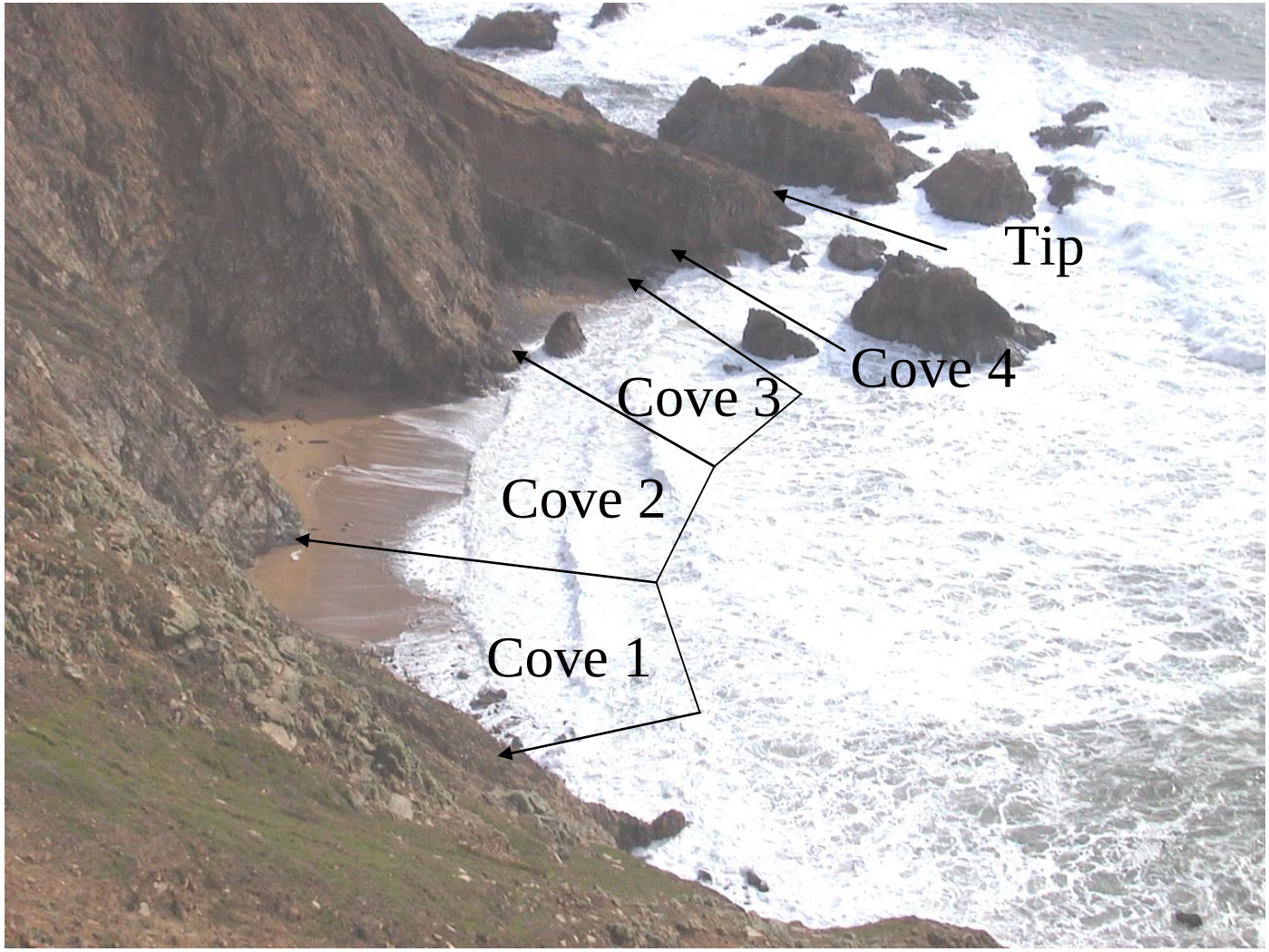
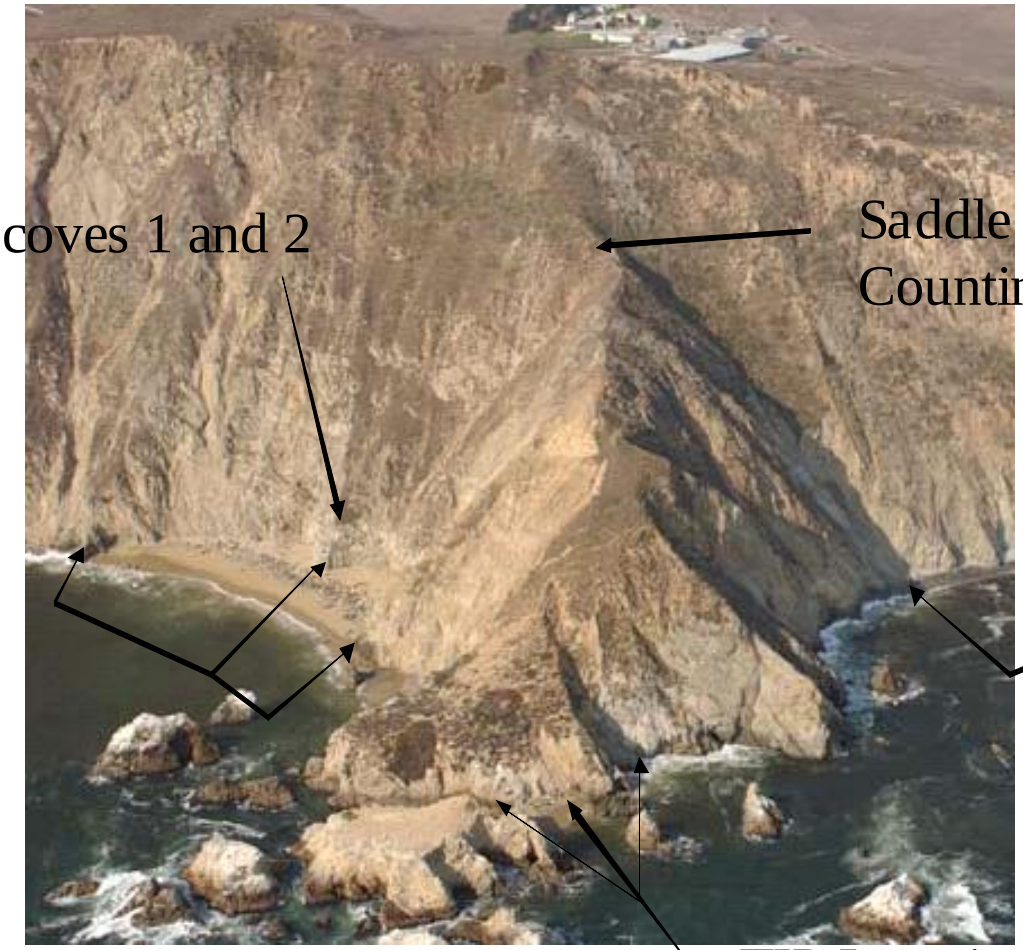


Photo taken from cliff site which is one of the counting locations for the coves.

Elephant seal breeding sites: Point Reyes Headlands



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Elephant seal breeding sites: Point Reyes Headlands

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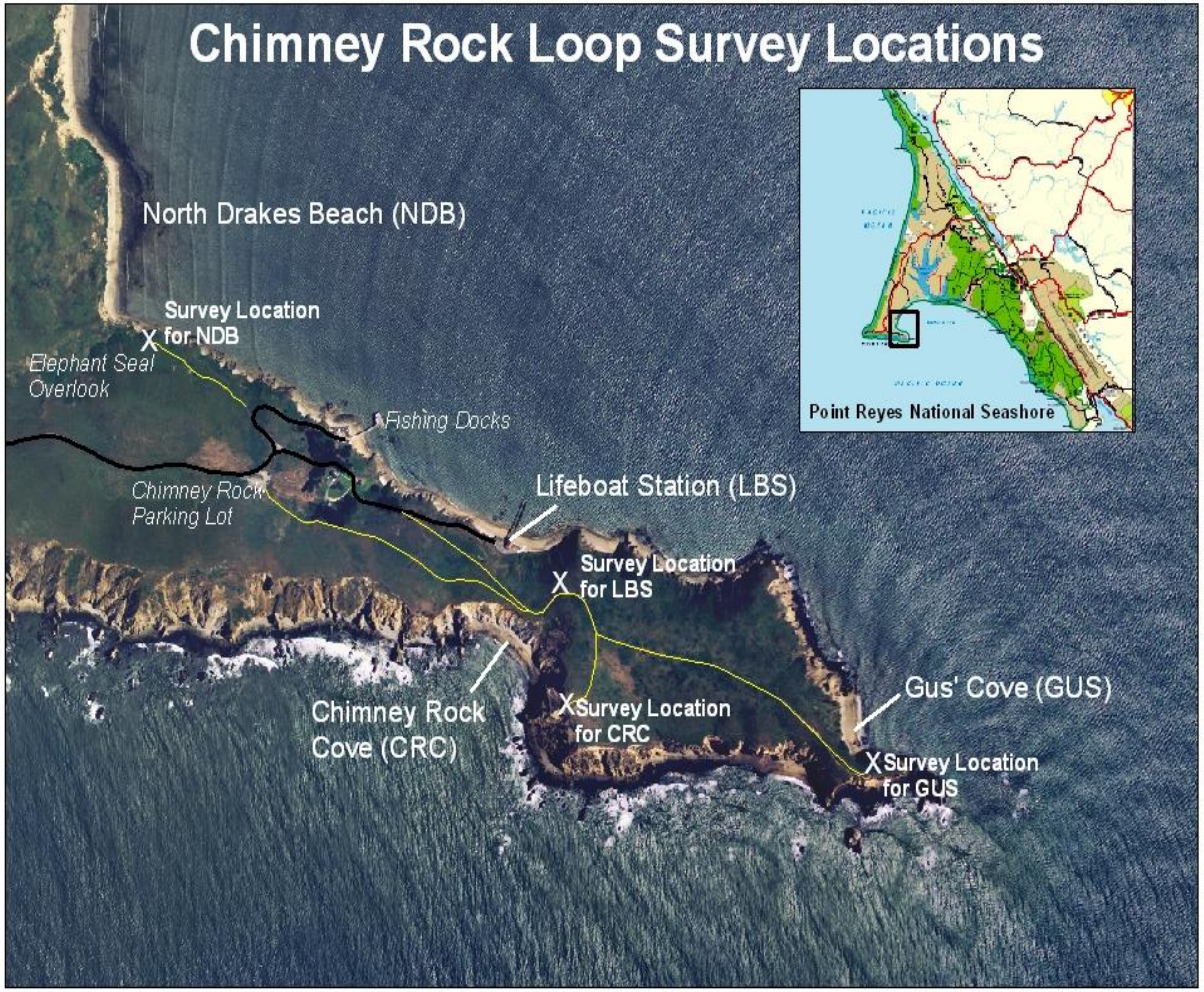
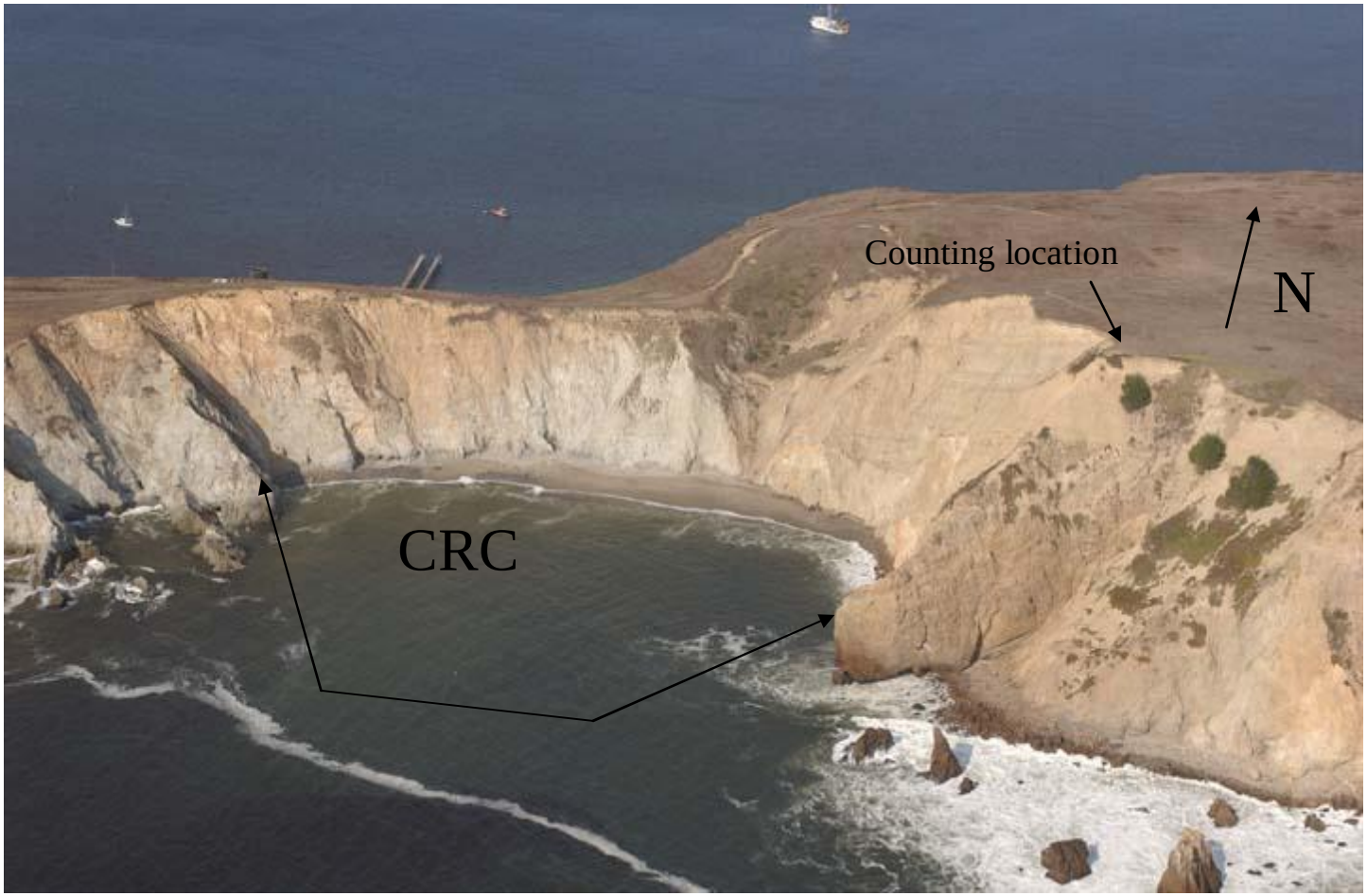
Elephant seal breeding sites: Chimney Rock Loop



Elephant seal breeding sites: Chimney Rock Cove



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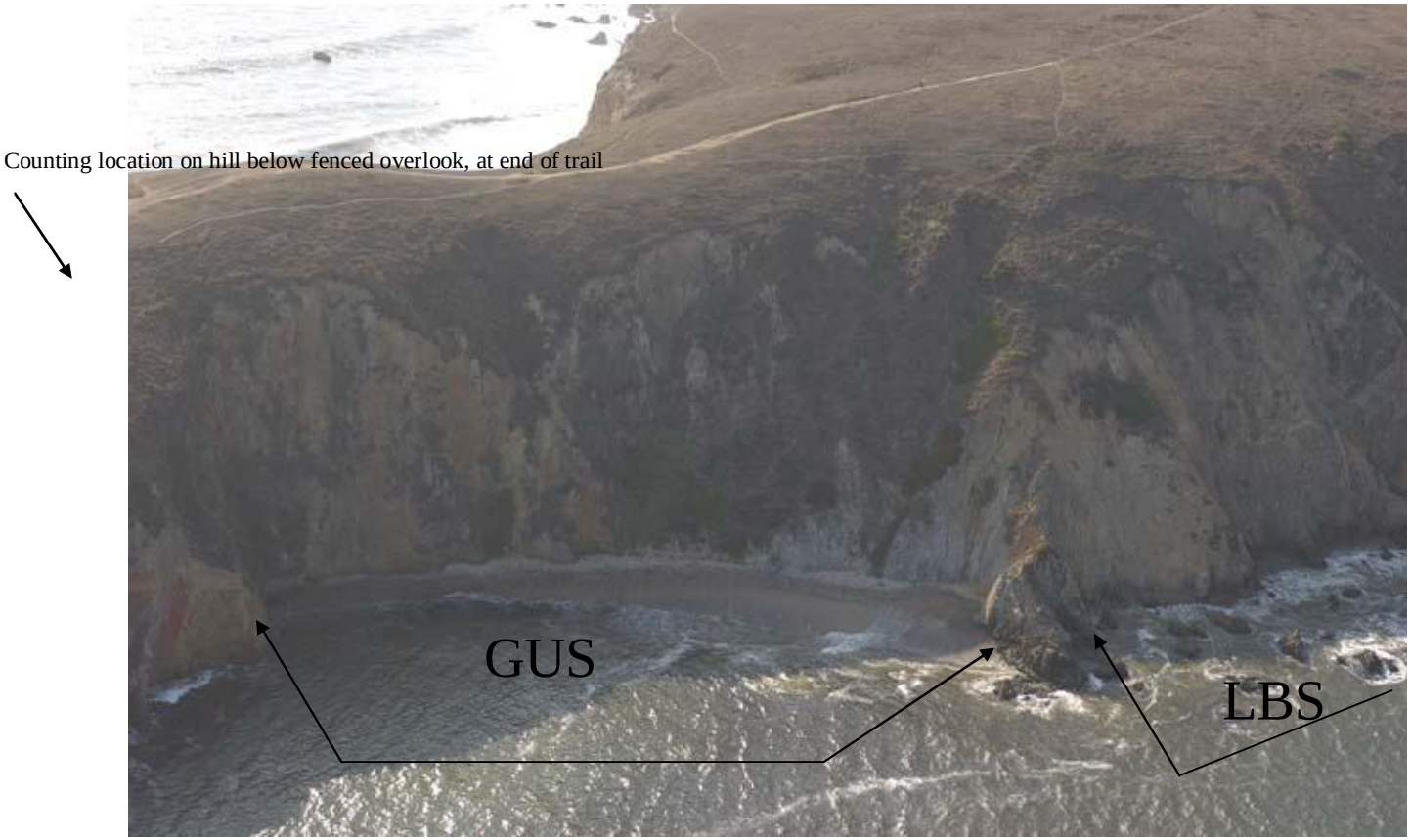
Elephant seal breeding sites: Gus's Cove and Lifeboat Station



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Elephant seal breeding sites: Lifeboat Station

This stretch of beach is not regularly counted unless surveyors are hiking to Gus' Cove via the beach.
Area currently contains no breeding sites, just subadult haul out sites.

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Elephant seal breeding sites: North Drakes Beach

Other animals visible from the overlook but beyond the NDB colony can also be counted in NDB

Photo taken from Overlook platform which is the counting location.

California Seal Lion haul out site: Seal Lion Overlook (SLO)

Area to be counted, including seals hauled out on offshore rocks, but not including seals swimming offshore.

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SOP 3. Data Management

Version 1.5

Revision History Log

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
	September 2007	D. Roberts	Used SFAN stream flow data management plan as template		1.0
1.0	March 2008	David Press, Marcus Koenen	Review, edits, and additions to version 1.0, Format		1.1
1.1	July 2008	David Press	Added Figure 26. Annual pinniped data work flow.		1.2
1.2	September 2009	D. Press, M. Koenen	Edits to SOP format and layout. Added descriptions of new database features.	Preparation for final protocol submission.	1.3
1.3	November 2009	K. Freeman, D. Press	Changed tables and figures to a modular numbering system, added a literature cited section, additional minor edits.	Formatting requirements.	1.4
1.4	December 2009	D. Press	Minor grammatical edits. Revised Table SOP 3.9.	Comments from Penny Latham.	1.5

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1.0 Overview

Two critical long-term goals of the SFAN I&M Program are to:

- Integrate natural resource inventory and monitoring information into National Park Service planning, management, and decision making.
- Share National Park Service accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives.

For the pinniped monitoring program to meet I&M Program goals, a detailed management plan is needed to ensure data quality, interpretability, security, longevity and availability. The pinniped monitoring program has a long history at SFAN parks. Since the late 1970s, staff scientists and volunteers have monitored seal colonies to determine population status, detect changes in population numbers and reproductive success and to identify factors such as human disturbance that might affect population trends. The pinniped database was designed to house legacy data as well as data taken by contemporary surveys. The database currently houses data back to 1997. Older legacy data will be added as staff time permits.

1.1 Scope and Applicability

The procedures below cover routine data management activities for the SFAN pinniped monitoring program. This Standard Operating Procedure describes how the SFAN pinniped monitoring protocol meets data management objectives through data entry specifications, database design, quality assurance and control measures, metadata development, data maintenance, data storage and archiving, and data distribution. Data management procedures are explained for all the components of the protocol.

The pinniped protocol encompasses three separate programs:

- Harbor Seal Monitoring (SFAN I&M Program)
- Northern Elephant Seal Monitoring (PORE Science Division)
- All Species Monitoring (PORE Science Division) (see Sections 1.5.4 and 2.6.2)

The pinniped database contains data collected by all three of these programs. There are separate data entry and editing procedures for the harbor seal and northern elephant seal programs. The census forms for northern elephant seal data entry and editing are also used for the all species pinniped program. While separate data entry and editing forms are used for harbor seals, data are stored in common tables to facilitate reporting and analysis across the three programs.

2.0 Description of Pinniped Monitoring Database

The SFAN staff has developed a relational Microsoft (MS) Access XP database compliant with the Natural Resource Database Template (NRDT), an application developed by the National Park Service's (NPS) Natural Resource Inventory and Monitoring Program (I&M). The database consists of two separate MS Access .MDB files. The 'front end' (Pinniped.mdb) contains forms, linked tables, reports, queries, macros and Visual Basic code while the 'back end'

(Pinniped_BE.mdb) houses the data tables. This organization of the database allows new development and edits of forms and reports (housed in the front end) to proceed without hindering use of the data (housed in the back end). The two .MDB files are linked using the 'Linked Table Manager' utility of MS Access.

The data organization is based on the concept of surveys (sampling events occurring at a specified time) recorded in an event table which are conducted at specified locations, that are geo-spatially described in a locations table. EventID and LocationID codes provide the unique keys for databases built on the NRDT model. Besides actual counts of pinnipeds, the database is used to record effects of natural and anthropogenic disturbances to harbor seals and track the fate of tagged northern elephant seals.

As described above, there are three separate pinniped programs but only two different data collection protocols, one for harbor seals and the other for northern elephant seals. The data collection and entry methodology for the all species pinniped program is identical to that used for northern elephant seal census data. The primary information collected by all programs is the number of pinnipeds observed at a specific time and location. The same tables are used to house the primary information from all programs, namely, *tblEvents*, *tblLocations*, *tblObservers* and *tblSealCoun*t. Events are linked to counts by an EventID which is automatically generated by Visual Basic code housed in the data entry forms. EventIDs are the concatenation of the following values: park, project, year, month, day and starting time (i.e. PORE_Pinniped_2005-Jan-03_12:30:00).

Ancillary event tables, equivalent to *tblEventDetails* in the NRDT model, which contain information unique to each program (such as weather information and survey number) are linked to *tblEvents* in a one-to-one relationship. These tables are:

TABLE	PROGRAM
TblPhocaEvents	Harbor Seal (counts)
tblElephantEvents	Northern Elephant Seal (counts)
tblDisturbanceSource	Harbor Seal (disturbances)
tblResightEvents	Northern Elephant Seal (tag resights)

Harbor seal disturbance responses are tracked by *tblDisturbanceBehav* while northern elephant seal tag resights are kept in *tblResight*. *tblPhocaSealCount* contains the number of harbor seals which had red fur as well as the number of harbor seals with shark bites and is linked to *tblSealCount* by EventID, LocationID and SubsiteTime.

In the following narrative, Section 2.1 describes the structure and operation of the harbor seal portion of the database while Section 2.2 describes the northern elephant seal portion of the database. Tables which are common to both programs are referenced in both sections.

A complete data dictionary for the pinniped database is included as Appendix SOP 3A.

2.1 Harbor Seal Monitoring

Relationships of tables in the pinniped database which house harbor seal data are shown in Figure SOP 3.1.

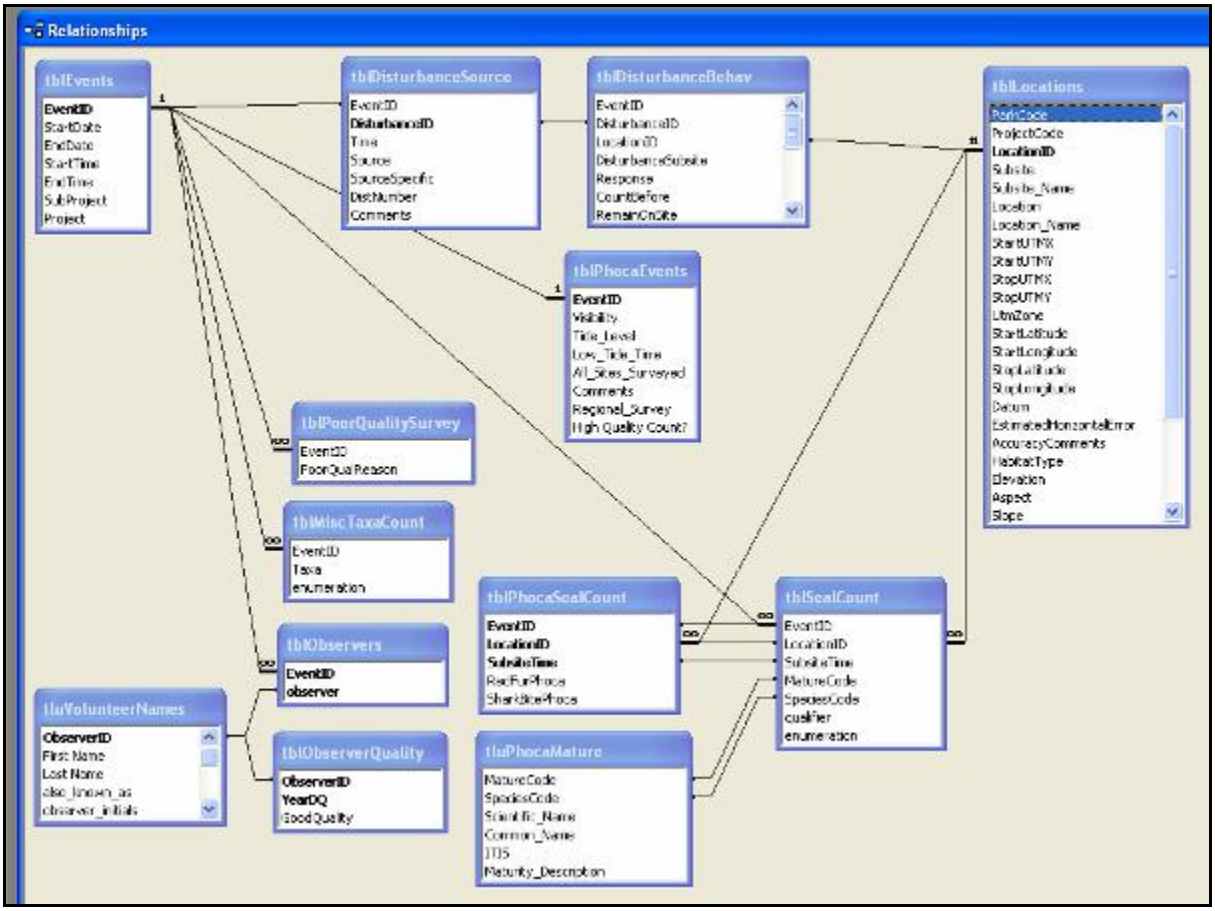


Figure SOP 3.1. Relationships of tables which house harbor seal data.

Note that harbor seal and northern elephant seal data are commingled in the primary data tables such as *tblEvents*, and *tblSealCounts.* Ancillary tables such as *tblPhocaEvents* and *tblElephantEvents* house event data specific to the harbor seal and northern elephant seal projects respectively. Data are differentiated as belonging to the harbor seal or the northern elephant seal program by values stored in the SubProject field of *tblEvents*.

2.1.1 Harbor Seal Census Data Entry

Project staff and volunteers regularly visit a standard suite of seal haul-out locations from early March through the end of July (see SOP 1: Harbor Seal Surveys). At each location, harbor seal adults/immatures and pups are counted. Dead harbor seal pups, harbor seals with red fur and seals which have obvious shark bites are tallied separately. Other less common pinniped species are also enumerated when observed, including:

- California Sea Lion
- Northern Elephant Seal

- Northern Fur Seal
- Steller Sea Lion
- Guadalupe Fur Seal

The database accommodates counts of these less common species.

frmMainMenu (Figure SOP 3.2)
The main menu is displayed automatically when the database is opened. A start-up or welcome form allows the user to navigate to one of three switchboard forms each of which control access to different database functions. To access the data entry forms the user selects the 'Enter and Verify Data' button which opens *frmEnterDataMenu*.

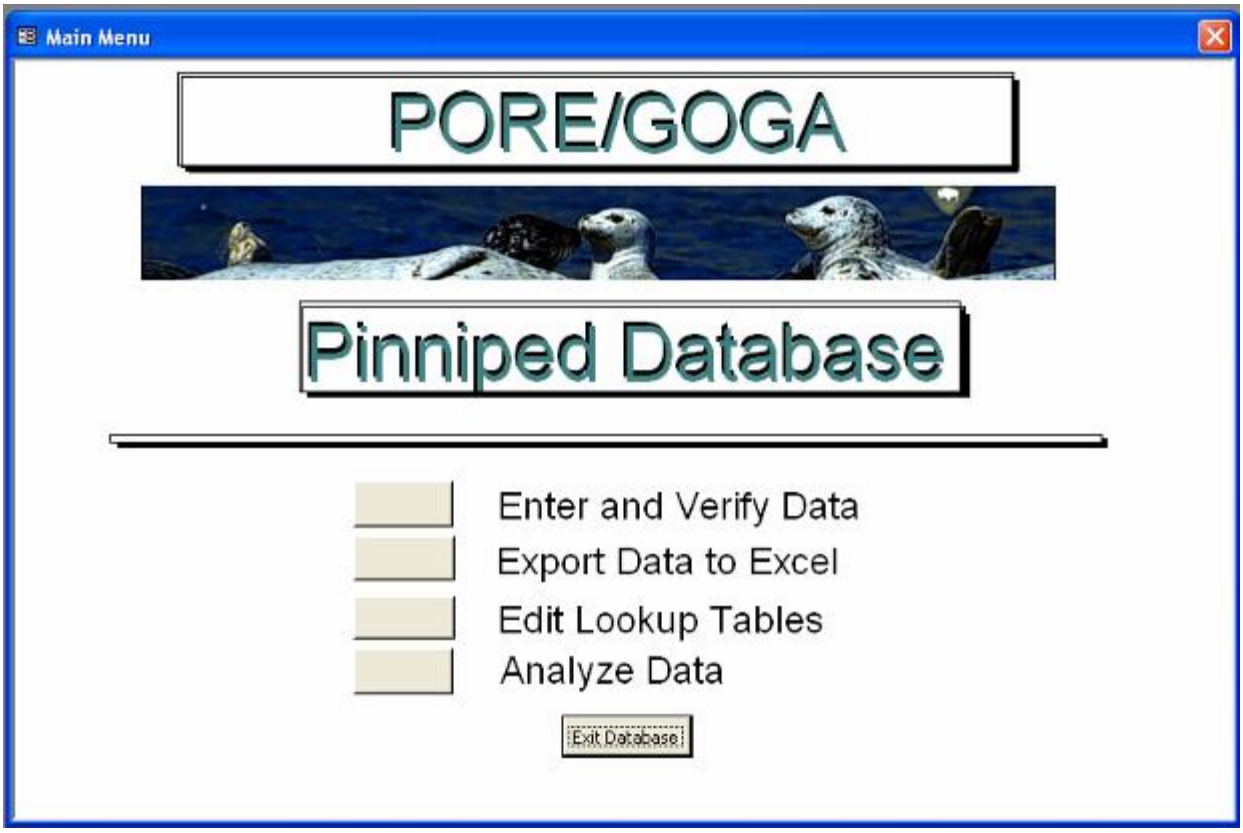


Figure SOP 3.2. Main menu which is displayed when the pinniped database is started.

frmEnterDataMenu (Figure SOP 3.3)
This switchboard menu allows the selection of data entry and editing forms for both the harbor seal and northern elephant seal projects. To add newly collected harbor seal data to the database, select the 'Add Harbor Seal Data' button which opens *frm_PhocaObservation1*.

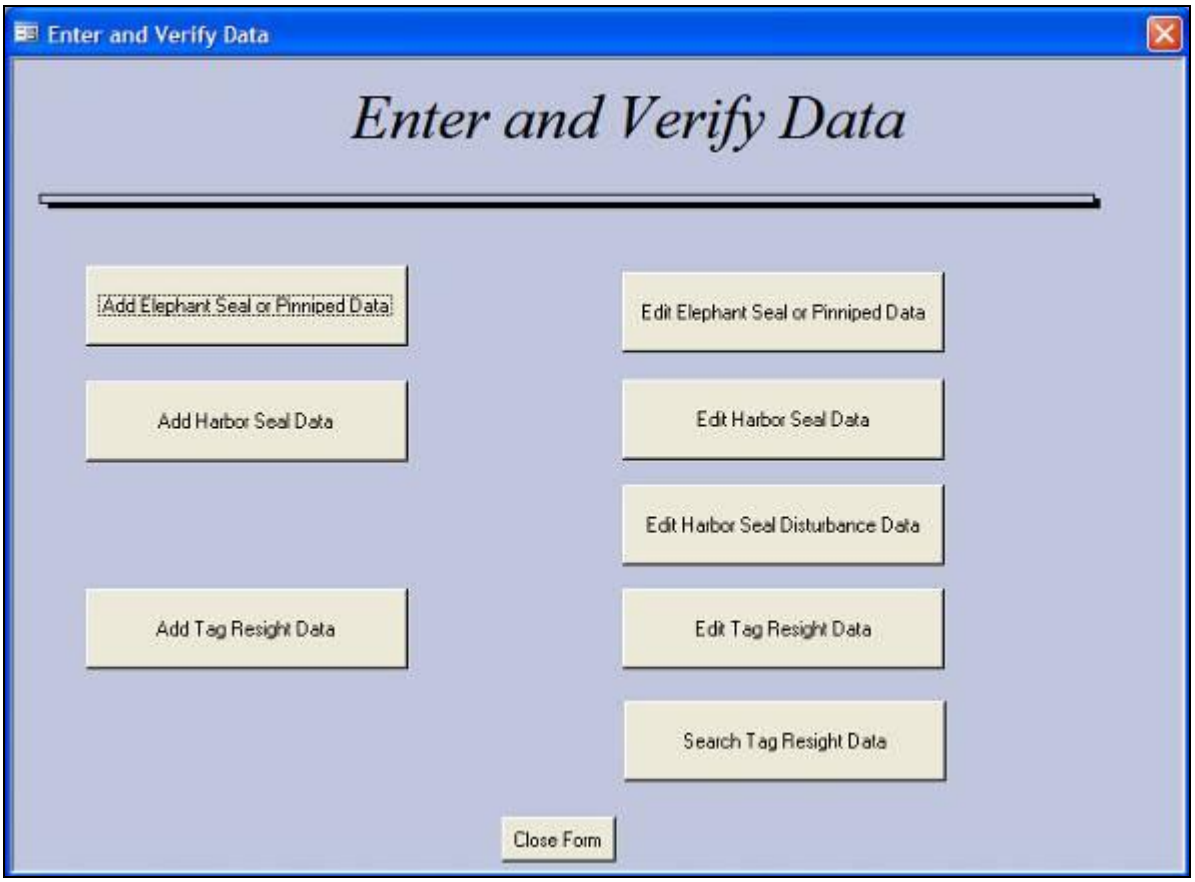
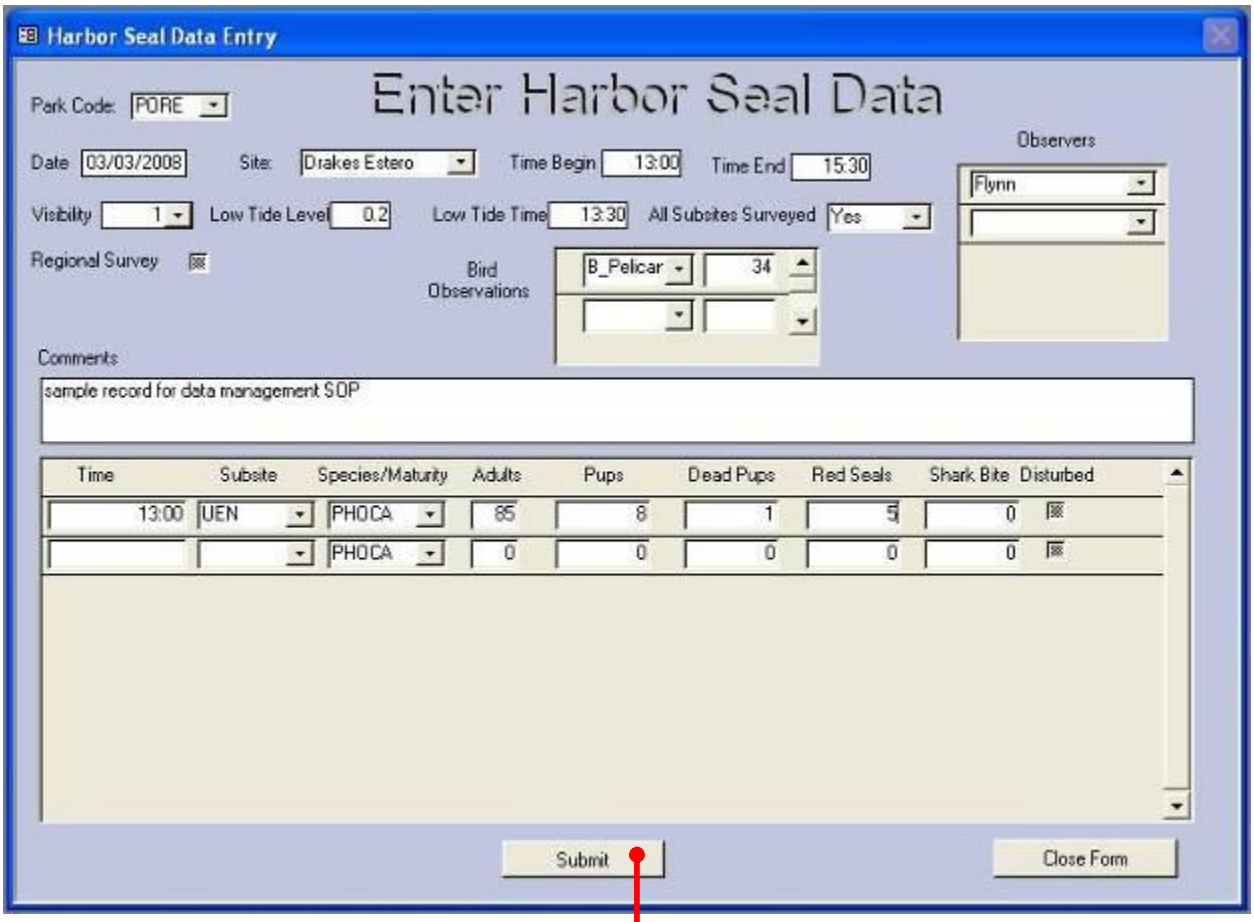


Figure SOP 3.3. Enter and verify data menu.

frm_PhocaObservation1 (Figure SOP 3.4)
Data recorded on the field data sheets can be entered into the database through this form which contains three subforms that are bound to temporary tables. When entries in the form are committed to the database by selecting the 'Submit' button at the bottom of the form, Visual Basic code is executed to move data from the frm_PhocaObservation1 and the temporary tables to permanent tables. After the data are moved, the forms and temporary tables are cleared.

Temporary data tables are required during initial data entry because of the desire to store the entire pinniped project's count data in one table, *tblSealCount*, regardless of which data form is used. In this table, each record represents a single count of a pinniped species and age class, at a specific subsite and at a specific time. Because of many problems with organizing a datasheet in this manner, the database instead accommodates what is most convenient from a data collection stand-point, organizes the data entry form based on the datasheet, and then transfers and stores the data in a manner appropriate for the database.



tblSealCount

LocationID	Subsite	SubsiteTime	MatureCode	SpeciesCode	qualifier	enumeration
PORE_H_Seal_UEN	UEN	13:00:00	ADULT	PHRI		85
PORE_H_Seal_UEN	UEN	13:00:00	PUP	PHRI		7
PORE_H_Seal_UEN	UEN	13:00:00	PUP	PHRI	DEAD	1

tblPhocaSealCount

LocationID	SubsiteTime	RedFurPhoca	SharkBitePhoca
PORE_H_Seal_UEN	13:00:00	5	0

Figure SOP 3.4. Harbor seal data entry form and example of harbor seal count data storage.

The counts of red fur seals and shark bitten seals are maintained in a separate table because the field protocol specifies that these counts be taken as a subset of the total number of harbor seals. Keeping red fur and shark bite seals in a separate table reduces the risk of tabulating the same individual twice when data summaries are prepared.

Dead harbor seal pups are also tallied in the field as a subset of the total number of pups. When dead pup data are committed to the database, the number of dead pups is subtracted from the total number of pups and the value of 'DEAD' is placed in the 'Qualifier' field of *tblSealCount*.

Table SOP 3.1 lists the data entry forms and their associated temporary and permanent tables. Figure SOP 3.4 illustrates how pinniped count data is stored once the data has been submitted to the database.

When data entry is complete the data technician should initial and date the field data sheet in the upper right hand corner.

Table SOP 3.1. Forms and tables used for harbor seal data entry.

Form	Temporary Table	Permanent Table	Table Contents
frmPhocaObservation1	None	tblEvents	Event fields common to all projects.
frmPhocaObservation1	None	tblPhocaEvents	Event fields specific to harbor seal surveys.
frmObserversSUB	tblObservers_Tmp	tblObservers	Observers performing survey
frmMiscTaxaCountSUB	tblMiscTaxaCount_TEMP	tblMiscTaxaCount	Counts of select bird species
frm_harborsealCount_SUB	tblSealCount_TEMP	tblSealCount	Location and time specific adult, pup and dead pup counts
frm_harborsealCount_SUB	tblSealCount_TEMP	tblPhocaSealCount	Red fur and shark bitten seal counts

Important notes for harbor seal data entry include:

- The regional survey check box should be checked for all surveys that occur within a five day window (Thurs-Mon) of the scheduled regional survey date, which is always a Saturday. Each regional count date, its respective regional count code, and the five day range of dates is stored in *tlu_Regional_Counts*.See also SOP 1: Harbor Seal Surveys.
- Data entry of 'Pups' includes live plus dead pups.
- 'All Subsites Surveyed' is a mandatory data entry field.

2.1.2 Harbor Seal Census Data Verification and Editing

Data verification is performed as an independent step after the data have been entered into the database. Data should be regularly verified and corrected by two individuals, one who reads the field data sheet and a second who verifies each record which is displayed in the harbor seal data editing form and subforms. Errors in the field data sheets should be corrected using a red pen. The correction should be signed and dated by the individual who made the change. Once the data in the database have been verified as correct, the field data sheet should be initialed and dated in the upper right hand corner by the data technician.

frmEditPhocaObservation (Figure SOP 3.5)
Access to the data editing form is through form *frmEnterDataMenu* (Figure SOP 3.3) and button "Edit Harbor Seal Data". The main form and three subforms are related to seven different data tables as shown in Table SOP3.2. "Subset by Date" and "Subset by Site" utilities have been included in the data editing form to filter records and eliminate the necessity of scrolling through the entire data set to locate records.

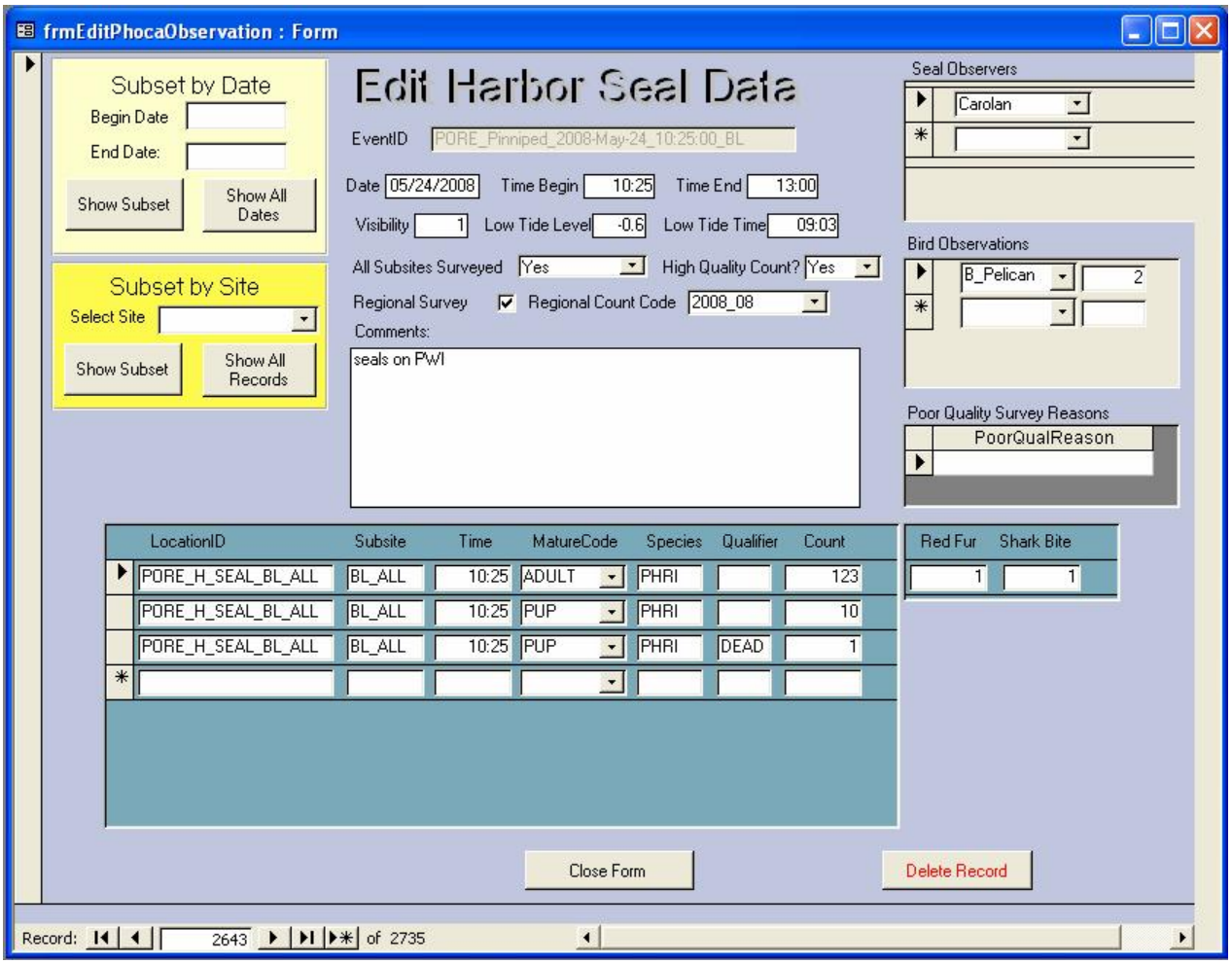


Figure SOP 3.5. Harbor seal data verification and editing form.

Table SOP 3.2 Forms and tables used for harbor seal data verification.

Form	Query	Permanent Table	Table Contents
frmEditPhocaObservation	qryEditPhoca	tblEvents	Event fields common to all projects.
frmEditPhocaObservation	qryEditPhoca	tblPhocaEvents	Event fields specific to harbor seal surveys.
frmObserversSUB		tblObservers	Observers performing survey
frmMiscTaxaCountSUB3		tblMiscTaxaCount	Counts of specific bird species
frmSealCountSUB		tblSealCount	Location and time specific adult, pup and dead pup counts
frmPhocaSealCountSUB		tblPhocaSealCount	Red fur and shark bitten seal counts
frmSubPoorQuality		tblPoorQualitySurvey	Reasons for when HighQualitySurvey? is selected as “no”.

Important notes for the harbor seal data editing form include:

- The regional count code, which is based on the year and survey number (ie. 2008_03), should be set in the editing form. If a site is visited more than once during a regional count weekend, the survey with the maximum count should be given the regional count code. This will identify the survey as the one to use for analytical purposes.
- The quality of the survey is noted in this form by selecting “yes” or “no” in the “HighQualitySurvey?” field. Poor quality surveys are given reason in the provided subform. See also Harbor Seal QA/QC.

2.1.3 Harbor Seal Disturbance Data Entry

In addition to population censuses, biologists observe seal behavior, particularly with regard to factors which could disturb seals while they are resting onshore. Disturbance data include any potential or actual disturbance of the seals causing them to alter their behavior. Information collected includes the source of the disturbance and seal responses (a gradient from no response to flush into water). The database also tracks the fate of seals flushed into the water. Disturbance data are recorded on a separate data sheet in the field (see SOP 1: Harbor Seal Surveys).

frmDisturbance (Figure SOP 3.6)

The disturbance form is opened by selecting the ‘Disturbed’ check box on the harbor seal data entry form (Figure SOP 3.4). The disturbance form and the associated subform are bound to two tables which log the time, nature of the disturbance and subsites affected (Table SOP 3.3).

The disturbance source is recorded in two fields, “source” and “source specific”. The source field is a general category, such as “human”, where as the source specific field is more detailed, such as “hikers” or “surfers”. The table *tluSource* lists source values and related source specific values. The data entry form is designed to restrict data entry for source specific values based on the previously entered source value.

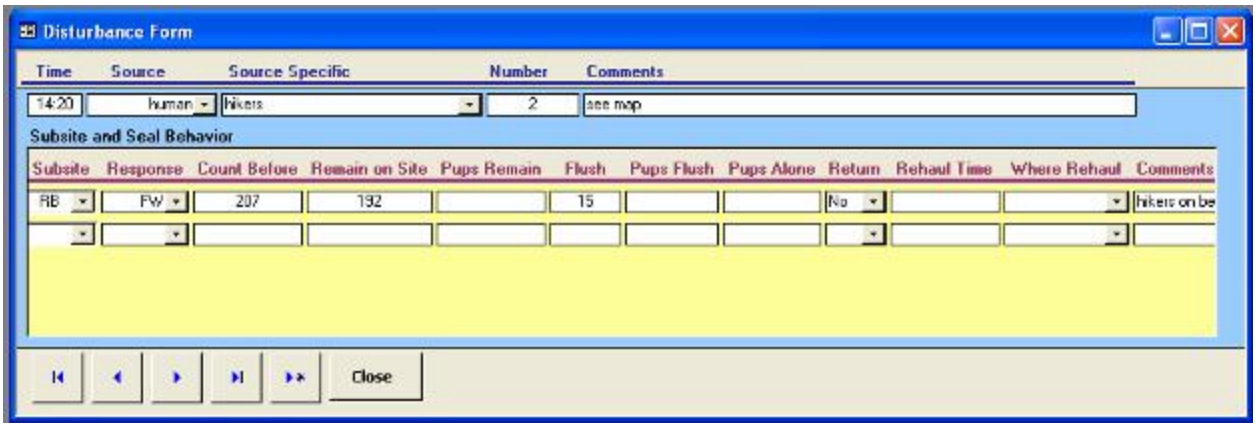


Figure SOP 3.6. Harbor seal disturbance data entry form.

Table SOP 3.3. Forms and tables used for harbor seal disturbance data entry.

Form	Permanent Table	Table Contents
frmDisturbance	tblDisturbanceSource	General description of disturbance source.
frmDisturbanceSub	tblDisturbanceBehav	Subsite specific observations.

A disturbance may affect more than one subsite, and seals at a subsite may have more than one response. The subform should note all disturbed subsites and subsite responses to a single disturbance source.

Since disturbances are observed during regular harbor seal censuses, general information about the census such as the date, location, and field survey team members don't have to be entered in the disturbance form. The EventID for the census and the disturbance are the same.

If disturbance data is not entered in consort with the associated seal census data, the harbor seal disturbance data verification and editing form (Figure SOP 3.7) must be used.

2.1.4 Harbor Seal Disturbance Data Verification and Editing

Data verification takes place as an independent step performed after the data have been entered into the database. Data should be verified and corrected by two individuals, one who reads the field data sheet and a second who verifies each record which is displayed in the harbor seal disturbance data editing form and subform. Once the data in the database have been verified as correct, each field data sheet should be initialed and dated in the upper right hand corner by the data technician.

frmEditDisturbance (Figure SOP 3.7)

Access to the data editing form is through *frmEnterDataMenu* (Figure SOP 3.3) and button "Edit Harbor Seal Disturbance Data". A "Subset by Date" utility has been included in the data editing form to filter records and eliminate the necessity of scrolling through the entire data set to locate records. The control source for the main form is *qryEditDisturbance* which joins *tblEvents* to

tblDisturbanceSource. The subform *frmEditDisturbanceSub* is bound to *tblDisturbanceBehav* which houses subsite specific disturbance data (Table SOP 3.4).

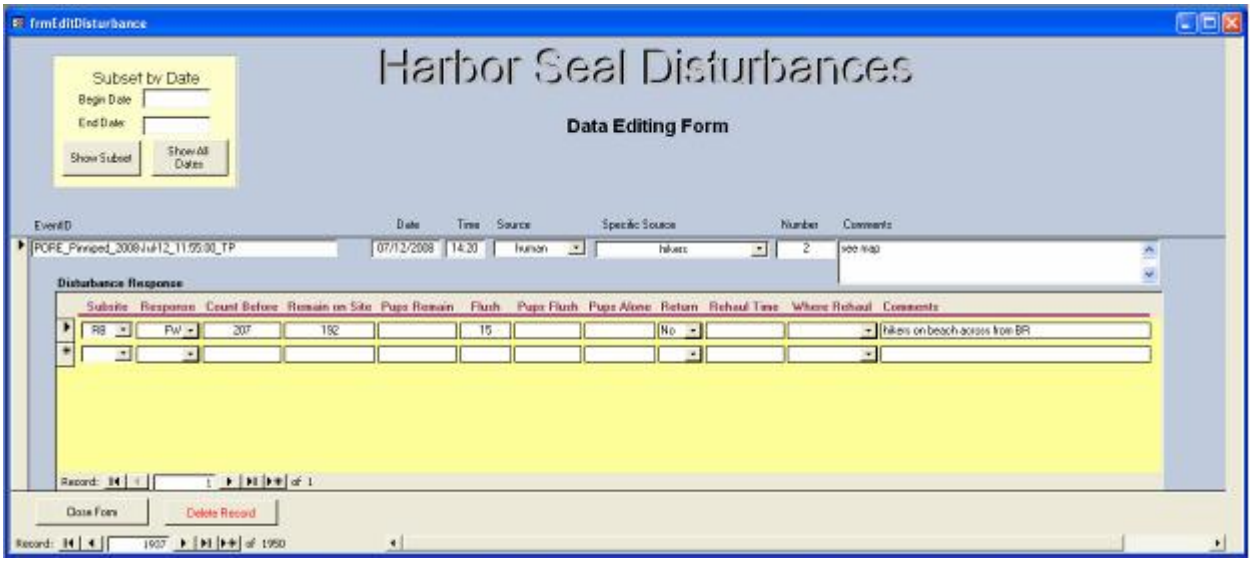


Figure SOP 3.7. Harbor seal disturbance data verification and editing form.

Table SOP 3.4. Forms, query and tables used for harbor seal disturbance data verification.

Form	Query	Permanent Table	Table Contents
frmEditDisturbance	qryEditDisturbance	tblEvents	Event fields common to all projects.
frmEditDisturbance	qryEditDisturbance	tblDisturbanceSource	General description of disturbance source.
frmEditDisturbanceSub		tblDisturbanceBehav	Subsite specific observations.

2.2 Northern Elephant Seal and All Species Pinniped Monitoring

Census data collected by the all species pinniped program conducted year-round at Point Reyes Headlands is identical to that collected for the northern elephant seal program. In this section, references to the handling of data collected by the northern elephant seal program also apply to the all species pinniped program. The database differentiates between the two programs by assigning different values to the Survey_Type field in *tblElephantEvents*. Northern elephant seals have an additional monitoring component built into the database regarding the tagging and resighting of tagged animals. Relationships of tables in the pinniped database which contain northern elephant seal data are shown in Figure SOP 3.8.

Note that harbor seal and northern elephant seal data are commingled in the primary data tables such as *tblEvents* and *tblSealCounts*. Ancillary tables such as *tblPhocaEvents* and *tblElephantEvents* contain event data specific to the harbor seal and northern elephant seal projects respectively. Data are differentiated as belonging to the harbor seal or the northern elephant seal program by values stored in the SubProject field of *tblEvents*.

2.2.1 Northern Elephant Seal Census Data Entry

Many of the same locations are surveyed during the northern elephant seal (late November through March) and the all species pinniped program (year-round). While northern elephant seals are the target species of this program, the database will accommodate incidental counts of other pinnipeds, including harbor seals.

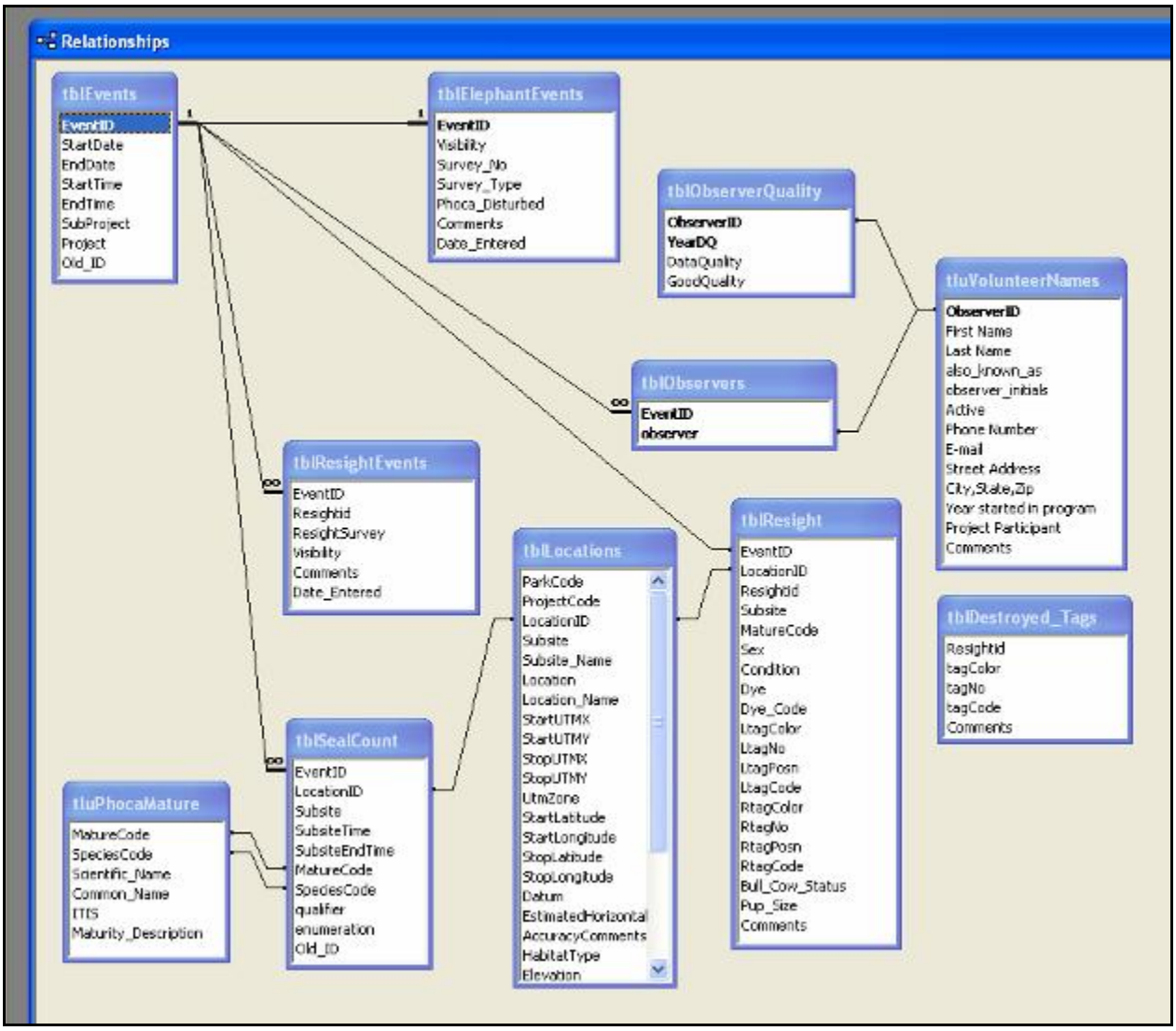
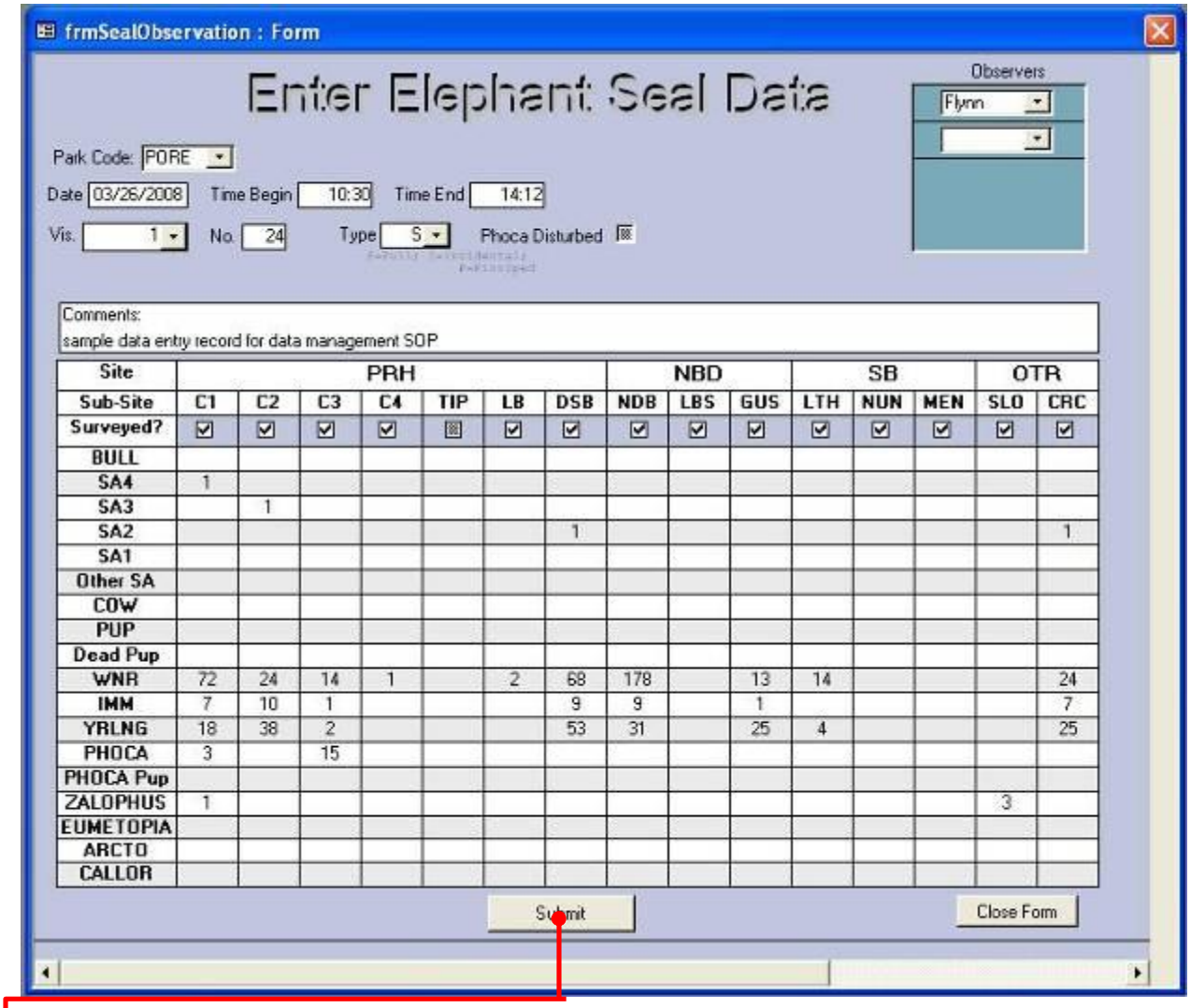


Figure SOP 3.8. Relationships of tables which house northern elephant seal data.

frmSealObservation (Figure SOP 3.9)



Site	PRH							NBD			SB			OTR	
Sub-Site	C1	C2	C3	C4	TIP	LB	DSB	NDB	LBS	GUS	LTH	NUN	MEN	SLO	CRC
Surveyed?	☑	☑	☑	☑	☒	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
BULL															
SA4	1														
SA3		1													
SA2							1								1
SA1															
Other SA															
COW															
PUP															
Dead Pup															
WNR	72	24	14	1		2	68	178		13	14				24
IMM	7	10	1				9	9		1					7
YRLNG	18	38	2				53	31		25	4				25
PHOCA	3		15												
PHOCA Pup															
ZALOPHUS	1													3	
EUMETOPIA															
ARCTO															
CALLOR															

tblSealCount

	LocationID	MatureCode	SpeciesCode	qualifier	enumeration
	PORE_E_Seal_C1	IMM	MIAN		7
	PORE_E_Seal_C1	PHOCA	PHRI		3
	PORE_E_Seal_C1	SA4	MIAN		1
	PORE_E_Seal_C1	WNR	MIAN		72
	PORE_E_Seal_C1	YRLNG	MIAN		18
	PORE_E_Seal_C1	ZAL	ZACA		1
	PORE_E_Seal_C2	IMM	MIAN		10

Figure SOP 3.9. Northern elephant seal data entry form and example of pinniped count data storage.

Data from the field data sheets is entered into the database using this form. The form is opened by selecting the 'Add Elephant Seal or Pinniped Data' button on *frmEnterDataMenu*. which can be accessed from the main menu (*frmMainMenu*) as described above. The form accommodates the entry of a number of northern elephant seal maturity categories as well as other pinniped species including harbor seal adults and pups. Harbor seal disturbances can also be recorded by selecting the 'Phoca Disturbed' check box which opens the disturbance form (Figure SOP 3.6). As explained for harbor seal survey data entry, the survey data is initially written to series of temporary tables. When the 'Submit' button on *frmSealObservation* is selected, Visual Basic code is executed to permanently write data to the appropriate data tables (Table SOP3.5). When data are committed to *tblSealCount* they are transposed and normalized so they are no longer in the non-normalized data entry format. After the data are moved, the forms and temporary tables are cleared. Figure SOP 3.9 illustrates how pinniped count data is stored once the data has been submitted to the database.

Table SOP 3.5. Forms and tables used for northern elephant seal data entry.

Form	Temporary Table	Permanent Table	Table Contents
frmSealObservation	None	tblEvents	Event fields common to all projects.
frmSealObservation	None	tblElephantEvents	Event fields specific to elephant seal surveys.
frmSealObservation	None	tblSealCount	Location specific counts of pinniped species and maturities.
frmObserversSUB	tblObservers_TEMP	tblObservers	Survey observers

When data entry is complete the data technician should initial and date the field data sheet in the upper right hand corner.

Important notes for the northern elephant seal survey data form include:

- You must check the box below each subsite for each subsite surveyed.
- It is not necessary to enter zero for species and/or age categories not observed at the subsites.
- When a full northern elephant seal survey must be completed during two field days, the data should be entered as one record, using the first day as the survey date and a note in the comments about when the survey was completed and why.
- Only select a survey type of "S" (full survey) when all northern elephant seal subsites have been surveyed, with the exception of the TIP.

2.2.2 Northern Elephant Seal Census Data Verification and Editing

Data verification is performed as an independent step after the data have been entered into the database. Data should be verified and corrected by two individuals, one who reads the field data sheet and a second who verifies each record which is displayed in the northern elephant seal data editing form and subforms. Errors in the field data sheets should be corrected using a red pen. The correction should be signed and dated by the individual who made the change. Once the data in the database have been verified as correct, the field data sheet should be initialed and dated in the upper right hand corner by the data technician.

Northern Elephant Seal Census Report

Since northern elephant seal counts are stored in *tblSealCount*,which is a normally formatted data table, display of northern elephant seal census data does not resemble the field data sheets and is difficult to check. To aid data checking, a report can be generated which presents the data in a format similar to the original field data sheet. This report can be printed or viewed on the computer screen and used to verify the data displayed by the data editing form (*frmEditE_Seal*) against the field data sheets. The northern elephant seal census data report is accessed from the Analyze Seal Data form (Figure SOP 3.10) which can be opened by selecting the "Analyze Data" button in the main menu (Figure SOP 3.2). The report can not be used to edit data, but can instead be used to identify errors to fix using *frmEditE_Seal*. Reports are further described in Section 2.4 Data Reporting Tools.

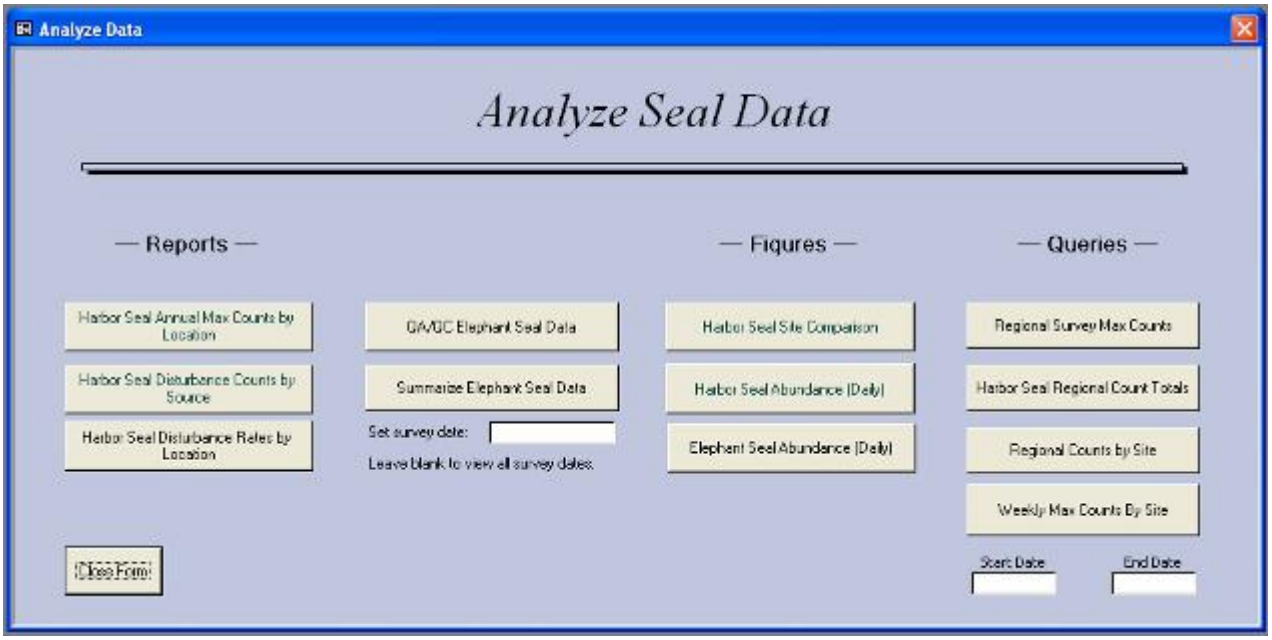


Figure SOP 3.10. Analyze Seal Data Menu.

frmEditE_Seal (Figure SOP 3.11)

Changes to the northern elephant seal data can be made using this form. Access to the data editing form is through form *frmEnterDataMenu* (Figure SOP 3.3) and button "Edit Elephant Seal or Pinniped Data". Errors identified during the data verification step can be corrected by entering changes in this form. The main form and two subforms are related to the four tables containing northern elephant seal data as shown in Table SOP 3.6.

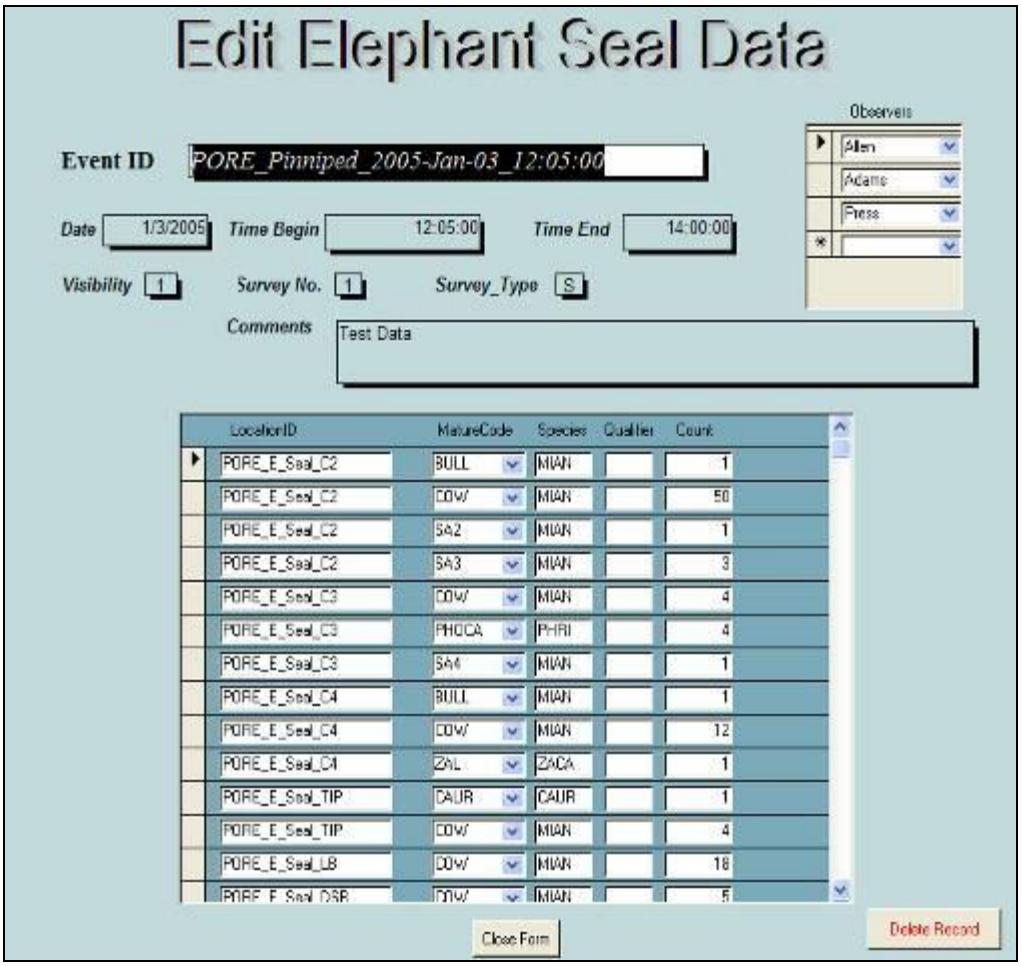


Figure SOP 3.11. Northern elephant seal data verification and editing form.

Table SOP 3.6. Forms and tables used for northern elephant seal data verification.

Form	Query	Permanent Table	Table Contents
frmEditESeal	qryEditESeal	tblEvents	Event fields common to all projects.
frmEditESeal	qryEditESeal	tblElephantEvents	Event fields specific to elephant seal surveys.
frmObserversSUB	None	tblObservers	Observers performing survey
frmSealCountSUB	None	tblSealCount	Location specific counts of pinniped species and maturities

2.2.3 Northern Elephant Seal Resight Data Entry

In addition to population censuses, biologists tag weaned pups by placing Dalton cattle ear tags in their hind flippers. Subsequent resighting of tagged northern elephant seals is performed by biologists on resight surveys using binoculars and spotting scopes. A log of tag numbers attached to northern elephant seals as well as a resight record is maintained on a daily field data sheet (see SOP 2: Northern Elephant Seal Surveys). Observations of dye-marked northern elephant seals

are also recorded on the resight field data sheet. A log of damaged tags is maintained separately (see Section 2.3). Resight surveys are independent of northern elephant seal census surveys and are therefore assigned unique EventIDs. The database differentiates between census and resight surveys by assigning different values to the SubProject field of *tblEvents*. Censuses are assigned a value of 'E_Seal' and resight surveys are assigned a value of 'Seal_Resight'. If resight surveys happen to coincide with census surveys different starting times must be assigned by the field team to avoid creating duplicate EventIDs.

frmResight (Figure SOP 3.12)

Data from the resight data sheets are entered into the database using *frmResight*. The form is opened by selecting the 'Add Tag Resight Data' button on *frmEnterDataMenu* which can be accessed from the main menu (*frmMainMenu*) as described above. The form lists tag color, number and position as well as northern elephant seal location and maturity. When the 'Submit' button is selected, Visual Basic code is executed which writes data to the appropriate data tables (Table SOP 3.7). Upon the completion of data entry, the data technician should initial and date the field data sheet in the upper right hand corner.

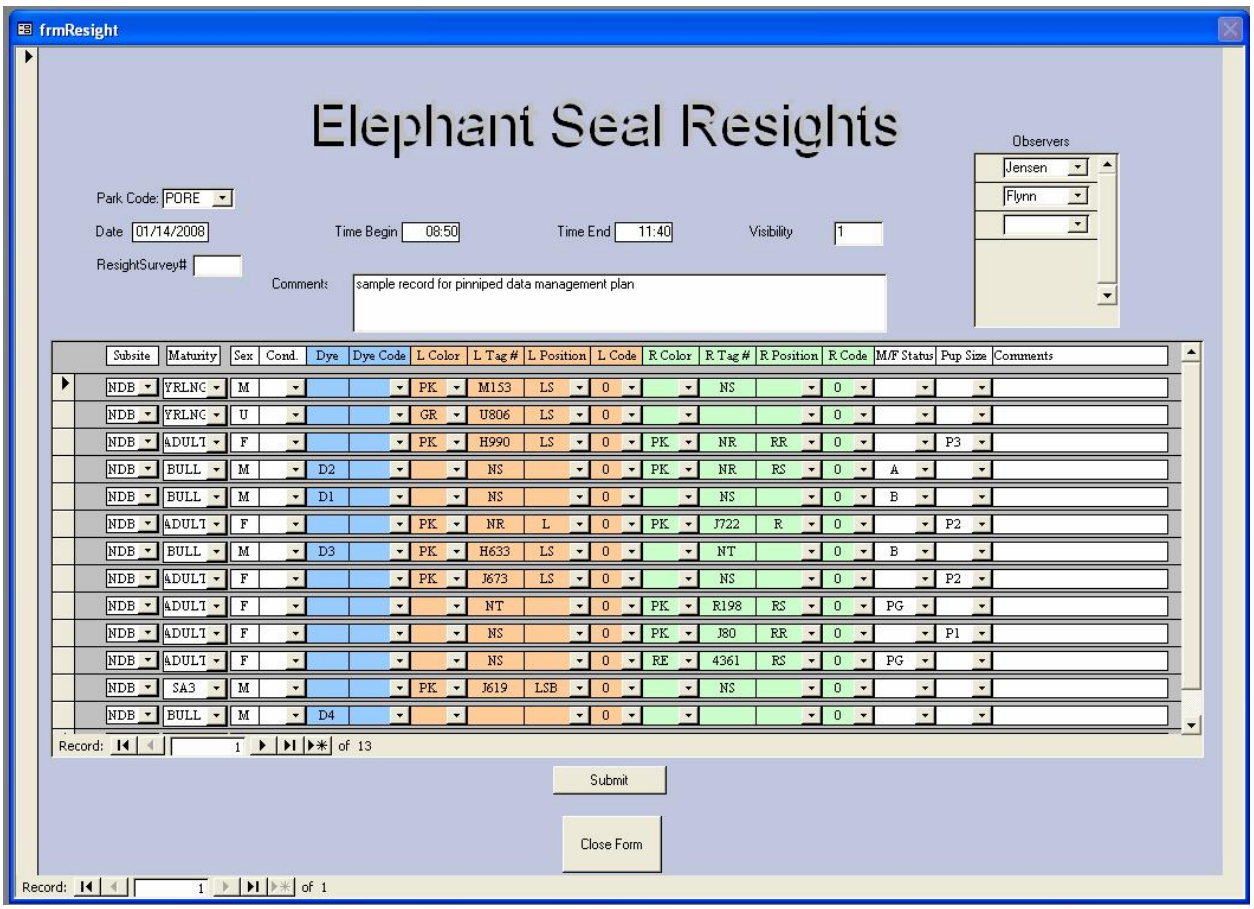


Figure SOP 3.12. Northern elephant seal resight data entry form.

Table SOP 3.7. Forms and tables used for northern elephant seal resight data entry.

Form	Temporary Table	Permanent Table	Table Contents
frmResight	None	tblEvents	Event fields common to all projects.
frmResight	None	tblResightEvents	Event fields specific to elephant seal resights
frmResightSUB	None	tblResight	Log of elephant seals tagged or observed
frmObserversSUB	tblObservers_TEMP	tblObservers	Observers performing survey

2.2.4 Northern Elephant Seal Resight Data Verification and Editing

Data verification takes place as an independent step performed after the data have been entered into the database. The resight editing form was designed to closely resemble the data entry form to facilitate the data verification process. Data should be verified and corrected by two individuals, one who reads the field data sheet and a second who verifies each record which is displayed in the northern elephant seal resight editing form and subform. Errors in the field data sheets should be corrected using a red pen. The correction should be signed and dated by the individual who made the change. Once the data in the database have been verified as correct, the field data sheet should be initialed and dated in the upper right hand corner by the data technician.

frmEditResight (Figure SOP 3.13)

Access to the data editing form is through *frmEnterDataMenu* (Figure SOP 3.3) and button "Edit Tag Resight Data". Specific individual field values can be changed or entire records can be removed from the database using the "Delete Record" button. The resight editing form and the associated subform are bound to four tables which contain date, time, and location of the tagged or resighted seal as well as information about the life history stage of the seal and the location and number of tags (Table SOP 3.8).

2.3 Lookup Tables

Lookup tables are included in the pinniped database for the purpose of tracking and controlling information about sampling locations and field observers. The pinniped data entry forms will not allow input of locations or observers which are not listed in *tblLocations* or *tluVolunteerNames*. Additions of new locations and observers can be made through forms accessible from form *frmEditLookupTables* (Figure SOP 3.14) which can be opened by selecting 'Edit Lookup Tables' on the 'Main Menu' (Figure SOP 3.2). A table for tracking the fate of damaged northern elephant seal tags which were never deployed can also be accessed through this form.

Figure SOP 3.13. Northern elephant seal resight data verification and editing form.

Table SOP 3.8. Forms and tables used for northern elephant seal resight data verification.

Form	Query	Permanent Table	Table Contents
frmEditResight	qryEditResight	tblEvents	Event fields common to all projects.
frmEditResight	qryEditResight	tblResightEvents	Event fields specific to elephant seal resights
frmResightObserversSUB2	None	tblObservers	Observers performing survey
frmEditResightSUB2	None	tblResight	Log of elephant seals tagged or observed

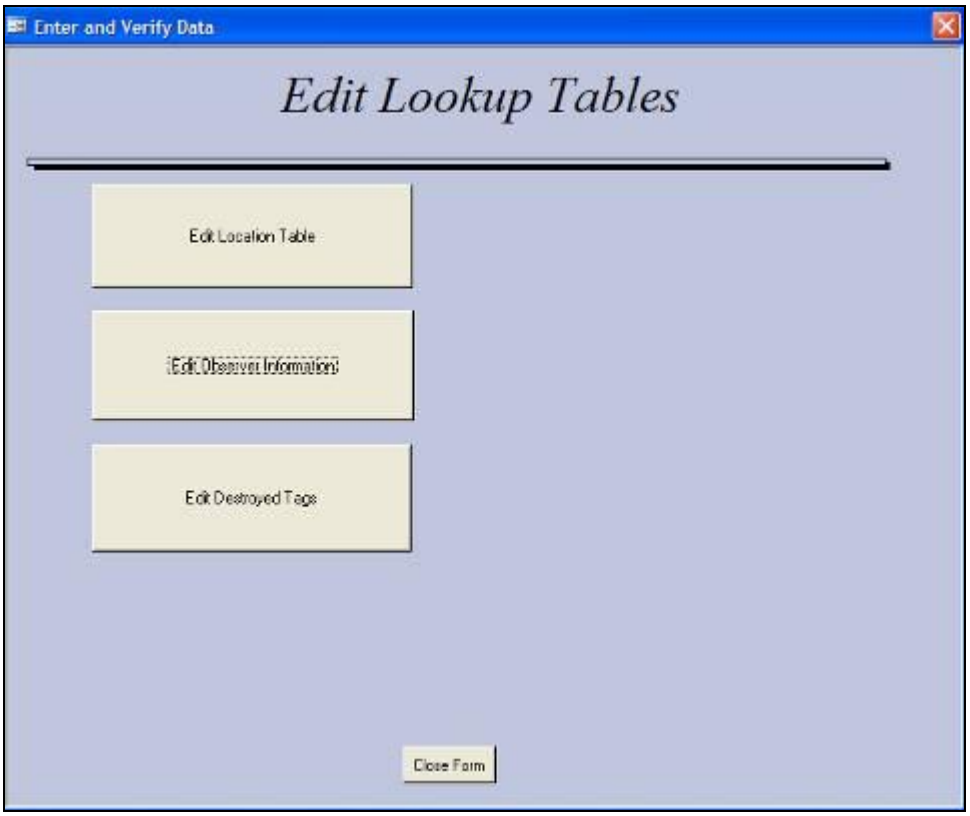


Figure SOP 3.14. Switchboard menu for accessing lookup tables.

frmEditLocations (Figure SOP 3.15)
The table which lists all sampling locations (*tblLocations*) can be viewed and edited using form *frmEditLocations*. Each of the harbor seal and northern elephant seal subsite locations are represented as separate records in tblLocations. Each of the sampling sites (ie. Drakes Estero, Double Point, etc) are also represented in tblLocations, with default subsite names such as "DE_All" (Drakes Estero – All Subsites). UTM coordinates represent the center point of each location.

frmVolunteerNames (Figure SOP 3.16)
The table which contains the list of all pinniped observers is *tluVolunteerNames*. The control source for *frmVolunteerNames* is *qryVolunteerNamesDisplayForm* which sorts the table by the 'LastName' field. Each year seal observers are assigned a 'GoodQuality' rating of "Yes" or "No" by the program staff. Ratings are based on experience and familiarity with the pinniped program and allow us to filter out surveys from inexperienced staff or volunteers prior to analysis. Ratings are displayed in the subform *frmObserverQualitySub* which is linked to table *tblObserverQuality*.

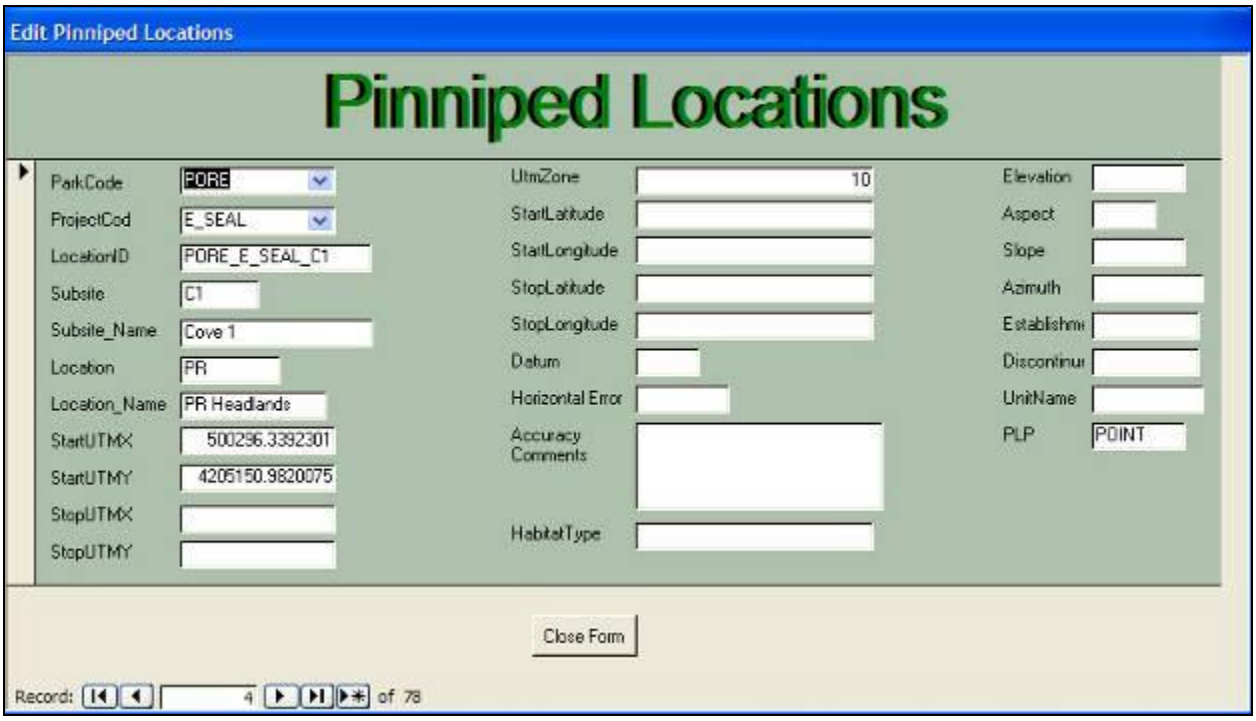


Figure SOP 3.15. Viewing and editing form for the location table.

Figure SOP 3.16. Viewing and editing form for the listing of project observers.

frmDestroyedTags (Figure SOP 3.17)

The table containing records of destroyed northern elephant seal tags is *tblDestroyed_Tags.* The code numbers of destroyed tags are kept for reporting purposes to the National Marine Fisheries Service. Tags may be destroyed in the office or in the field when the tag code drilling or application process fails (see SOP 2: Northern Elephant Seal Surveys). Tags destroyed in the field are recorded on the field resight form with a tag code of '9'. Upon data entry, the appropriate 'Resightid' value from the resight form may be given to tags which are destroyed in the field. To minimize confusion between tag numbers which were actually deployed and those which were not, destroyed tag numbers are kept in a separate table. This table is not directly related to any other table in the database.

Resightid	Tag Color	Tag Number	Tag Code	Comments
no resight 2	PK	9427	9	
R021399-50	PK	H119	9	
R021199-48	PK	H123	9	
R021099-47	PK	H141	9	X
R021199-48	PK	H143	9	
R021399-50	PK	H151	9	
R021999-53	PK	H155	9	
R021999-53	PK	H159	9	
R021999-53	PK	H160	9	
R021999-53	PK	H161	9	
R021999-53	PK	H178	9	
R021899-76	PK	H178	9	
R022699-59	PK	H182	9	
R021299-49	PK	H204	9	
R022399-56	PK	H207	9	
R122898-18	PK	H23	9	
R021299-49	PK	H235	9	
R021299-49	PK	H236	9	
R021299-49	PK	H237	9	
R022599-58	PK	H244	9	

Figure SOP 3.17. Viewing and editing form for the listing of destroyed tags.

2.4 Data Reporting Tools

The pinniped database employs the reporting features of MS Access to produce summary figures and tabular queries and reports. All summary figures, reports, and queries can be viewed by selecting the appropriate button on the "Analyze Seal Data" menu (Figure SOP 3.10) which can be opened by selecting the "Analyze Data" button in the main menu (Figure SOP 3.2). All figures and tables can be printed using the File>Print pull-down menu located on the MS Access menu bar. All figures, reports, and queries were designed so that no changes to the reporting software are required to display new data when it is added to the database.

2.4.1 Summary Reports

The pinniped database provides different tabular reports which can be accessed through the "Analyze Seal Data" menu (Figure SOP 3.10). The reports summarize harbor seal census and disturbance data. A listing of survey specific northern elephant seal census data is also available.

Report of harbor seal annual maximum daily count by location (Figure SOP 3.18).
Report *rpt_H_Seal_Max_Counts* is based on *qry_Seal_Count_FindMax3* which identifies the maximum harbor seal abundance by year and sampling location from *qry_Seal_Count2*, which joins red fur and shark bitten seal counts in *tblPhocaSealCount* with harbor seal adult and pup counts from *qrySealCount_Crosstab1*. Query *qrySealCount_Crosstab1* selects harbor seals from *tblSealCount* and transposes the row major count data to column major format. Poor quality counts are excluded from the report. The report lists results for all locations and years for which there are data in the database. Maximum values for each column in the report may have occurred on separate surveys within a given year. Queries and tables employed for report generation are shown in Table SOP 3.9.

Report of harbor seal disturbances by year, location and disturbance type (Figure SOP 3.19).
Report *rpt_H_Seal_Disturbance_Ann_Smry* lists tallies of harbor seal disturbances by type, location and year. The primary control source for the report is *qryNewDisturbance3*, the last of a multi-step query process. The queries sum the number of disturbances and transpose the disturbance sources in *tblDisturbancesSource* to column major format. Only disturbances sources from the breeding or molting season that result in a Head Alert, Flush, or Flush Water event are included in the report. Queries and tables employed for report generation are shown in Table SOP 3.10.

Report of harbor seal disturbance rate by year, location and day (Figure SOP 3.20).
Report *rpt_H_Seal_Disturbance_Rate* lists the number of harbor seal disturbances per hour. Disturbance rate data are tabulated by location and year. Only disturbances sources from the breeding or molting season that result in a Head Alert, Flush, or Flush Water event are included in the disturbance rate calculations. The primary control source for the report is *qryDisturbanceRate40*, the final of a series of four queries that calculate the total survey time by year and location and tally associated disturbance events observed during the surveys. Queries and tables employed for report generation are shown in Table SOP 3.11.

Pt. Reyes Harbor Seals

Maximum Number Observed at Each Location

Year	Location	Weekday Surveys	Weekend Surveys	Breed	Molt	Pup	Dead Pup	Red Fur	Shark Bite
2000	Bolinas Lagoon	5	8	165	428	108	2	9	1
	Double Point	20	18	664	853	412	5	9	4
	Drakes Estero	17	15	755	980	376	1	11	2
	Duxbury Reef	3	6	92	10	20		2	0
	PR Headlands	18	5	118	276	45	1	2	0
	Tomales Bay	9	6	470	380	188	1	17	0
	Tomales Point	9	9	269	311	189		5	3
Year Totals		81	67	2533	3238	1338	10	55	10
2001	Bolinas Lagoon	16	7	224	401	123	1	9	10
	Double Point	20	16	563	1145	350	5	10	10
	Drakes Estero	15	14	687	1305	327	1	16	2
	Duxbury Reef	10	6	71	99	5		2	0
	PR Headlands	11	2	65	231	51		2	0
	Tomales Bay	7	5	516		179	1	17	0
	Tomales Point	8	6	388	221	194	1	1	2
Year Totals		87	56	2514	3402	1229	9	57	24

Figure SOP 3.18. Report of harbor seal annual maximum daily count by location.

Table SOP 3.9. Queries and tables used for harbor seal annual summary report.

Query	Table	Table Contents or Query Function
	tblEvents	EventID is used to count number of surveys
	tblPhocaSealCount	Counts of red and shark bitten harbor seals
	tluPhocaLocation	Lookup containing location names
	tblSealCount	Adult and pup harbor seal counts by location
qry_Seal_Count2		Filters for breeding and molting season harbor seal counts
qry_Seal_Count_FindMax3		Identifies maximum counts by location for breeding and molting seasons.
qrySealCount_Crosstab1		Transposes harbor seal adult and pup data.

Pt. Reyes Harbor Seals

Number of Disturbances by Year and Source

Year	Location	Motor Boat	Non-Motor Boat	Vehicle	Dog	Aircraft	Human	Bird	Unknown	Other	Total
2000	Bolinas Lagoon	0	5	0	0	0	0	2	3	0	10
	Double Point	0	0	0	0	3	3	6	17	3	32
	Drakes Estero	0	3	0	0	8	11	12	19	1	54
	Tomales Bay	9	1	0	0	1	2	0	0	0	13
	Tomales Point	2	0	0	0	2	2	0	1	0	7
	Year Totals	11	9	0	0	14	18	20	40	4	116
	Per Cent of Total	9.5	7.8	0.0	0.0	12.1	15.5	17.2	34.5	3.4	
2001	Bolinas Lagoon	0	10	0	0	1	6	4	12	1	34
	Double Point	0	0	0	0	1	2	1	4	11	19
	Drakes Estero	0	4	1	0	1	12	4	8	0	30
	Duxbury Reef	0	0	0	0	0	2	0	0	0	2
	Tomales Bay	11	3	0	0	0	3	0	0	0	17
	Tomales Point	0	0	0	0	1	4	0	1	0	6
	Year Totals	11	17	1	0	4	29	9	25	12	108
	Per Cent of Total	10.2	15.7	0.9	0.0	3.7	26.9	8.3	23.1	11.1	

Figure SOP 3.19. Report of harbor seal disturbance count by year, location and disturbance type.

Table SOP 3.10. Queries and tables used for harbor seal annual disturbance count report.

Query	**Secondary Query or Lookup Table**	**Table**	**Table Contents or Query Function**
qryNewDisturbance3	qryNewDisturbance2		
	tluPhocaLocation		Translates location code to full name.
qryNewDisturbance2	qryNewDisturbance1		Transposes disturbance source data by year, location, and source type
qryNewDisturbance1	qryNewDisturbance0		Groups records of disturbances that affected multiple sub-sites into single source records.
qryNewDisturbance0	qryNewDisturbance0	tblEvents	Event table, provides survey date
		tblDisturbanceSource	Table of disturbance events and sources
		tblDisturbanceResponse	Table of related disturbance responses

Pt. Reyes Harbor Seals

Disturbance Rate by Year, Location and Day of the Week

Year	Location	Day of Week	Number Surveys	Survey Time (Hrs.)	Number Disturb	Disturbances / Hr.
2004	Bolinas Lagoon	Mon-Fri	26	38.63	17	0.440
		Sat-Sun	12	17.58	17	0.967
	Double Point	Mon-Fri	20	30.42	7	0.230
		Sat-Sun	14	23.42	3	0.128
	Drakes Estero	Mon-Fri	33	53.83	15	0.279
		Sat-Sun	18	34.12	24	0.703
	Duxbury Reef	Mon-Fri	23	20.22	0	0.000
		Sat-Sun	10	4.67	0	0.000
	Tomales Bay	Mon-Fri	8	15.13	1	0.066
		Sat-Sun	14	15.42	1	0.065
	Tomales Point	Mon-Fri	9	22.25	0	0.000
		Sat-Sun	13	30.83	2	0.065
	Year Totals		200	306.52	87	0.284

Figure SOP 3.20. Report of harbor seal disturbance rate (first page of report).

Table SOP 3.11. Queries and tables used for harbor seal disturbance rate report.

Query	Query Secondary or LookupTable	Table	Table Contents or Query Function
qryDisturbanceRate40	qryDisturbanceRate30		
	tluPhocaLocation		Translates location code to full name.
qryDisturbanceRate30	qryDisturbanceRate20		Links survey date/time data to disturbance counts
		tblEvents	Event table, provides survey date
		tblPhoceEvents	Event fields specific to harbor seal surveys – provides survey length
qryDisturbanceRate20	qryDisturbanceRate10		Groups disturbance event records
qryDisturbanceRate10		tblEvents	Event table, provides survey date
		tblDisturbanceSource	Table of disturbance events and sources
		tblDisturbanceResponse	Table of related disturbance responses

Reports of daily northern elephant seal counts

Daily northern elephant seal survey data can be viewed in two different formats, and for each format, the user can report a specific survey date or the entire set of census data. The reports are intended to aid the data verification process, as previously described, and to summarize northern elephant seal counts for reporting purposes (see SOP 4. Data Analysis and Reporting). The

primary control source for each report is a query which joins *tblEvents* with *tblElephantEvents* providing descriptive information about survey date and time with detailed northern elephant seal counts from *qry_E_Seal_Crosstab2*. *Qry_E_Seal_Crosstab2* transposes the seal count data from row major to column major format so that the appearance of the data display resembles the field data sheet. The macro *mcrE_Seal_rawdata_report* runs the command buttons associated with these reports. Report titles, descriptions, and their respective underlying query titles are listed in Table SOP 3.12.

Table SOP 3.12. Reports and queries used for daily northern elephant seal census reports.

Query	Report	Report Description
qryE_Seal_Raw_Report_ALL	rptDisplayE_Seal_Rawdata_ALL	All survey dates, listed in descending order, and all pinniped species counted. Includes row totals.
qryE_Seal_Raw_Report_ALL_MIAN	rptDisplayE_Seal_Rawdata_ALL_MIAN	All survey dates, listed in descending order, and only elephant seal counts. Includes row totals.
qryE_Seal_Raw_Report_Date	rptDisplayE_Seal_Rawdata_Date	Survey date specified on frmAnalyzeData and all pinniped species counted. Includes row and column totals.
qryE_Seal_Raw_Report_Date_MIAN	rptDisplayE_Seal_Rawdata_Date_MIAN	Survey date specified on frmAnalyzeData and all only elephant seal counts. Includes row and column totals.

From the Analyze Seal Data form (Figure SOP 3.10), selecting the “QA/QC Elephant Seal Data” command button opens *rptDisplayE_Seal_Rawdata_ALL* (Figure SOP 3.21), which should be used for error-checking northern elephant seal census data. Selecting the “Summarize Elephant Seal Data” command button opens *rptDisplayE_Seal_Rawdata_ALL_MIAN* (Figure SOP 3.22), which only displays northern elephant seal counts and is best used for producing quick summary counts for reporting purposes (see SOP 4. Data Analysis and Reporting). Both reports display all surveys in the database unless a date is first entered before selecting the command buttons.

POINT REYES NATIONAL SEASHORE ELEPHANT SEAL SURVEY

DATA REPORT

Event ID PORS_Pinniped_2008-Feb-15_10:40:00 AM

Date 02/15/2008 **Time Begin** 10:40:00 **Time End** 15:40:00

Visibility 1 **Survey No.** 16 **Survey_Type** S

Comments D. Munton also surveyed; C2: female with P2 with old shark bite on belly; 1 steller's sea lion at SLO

Observers

Jensen Heather

Maturity	C1	C2	C3	C4	TIP	LB	DSB	NDB	LBS	GUS	LTH	NUN	MEN	SLO	OTR	CRC	TOTAL
BULL	5	7	1		1		1	22		1	5						43
SA4	2	3		1				10		1	1					3	21
SA3	5	4			2		2				5					1	19
SA2	2															1	3
SA1								1									1
Other SA	4						2	25	2		12	3				2	50
COW	30	77	6				12	104		10	12					31	282
PUP	29	67	6				10	98		5	12					30	257
Dead Pup		6						4									10
WNR	28	42	7				30	110		18	12					13	260
YRLNG	2							1									3
PHOCA	8	1	2														11
ZALOPHUS														67			67
EUMETOPIA														1			1

Figure SOP 3.21. Daily northern elephant seal census report, all species.

POINT REYES NATIONAL SEASHORE ELEPHANT SEAL SURVEY

DATA REPORT

Event ID: PORR_Pinniped_2008-Feb-15_10:40:00 AM

Observers: Jensen, Heather

Date: 02/15/2008 Time Begin: 10:40:00 Time End: 15:40:00

Visibility: 1 Survey No.: 16 Survey_Type: S

Comments: D. Munton also surveyed. C2: female with P2 with old shark bite on belly; 1 steller's sea lion at SLO

Maturity	C1	C2	C3	C4	TIP	LB	DSB	NDB	LBS	GUS	LTH	NUN	MEN	SLO	OTR	CRC	TOTAL
BULL	5	7	1		1		1	22		1	5						43
SA4	2	3		1				10		1	1					3	21
SA3	5	4			2		2				5					1	19
SA2	2															1	3
SA1								1									1
Other SA	4						2	25	2		12	3				2	50
COW	30	77	8				12	104		10	12					31	282
PUP	29	67	6				10	98		5	12					30	257
Dead Pup		6						4									10
WNR	28	42	7				30	110		18	12					13	260
YRLNG	2							1									3
Elephant Seal TOTAL	107	206	20	1	3		57	375	2	35	59	3				81	949

Figure SOP 3.22. Daily northern elephant seal census report, northern elephant seals only.

2.4.2 Summary Graphs

The pinniped database provides three different graphs which can be accessed via the Analyze Seal Data form (Figure SOP 3.10). The graphs summarize harbor seal or northern elephant seal adult and pup abundances using bar histograms. The time period displayed in each of the graphs is specified by the user through a start-up form which is opened when the appropriate button is selected on the Analyze Seal Data form. The date range specified by the user is displayed in the title of the graph.

Graph of harbor seal abundance by location. (Figure SOP 3.23)

Form *frmH_Seal_Location_Chart* displays the maximum harbor seal counts by location for a specified time period. The maximum number of adult harbor seals and harbor seal pups per location may have been observed on separate surveys. The control source for the figure is query *qryH_Seal_Chart2* which employs the MAX function to identify the maximum seal count. The control source joins the initial query *qryH_Seal_Chart1* to the lookup table *tluPhocaLocation*. *QryH_Seal_Chart1* extracts harbor seal counts from *tblSealCount* based on the date range specified by the user in *frmStartChart*. Poor quality surveys are not included in the graph. Queries and tables used by the figure are shown in Table SOP 3.13.

Figure SOP 3.23. Harbor seal maximum abundance by location.

Table SOP 3.13. Queries and tables used for harbor seal abundance by location histogram.

Query	Query Secondary	Table	Table Contents or Query Function
qryH_Seal_Chart2	qryH_Seal_Chart1	tblEvents	Event table provides survey dates and times.
	qryH_Seal_Chart1	tblSealCount	Adult and pup harbor seal counts by location
		tluPhocaLocation	Lookup table which translates location codes

Graph of harbor seal daily abundance for a single location. (Figure SOP 3.24)
Form *frmH_Seal_Daily_Chart3* displays the number of harbor seals counted at a given location by survey date for a specified time period. The control source for the graph is query *qryH_Seal_Location_Chart2*, which joins the initial query *qryH_Seal_Location_Chart1* to the lookup table *tluPhocaLocation*. Query *qryH_Seal_Location_Chart1* extracts harbor seal counts

at a specified location from *tblSealCount* based on the date range and location specified by the user in *frmStartChart_Seal_Daily*. Poor quality surveys are not included in the graph. Queries and tables used by the graph are shown in Table SOP 3.14.

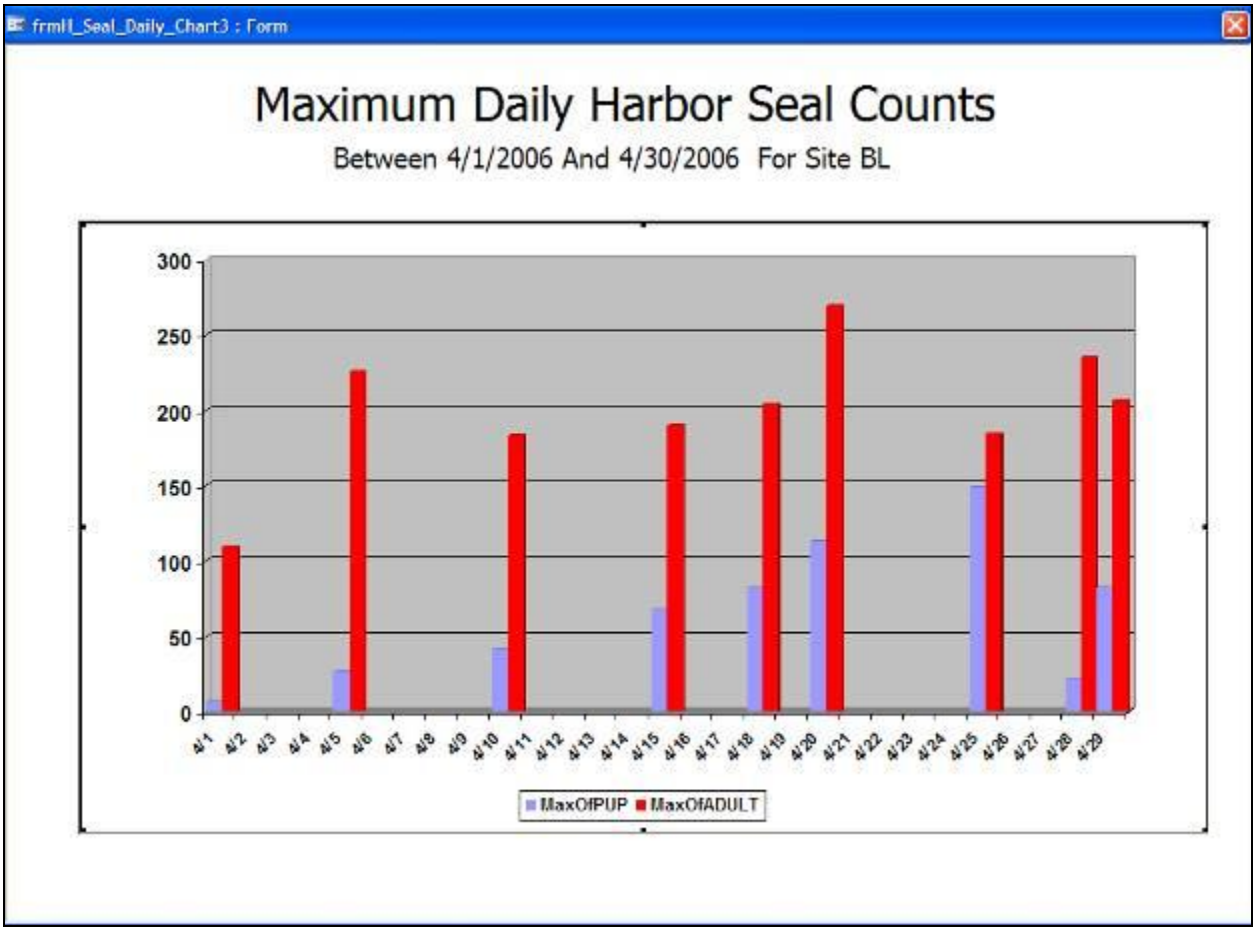


Figure SOP 3.24. Harbor seal daily abundance for a single location.

Table SOP 3.14. Queries and tables used for harbor seal daily abundance histogram.

Query	Query Secondary	Table	Table Contents or Query Function
Query1	qryH_Seal_Location_Chart2	tblEvents	Event table provides survey dates.
	qryH_Seal_Location_Chart2	tblSealCount	Adult and pup harbor seal counts by location
		tluPhocaLocation	Lookup table which translates location codes

Graph of northern elephant seal daily abundance. (Figure SOP 3.25)

Form *frmE_Seal_Daily* displays the number of northern elephant seals counted at all Point Reyes Headlands subsites by survey date for a specified time period. Only surveys of type “S” (full survey) are included so that partial counts are not included in the graph. The control source for the graph is *qry_E_Seal_Daily_Chart* which sums counts for surveys extracted by the initial

query *qry_E_Seal_Weekly_Chart.* Dates to be analyzed are specified by the user on *frmStartChart_E_Seal_Daily*. Queries and tables used by the graph are shown in Table SOP 3.15.

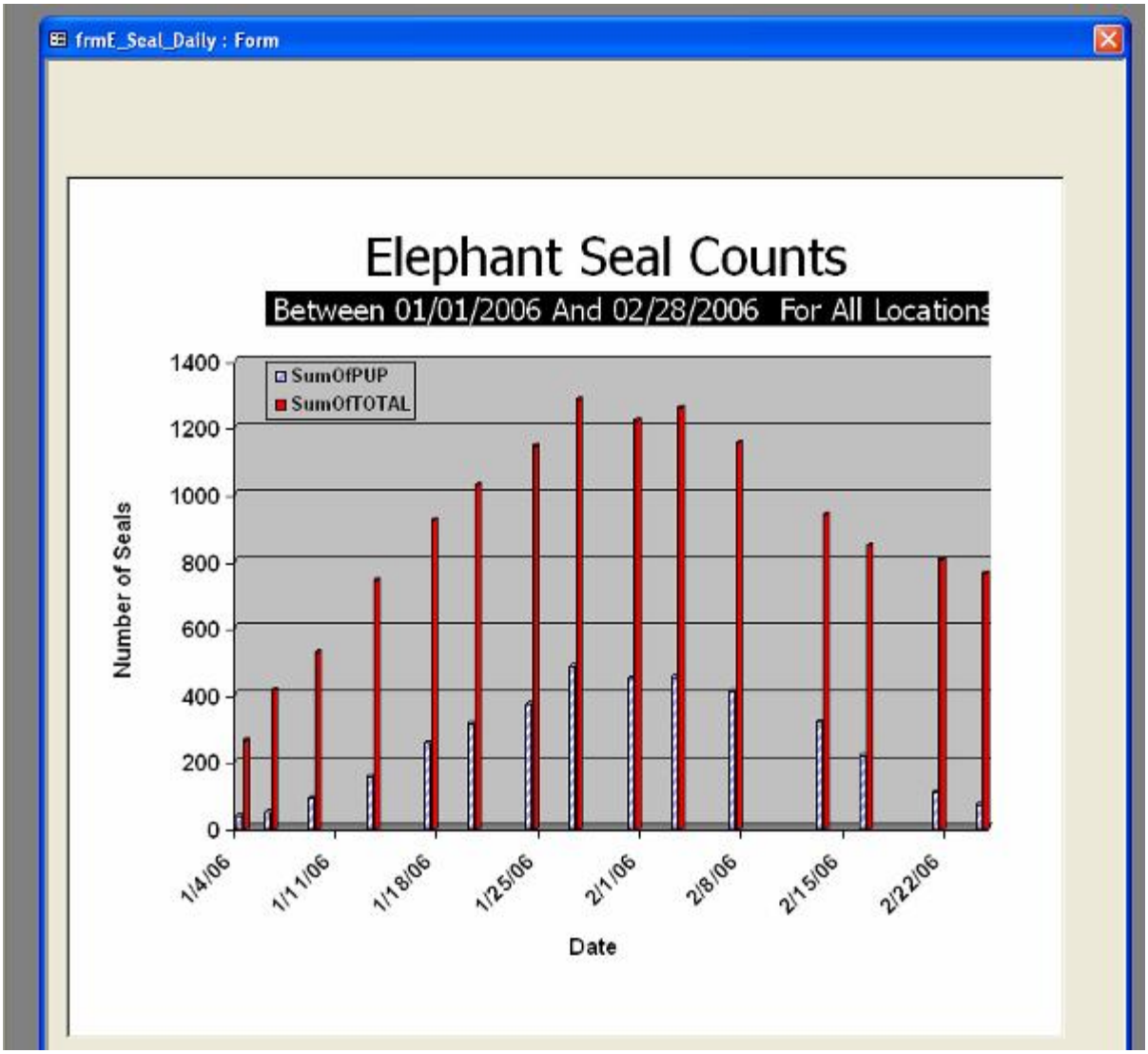


Figure SOP 3.25. Northern elephant seal daily abundance for all subsites combined.

Table SOP 3.15. Queries and tables used for northern elephant seal daily abundance histogram.

Query	Query Secondary	Table	Table Contents or Query Function
Qry_E_Seal_Daily_Chart	Qry_E_Seal_Weekly_Chart	tblEvents	Event table provides survey dates.
	Qry_E_Seal_Weekly_Chart	tblSealCount	Elephant seal counts by maturity

2.4.3 Summary Queries

Four queries are available from the Analyze Seal Data form (Figure SOP 3.10) that summarize harbor seal monitoring data. The queries are predominantly designed to assist with the development of regular monitoring updates that are distributed to park staff and project volunteers (see SOP 4: Data Analysis and Reporting). Each query only displays high quality rated surveys.

A notable difference between these queries and the annual maximum daily count by location report (Figure SOP 3.18) is that, in the report, the maximum pup value may occur on a different day than the maximum adult/immature count. In these queries, however, pup values are reported as a component of a total harbor seal maximum count, and therefore always occur on the same day as the reported adult/immature count.

Regional survey maximum counts

The query titled *qryH_Seal_Update_ViewRegionalSurveys* is opened from the "Regional Survey Max Counts" command button. The query displays the maximum count of all harbor seals, including pups, for each survey in the data that occurred during a regional count five-day window. At times, a site may be surveyed more than once during a regional count window. For reporting purposes, the survey with the higher maximum count will be displayed. This query helps to identify which regional survey should be used and therefore assigned a value in the "Regional_Count_Code" field.

Regional count totals

The query titled *qryH_Seal_Update_RegionalCountTotals* is opened from the "Harbor Seal Regional Count Totals" command button. The query reports the sum of the maximum counts of harbor seals from each site surveyed during a regional count. The count data is split between adults/immatures and pups. The date value is the assigned regional count date and does not necessarily represent the date that all sites were surveyed. The query is designed to help develop the regional count graph that is produced for harbor seal monitoring updates (Figure SOP 4.4).

Regional count totals by site

The query titled *qryH_Seal_Update_RegionalCountTotals_BySite* is opened from the "Regional Counts by Site" command button. The query reports the maximum count of harbor seals for each site surveyed during a regional count. The query differs from the regional survey maximum count query described above in that the count data is split between adults/immatures and pups and only surveys used for regional count summaries are displayed. The date value is the assigned regional count date and does not necessarily represent the date that the site was surveyed. The query is useful for reporting regional count data by site for the harbor seal monitoring annual report.

Weekly maximum counts by site

The query titled *qryH_Seal_Update_WeeklyMaxBySite_Final* is opened from the "Weekly Max Counts By Site" command button. The macro *mcr_Run_Phoca_WeeklyMax_Query* runs the command button associated with this query. The query reports the maximum count of harbor seals for each site surveyed during the date ranges specified below the command button. The maximum count is split between adults/immatures and pups. The date on which the maximum count occurred at each site during the specified date range is also reported. The query is designed

to help develop the weekly maximum count graphs that are produced for harbor seal monitoring updates (Figure SOP 4.3).

2.5 Data Export Functions

A simple feature built into the pinniped monitoring database is the ability to export large datasets in Microsoft Excel format. This feature was designed for users that want to explore and analyze the data further but do not have the skills to develop their own queries in Microsoft Access. The export data form (Figure SOP 3.26) is accessible from the database main menu. The four command buttons on the form are run from the macro mcr_Export_Counts. The command buttons export data compiled in queries are by default saved to the user's "My Documents" folder. Table SOP 3.16 lists the queries, source tables, and exported products associated with the export data form.

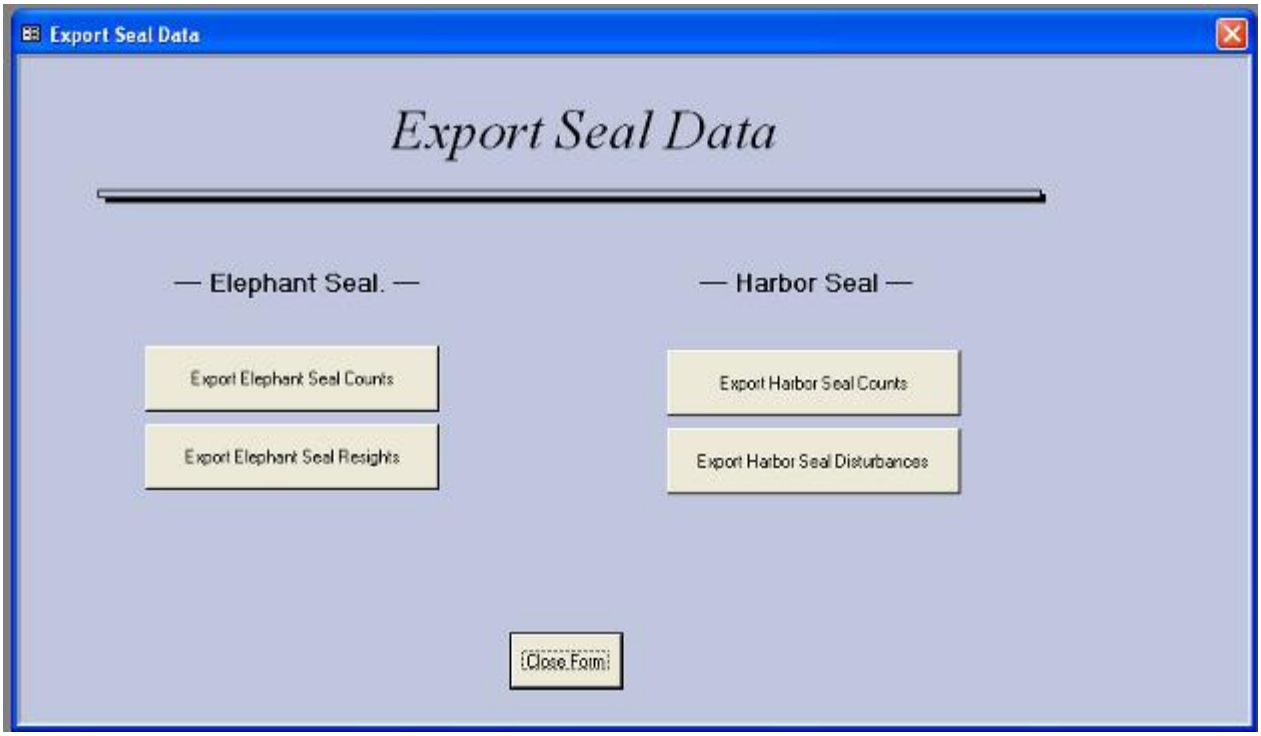


Figure SOP 3.26. Export seal data form.

Table SOP 3.16. Queries and tables used to export data sets in Microsoft Excel format from the database.

Command Button	Query	Tables	Export File
Elephant Seal Counts	qryE_Seal_Export	tblEvents tblElephantEvents tblSealCount	E_Seal_Counts.xls
Elephant Seal Resights	qryResight_Export	tblEvents tblResight	E_Seal_Resights.xls
Harbor Seal Counts	qryH_Seal_Export	tblEvents tblPhocaEvents tblSealCount	H_Seal_Counts.xls
Harbor Seal Disturbances	qryDisturbance_Export	tblEvents tblDisturbanceSource tblDisturbanceBehavior	H_Seal_Disturbance.xls

3.0 Annual Data Work Flow

The pinniped monitoring program is based at Point Reyes National Seashore, includes sites at Golden Gate National Recreation Area, utilizes a large volunteer contingent, and has traditionally employed AmeriCorps interns that serve for one-year appointments only. As such, it is critical that the program have a detailed and well-organized data work flow to ensure that annual data is thoroughly error-checked and then uploaded into the master pinniped database. The annual data work flow and integration into the master pinniped databases is illustrated in Figure SOP 3.27.

3.1 Annual Satellite Databases

Rather than enter pinniped data directly into the master pinniped database, field staff are provided with satellite databases with identical front-end and back-end database structure for annual data entry. Satellite databases should begin with data collected after Aug 1 and continue through to the following July 31. This time frame captures the entire northern elephant seal breeding season (approximately Nov-March), the harbor seal breeding season (March-May), and the harbor seal molting season (June-July). In addition, the time frame nearly matches the AmeriCorps appointments, which run from October through to August. After July 31, the AmeriCorps for that year should not enter any new field data, and should instead focus on error-checking and finalizing the satellite database. Satellite databases are distributed to PORE and GOGA, which enters data just for Point Bonita harbor seal data. Table SOP 3.17 identifies the names and locations of the annual database files.

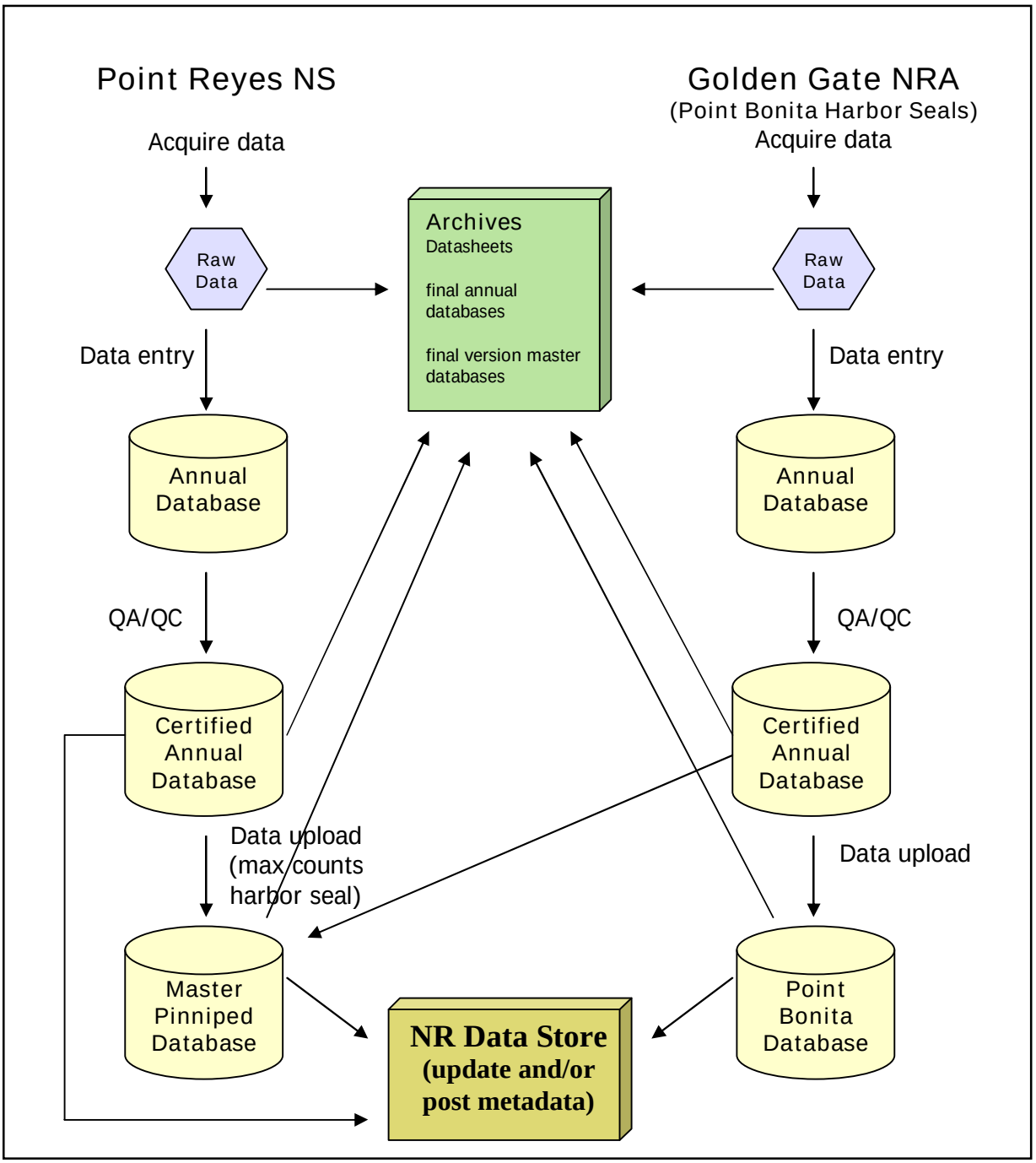


Figure SOP 3.27. Annual pinniped data work flow.

Table SOP 3.17. Annually distributed pinniped database files.

Park	File Name Example	Description	Location
PORE	Pinniped_2008.mdb	Front-end annual pinniped database	Inppore05 \ Resources \ Natural \ _Databases \ Pinniped
PORE	Pinniped_BE_2008.mdb	Back-end annual pinniped data tables	Inppore05 \ Resources \ Natural \ _Databases \ Pinniped \ BE
GOGA	GOGA_PINN_PB2008.mdb	Annual pinniped database, Point Bonita harbor seals only	Inpgogamahe1 \ Divisions \ Network I&M \ Individual Vital Signs \ Pinniped \ data

3.2 Northern Elephant Seal and All Pinniped Count QA/QC

As previously described above, field staff must cross check the northern elephant seal census, all pinniped counts, and northern elephant seal resight data in the database against the paper datasheets completed in the field. In addition, after the field staff has completed its review, the Network Data Manager should independently check a random 10% of the records for accuracy. If the Network Data Manager discovers less than 95% accuracy in the data, the data should be error-checked a second time by the field staff.

3.3 Harbor Seal QA/QC

The harbor seal monitoring program undergoes a higher level of data scrutiny because it is primarily collected by volunteers and is more subject to difficult field conditions, such as fog and high winds, that may compromise the accuracy of the data.

As previously described, each volunteer is given a “GoodQuality” ranking of “yes” or “no” for each year that they participate in the program. Generally, “no” values are applied to a volunteer’s first year with the program or at the project staff’s discretion based on the perceived quality of the data collected by the volunteer. The rankings may be applied in the form *frmVolunteerNames* (Figure SOP 3.16).

During the course of the season, and again at the end of the season, each survey should be evaluated and assigned a “HighQualityCount?” value of “yes” or “no”. A survey may be of poor quality and assigned a value of “no” for the following reasons:

- poor visibility
- not all subsites were surveyed
- poor observer quality of all survey participants
- other comments noted on the datasheet, ie.
    - “too windy to distinguish pups from rest of seals”
    - “can't see DEM seals well - far undercounted”
    - “lots of glare and haze - difficult count”
    - “too rainy”

The form *frmEditPhocaObservation* (Figure SOP 3.5) is used to assign the “HighQualityCount?” value, with the reason(s) for a rating of “no” listed in the subform *frmSubPoorQuality*.

As previously described above, field staff must cross check the harbor seal survey and disturbance data in the database against the paper datasheets completed in the field. In addition,

after the field staff has completed its review, the Network Data Manager should independently check a random 10% of the records for accuracy. If the Network Data Manager discovers less than 95% accuracy in the data, the data should be error-checked a second time by the field staff.

3.4 Annual Data Integration with Master Pinniped Database

Once data in the satellite databases have been completely error-checked against the paper datasheets, the Network Data Manager should perform a final review of each of the field data tables. As examples, the Network Data Manager should check for:

- erroneously generated records with no actual data
- orphaned records within the sub-tables (ie. no link back to *tblEvents*)
- data outliers
- logic errors (ie. start time is after the end time, more than one pup count record for the same species, subsite, and time)
- accurate generation of automated fields (ie. LocationID, MatureCode, SpeciesCode)
- correct values for fields with fixed domains (ie. Visibility = 1, 2, or 3 ; Response = HA, F, FW, Unk, or None)

Once satisfied, the Network Data Manager uploads the annual data into the master pinniped database. All data is uploaded with no alterations, with the exception of the harbor seal count data. Due to limited staff time, only summarized harbor seal data was entered into the master database for many years. Beginning in 2008, all subsite data is entered into the annual satellite database, but only the maximum count per survey is uploaded into the master database. This process of summarizing annual harbor seal data before uploading it to the master database will continue until we are able to return to the legacy datasheets and re-enter the raw data by subsite in its entirety. The master database file names and locations are listed in Table SOP 3.18.

Table SOP 3.19 describes harbor seal data elements that are queried prior to upload. Before the annual data is uploaded into the master database, a copy of the master should be made and archived with the date incorporated into the file name. The satellite databases should be archived after the data has been uploaded. PORE database archives will be stored at PORE, while GOGA files will be archived at GOGA.

3.5 Master Point Bonita Database

At the request of GOGA natural resource managers, who originally maintained the Point Bonita harbor seal data themselves, the Network staff maintains a master Point Bonita database hosted on the GOGA Marin Headlands server. Because the Point Bonita data was always entered as is with no summarization, the annual harbor seal data is transferred directly to the master Point Bonita database with no alterations after the Network Data Manager has reviewed and approved the data. The master database file name and location is listed in Table SOP 3.18.

Table SOP 3.18. Master pinniped database files.

Park	File Name Example	Description	Location
PORE	Pinniped.mdb	Front-end pinniped database	Inppore05 \ Resources \ Natural \ _Databases \ Pinniped
PORE	Pinniped_BE.mdb	Back-end pinniped data tables	Inppore05 \ Resources \ Natural \ _Databases \ Pinniped \ BE
GOGA	GOGA_PINN_Master_.mdb	Point Bonita harbor seals only	Inpgogamahe1 \ Divisions \ Network I&M \ Individual Vital Signs \ Pinniped \ data \ Master_PB

Table SOP 3.19. Data components and process for transferring annual harbor seal count data to the master pinniped database.

Data Type	Source Table	Summarization Process
Adult / Immature Harbor Seal Count	tblSealCount	Per survey, identify the subsite count time with the single maximum harbor seal count, including pups, across all subsites. From this maximum count, transfer the adult / immature component and maximum count time to the master database.
Pup Harbor Seal Count	tblSealCount	Per survey, identify the subsite count time with the single maximum harbor seal count as above. From this maximum count, transfer the pup component and maximum count time.
Dead Pup Harbor Seal Count	tblSealCount	Per survey, identify and transfer the maximum dead pup count with the subsite time set to that for harbor seals.
Other Pinniped Counts	tblSealCount	Per survey, identify and transfer the maximum counts of other pinniped species, with the subsite time set to that for harbor seals.
Red Fur Harbor Seal Counts	tblPhocaSealCount	Per survey, identify and transfer the maximum red fur count with the subsite time set to that for harbor seals.
Shark Bite Harbor Seal Counts	tblPhocaSealCount	Per survey, identify and transfer the maximum shark bite count with the subsite time set to that for harbor seals.

Version control guidelines for the MS Access pinniped monitoring databases will follow those presented in the SFAN's Data Management Plan (Press 2005). Prior to any major changes to the database design, a back-up copy of the database should be made. Once the database design changes are complete, the database should be assigned the next incremental version number. The final copy of the previous database version should be archived with the version closing date incorporated into the database title. Version numbers should increase incrementally by hundredths (e.g. version 1_01, version 1_02, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2_0, 3_0, 4_0 …). With proper controls and communication, versioning ensures that only the most current database version is used for queries and analyses. The front-end and back-end databases should be titled with the same version number, regardless of in which database file modifications are made. Significant database re-design may require approval by the project manager, review by other data management staff, and revisions to this data management SOP.

The Network Data Manager maintains a history of the pinniped database in a Microsoft Word document titled *Pinniped_Database_History* located at:

Inppore05\Resources\Natural_Databases\Pinniped\word

All front-end and back-end design modifications to the database files are tracked within this document and are referenced to changes in database version numbers. Major changes to the data themselves are also noted in this document, such as when a new set of annual data is uploaded. It is especially important to note edits to the data that will result in changes to final data summaries previously published in annual reports or other mediums. Edits to all database files are maintained in the database history document, including the GOGA Point Bonita master database and the annual satellite databases.

4.0 Version Control Guidelines and Database History

Version control guidelines for the MS Access pinniped monitoring databases will follow those presented in the SFAN's Data Management Plan (Press 2005). Prior to any major changes to the database design, a back-up copy of the database should be made. Once the database design changes are complete, the database should be assigned the next incremental version number. The final copy of the previous database version should be archived with the version closing date incorporated into the database title. Version numbers should increase incrementally by hundredths (e.g. version 1_01, version 1_02, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2_0, 3_0, 4_0 …). With proper controls and communication, versioning ensures that only the most current database version is used for queries and analyses. The front-end and back-end databases should be titled with the same version number, regardless of in which database file modifications are made. Significant database re-design may require approval by the project manager, review by other data management staff, and revisions to this data management SOP.

The Network Data Manager maintains a history of the pinniped database in a Microsoft Word document titled *Pinniped_Database_History* located at:

Inppore05\Resources\Natural_Databases\Pinniped\word

All front-end and back-end design modifications to the database files are tracked within this document and are referenced to changes in database version numbers. Major changes to the data themselves are also noted in this document, such as when a new set of annual data is uploaded. It is especially important to note edits to the data that will result in changes to final data summaries previously published in annual reports or other mediums. Edits to all database files are maintained in the database history document, including the GOGA Point Bonita master database and the annual satellite databases.

5.0 Data Archival Procedures

Before the annual data is uploaded into the master database, a copy of the master is made and archived with the date incorporated into the file name. The satellite databases are archived after the data has been uploaded. PORE database archives will be stored at PORE, while GOGA files will be archived at GOGA. In addition, when changing the database to a new version, the final copy of the previous database version is archived with the version closing date incorporated into the database title. Both GOGA and PORE servers have regular back-ups that are maintained by park IT staff.

At the end of each field season, after error-checking, proofing, and uploading the seasonal data, all of the field datasheets are organized into a binder for that year. Included in the binder are a hardcopy of the annual report once completed and a CD containing a copy of the complete master database and an electronic copy of the annual report. With the exception of the Point Bonita datasheets, which are stored at GOGA in the Marin Headlands I&M office, all data binders are stored in the PORE Science office.

6.0 Metadata Procedures

The NPS GIS Committee requires all NPS GIS data layers be described with the NPS Metadata Profile, which combines the FGDC standard, elements of the ESRI metadata profile, the Biological Data Profile, and NPS-specific elements. Although no standard has been applied to natural resource databases and spreadsheets, the SFAN will complete the NPS Metadata Profile to the greatest extent possible to document the annual and master pinniped back-end databases. Because the annual Point Bonita harbor seal data is uploaded into the master Point Bonita database without alteration, it is not necessary to create metadata records for the annual Point Bonita back-end databases.

Complete metadata records for the SFAN pinniped databases will be generated in compliance with current NPS standards by the Network Data Manager. The metadata records are based on the FGDC standard, are formatted in XML, and can thus be imported or accessed by other standard metadata software programs (ie. ArcCatalog). Because the location data for this project is stored as UTM coordinates within the MS Access databases, there are no spatial data products associated with this protocol that require metadata records.

The metadata records for the pinniped databases will initially be developed in Dataset Catalog v3.0, an MS Access metadata development and catalog tool developed by the NPS I&M Program. Dataset Catalog is currently the preferred tool to begin metadata records for MS Access databases because of its ability to harvest entity and attribute information from this database format.

The metadata records will be exported from Dataset Catalog as XML files and completed in NPS Metadata Tools and Editor v1.1 (NPS MTE), thus allowing for all NPS-specific elements in the metadata records to be completed. When completed, metadata records, but not the data themselves, will be posted to the NPS Data Store for public discovery and consumption. Contact information within the metadata records will direct interested parties to the Network Data Manager for further inquiries. Metadata records posted to the NPS Data Store will be updated annually after the annual data has been uploaded or following database revision to a new version whole number (ie., v1_3 to v2_0, but not v2_0 to v2_1).

7.0 Data Distribution

In order for the pinniped monitoring protocol to inform park management and to share its information with other organizations and the general public, guidance documents, reports, and

data must be easily discoverable and obtainable. The main mechanism for distribution of the monitoring documents and data will be the Internet. The pinniped monitoring protocol, accompanying SOPs, and all annual reports will be made available for download at the SFAN website:

http://science.nature.nps.gov/im/units/sfan/

Although the pinniped monitoring database will not be posted for public download, as previously mentioned, metadata records for the master database will be maintained at the NPS Data Store. The metadata records will direct interested parties to the SFAN Data Manager for further inquiries.

In addition to the NPS Data Store, the NPS I&M Program maintains an on-line natural resource bibliographic database known as NatureBib. NatureBib records will be created for all of the pinniped monitoring documents, including the protocol, annual reports, and any resulting publications. The public version of NatureBib is in development by the NPS I&M program.

All documents produced by the pinniped monitoring program will be published in either the Natural Resource Report Series or the Natural Resource Technical Report Series following guidance from the NPS Natural Resource Program Center in Fort Collins, CO. The Natural Resource Publications Management home page hosts a list of all documents published in the NRR and NRTR Series. The home page can be found at:

http://www.nature.nps.gov/publications/NRPM/

8.0 Literature Cited

Press, D.T. 2005. Data management plan for the San Francisco Area Network Inventory and Monitoring Program. USDI National Park Service. San Francisco, CA. 113 pp.

Appendix SOP 3A. Pinniped Database Data Dictionary

Data Dictionary Report

Data Dictionary for: Pinniped Monitoring Database, SFAN I&M Program

TABLE NAME: **tblDestroyed_Tags**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Destroyed Tag Numbers "9" Codes
FORMAT: Microsoft Access
NO. OF FIELDS: 5

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Resightid	dbText	15	resight ID, if applicable. Link to tblResightEvents
tagColor	dbText	5	Tag color.
tagNo	dbText	255	Tag code.
tagCode	dbLong	4	Tag code fate. 9 = destroyed.
Comments	dbMemo	0	Comments related to destroyed tag.

TABLE NAME: **tblDisturbanceBehav**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Disturbances of Harbor Seals Detail Information
FORMAT: Microsoft Access
NO. OF FIELDS: 15

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	50	Sampling event ID code, link to tblEvents.
DisturbanceID	dbGUID	16	Disturbance ID code, link to tblDisturbanceSource.
LocationID	dbText	50	Unique location ID code, link to tblLocations.
DisturbanceSubsite	dbText	255	Subsite where observations took place
Response	dbText	255	Response of seals to disturbance
CountBefore	dbDouble	8	Count before disturbance began.
RemainOnSite	dbDouble	8	Number of seals that remain on the site after the disturbance.
PupsRemain	dbDouble	8	Pups remaining on beach.
Flush	dbDouble	8	The number of animals that leave the beach and enter the water.
PupsFlush	dbDouble	8	The number of pups that leave the beach and enter the water.
PupsAlone	dbDouble	8	Pups that were left alone on the beach.
Return	dbText	50	Did seals return (yes/no)

RehaulTime	dbDate	8	Time when seals return to beach or rock.
WhereRehaul	dbText	50	Location or subsite where seals return.
Comments	dbMemo	0	Comments

TABLE NAME: **tblDisturbanceSource**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Disturbances of Harbor Seals Header Information
FORMAT: Microsoft Access
NO. OF FIELDS: 8

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	50	Sampling event ID code, link to tblEvents.
DisturbanceID	dbGUID	16	Disturbance ID code.
Time	dbDate	8	Time of observation at subsite
Source	dbText	255	Generic disturbance source category.
SourceSpecific	dbText	50	Specific source/cause of disturbance
DistNumber	dbDouble	8	Number of people, aircraft, etc. causing disturbance.
Comments	dbMemo	0	Comments regarding disturbance source.

TABLE NAME: **tblElephantEvents**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Secondary data for elephant seal surveys
FORMAT: Microsoft Access
NO. OF FIELDS: 7

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
Visibility	dbDouble	8	Visibility Code (1=good, 2=fair, 3=poor)
Survey_No	dbText	50	Sequential survey number for the year.
Survey_Type	dbText	50	Type of survey (S = full survey, P = partial survey, I = incidental survey)
Phoca_Disturbed	dbBoolean	1	Did a harbor seal disturbance occur?
Comments	dbText	255	Comments
Date_Entered	dbDate	8	Date that record was entered into tblElephantEvents

TABLE NAME: tblEvents
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Primary events table
FORMAT: Microsoft Access
NO. OF FIELDS: 8

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling Event ID Code
StartDate	dbDate	8	Date (mm/dd/yy) when sampling began
EndDate	dbDate	8	Date (mm/dd/yy) when sampling ended
StartTime	dbDate	8	Time (hh:mm) when sampling began
EndTime	dbDate	8	Time (hh:mm) when sampling ended
SubProject	dbText	20	SubProject (Elephant Seal, Harbor Seal)
Project	dbText	8	1-10 character Project Code
Old_ID	dbLong	4	Unique ID key from old version of database

TABLE NAME: tblLocations
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Primary Location Table -- UTMs of all Sites
FORMAT: Microsoft Access
NO. OF FIELDS: 28

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
ParkCode	dbText	4	4-character Park Code
ProjectCode	dbText	6	Code for component of monitoring project (Harbor Seal, Elephant Seal)
LocationID	dbText	26	Unique Location ID code (when combined with ParkCode and Program)
Subsite	dbText	8	Subsite Abbreviation (Specific Location Where Seals Were Sampled)
Subsite_Name	dbText	38	Long Descriptive Name of Subsite
Location	dbText	12	General Location (frequently there are multiple subsites per location)
Location_Name	dbText	18	Long Descriptive Name of Location
StartUTMX	dbDouble	8	UTM X (northing) coordinate for the center of the plot or location OR starting point of a line or polygon
StartUTMY	dbDouble	8	UTM X (northing) coordinate for the center of the plot or location OR starting point of a line or polygon
StopUTMX	dbDouble	8	UTM X coordinate (northing) of ending point of line or polygon
StopUTMY	dbDouble	8	UTM Y coordinate (easting) of ending point of line or polygon
UtmZone	dbDouble	8	UTM zone
StartLatitude	dbDouble	8	Latitude in decimal degrees for the center of the plot or location OR starting point

			of a line or polygon
StartLongitude	dbDouble	8	Longitude in decimal degrees for the center of the plot or location OR starting point of a line or polygon
StopLatitude	dbDouble	8	Latitude in decimal degrees for the ending point of a line or polygon
StopLongitude	dbDouble	8	Longitude in decimal degrees for the ending point of a line or polygon
Datum	dbText	5	Datum of mapping ellipsoid
EstimatedHorizontalError	dbLong	4	Estimated horizontal accuracy error--see users guide for complete details and
AccuracyComments	dbMemo	0	Comments about how positional (horizontal) accuracy was estimated
HabitatType	dbText	50	Habitat type
Elevation	dbLong	4	Elevation in meters
Aspect	dbText	5	Elevation in meters
Slope	dbLong	4	Slope in degrees
Azimuth	dbSingle	4	Compass bearing between start and stop coordinates
EstablishmentDate	dbDate	8	Date site was established
Discontinued	dbDate	8	Date site was discontinued
UnitName	dbText	50	Management unit in which site is located
PLP	dbText	10	Indicates whether location is a point, line, or polygon

TABLE NAME: **tblMiscTaxaCount**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Harbor seal bird observations
FORMAT: Microsoft Access
NO. OF FIELDS: 3

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
Taxa	dbText	25	Code for miscellaneous taxa.
enumeration	dbInteger	2	Number counted

TABLE NAME: **tblObserverQuality**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Quality of Observer Data
FORMAT: Microsoft Access
NO. OF FIELDS: 4

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
ObserverID	dbLong	4	Observer ID Number
YearDQ	dbInteger	2	Year Ratings Were Developed For
GoodQuality	dbText	50	Yes or No

TABLE NAME: **tblObservers**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Field Observers
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
observer	dbInteger	2	Unique identification code number for seal observer, link to tluVolunteerNames.

TABLE NAME: **tblPhocaEvents**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Secondary data for harbor seal surveys
FORMAT: Microsoft Access
NO. OF FIELDS: 13

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents, link to tblEvents.
ObsTimeStart	dbDate	8	Start of harbor seal observation time.
ObsTimeEnd	dbDate	8	End of harbor seal observation time.
Visibility	dbDouble	8	Atmospheric Visibility (Miles)
Tide_Level	dbDouble	8	Level of Low Tide (Feet)
Low_Tide_Time	dbDate	8	Time low tide occurred
All_Sites_Surveyed	dbText	10	Were all Subsites Surveyed? If Location was visited and weather precluded sampling Say 'UNABLE'
Comments	dbMemo	0	Comments
Old_ID	dbLong	4	Unique ID key from old version of database
Date_Entered	dbDate	8	Date record was entered into database

Regional_Survey	dbBoolean	1	Designates this survey as part of a region wide study
Regional_Count_Code	dbText	50	Survey code of regional count, if applicable.
High Quality Count?	dbText	50	Is this survey data of high quality and useful for data analyses (yes/no) ?

TABLE NAME: **tblPhocaSealCount**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Secondary counts for harbor seals (red,shark bite)
FORMAT: Microsoft Access
NO. OF FIELDS: 6

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
LocationID	dbText	50	Unique Location ID code, link to tblLocations.
SubsiteTime	dbDate	8	Time observations were made at a subsite
RedFurPhoca	dbLong	4	Number of seals observed with red fur
SharkBitePhoca	dbLong	4	Number of seals observed which had shark bites
Old_ID	dbLong	4	Unique ID key from old version of database

TABLE NAME: **tblPoorQualitySurvey**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Harbor seal poor quality surveys
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
PoorQualReason	dbText	50	Reason why survey is considered of poor quality (may be many reasons).

TABLE NAME: **tblResight**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Resights of Tagged Seals
FORMAT: Microsoft Access
NO. OF FIELDS: 20

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	50	Sampling event ID code, link to tblEvents.
LocationID	dbText	50	Unique Location ID code, link to tblLocations.
Resightid	dbText	15	Resight survey ID. Rmm/dd/yy-# (#=resight survey #). Link to tblResightEvents.
Subsite	dbText	50	Subsite Abbreviation (specific location where seal observation occurred)
MatureCode	dbText	10	Maturity of seal

Sex	dbText	5	Sex of seal
Condition	dbText	5	Condition of seal
Dye	dbText	10	Number as read, use "-" for place holder
Dye_Code	dbText	5	1 = Dye mark partially read, 2 = Newly applied dye mark, use first time animal is marked, 4 = Data edited
LtagColor	dbText	5	Left tag color
LtagNo	dbText	10	Left tag number
LtagPosn	dbText	5	Left tag position
LtagCode	dbLong	4	1 = Tag partially read, 2 = Newly applied tag, use first time animal is marked, 4 = Data edited, 8 = tag recovered
RtagColor	dbText	5	Right tag color
RtagNo	dbText	10	Right tag number
RtagPosn	dbText	5	Right tag position
RtagCode	dbLong	4	1 = Tag partially read, 2 = Newly applied tag, use first time animal is marked, 4 = Data edited, 8 = tag recovered
Bull_Cow_Status	dbText	10	A=Alpha Male, B=Beta Male, P=Periphery, NA=Not Associated, PG=Pregnant, NU=Nursing, NP=No Pup
Pup_Size	dbText	5	Pup size
Comments	dbMemo	0	Comments on seal observation.

TABLE NAME: **tblResightEvents**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Secondary data for seal resights surveys
FORMAT: Microsoft Access
NO. OF FIELDS: 6

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling Event ID Code, link to tblEvents.
Resightid	dbText	15	Reisht survey ID. Rmm/dd/yy-# (#=resight survey #).
ResightSurvey	dbLong	4	Resight survey ID number for year.
Visibility	dbByte	1	Atmospheric Visibility (Miles)
Comments	dbMemo	0	Comments on resight survey.
Date_Entered	dbDate	8	Date record was entered in this table.

TABLE NAME: **tblSealCount**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Primary table for pinniped count data
FORMAT: Microsoft Access
NO. OF FIELDS: 9

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
EventID	dbText	45	Sampling event ID code, link to tblEvents.
LocationID	dbText	50	Unique Location ID code, link to tblLocations.
Subsite	dbText	255	Subsite code.
SubsiteTime	dbDate	8	Time observations were made at a subsite
MatureCode	dbText	10	Pinniped maturity code.
SpeciesCode	dbText	10	Pinniped species code, link to tluPhocaMature.
qualifier	dbText	10	Qualifier describing condition of the pinniped.
enumeration	dbDouble	8	Number of pinnipeds counted.
Old_ID	dbLong	4	Unique ID key from old version of database

TABLE NAME: **tluPhocaMature**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: All Seal Names and ITIS Codes
FORMAT: Microsoft Access
NO. OF FIELDS: 6

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
MatureCode	dbText	50	Maturity Code
SpeciesCode	dbText	6	Species Code
Scientific_Name	dbText	50	Scientific name
Common_Name	dbText	50	Common Name
ITIS	dbLong	4	ITIS Number
Maturity_Description	dbText	50	Meaning of Maturity Code

TABLE NAME: **tluRegional_Counts**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Regional count dates and codes -- Lookup
FORMAT: Microsoft Access
NO. OF FIELDS: 5

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Year	dbLong	4	Survey year.
Regional_Count	dbText	50	Regional count sequential code, ie. 2008_09
Date	dbDate	8	Scheduled date of regional count.
MinDate	dbDate	8	Date minus two days.
MaxDate	dbDate	8	Date plus two days.

TABLE NAME: **tluResponse**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Seal response to disturbance -- Lookup
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Response	dbText	255	Code to describe response of seals to disturbance events.

TABLE NAME: **tluSource**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Harbor Seal Disturbance Sources -- Lookup
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Source	dbText	50	A list of the posible sources of disturbance simplified to match the original reports.
SourceSpecific	dbText	50	A list of specific disturbance sources.

TABLE NAME: **tluVolunteerNames**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Names and Addresses of Seal Observers
FORMAT: Microsoft Access
NO. OF FIELDS: 14

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
ObserverID	dbLong	4	Observer ID Number
First Name	dbText	50	Observer's First Name
Last Name	dbText	50	Observer's Last Name
also_known_as	dbText	50	Other names (such as maiden names) the observer has used
observer_initials	dbText	50	Observer's Initials
Active	dbText	50	Are they still participating in surveys? yes/no
Phone Number	dbText	50	Observer's Phone Number
E-mail	dbText	50	Observer's Email Address
Street Address	dbText	255	Observer's Street Address
City,State,Zip	dbText	50	Observer's City of Residence
Year started in program	dbLong	4	Year volunteer started in program.
Project Participant	dbText	10	Project Which the Observer works on (E_Seal or H_Seal)
Comments	dbMemo	0	Comments about the observer record
GOGA_ObserverID	dbDouble	8	ObserverID in GOGA database (if applicable).

TABLE NAME: **tluWeatherCodes**
FILENAME: Pinniped_BE.mdb
DESCRIPTION: Weather Condition -- Lookup
FORMAT: Microsoft Access
NO. OF FIELDS: 2

FIELD NAME	FIELD TYPE	FIELD WIDTH	FIELD DESCRIPTION
Weather Code	dbLong	4	Numeric weather code
Weather Description	dbText	50	Weather description

SOP 4. Data Analysis and Reporting
Version 1.5

Revision History Log

Prev. Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
1.0	March 2008	Marcus Koenen	General editing. Add revision history log.	Update.	1.1
1.1	June 2008	Dawn Adams, Sarah Allen, David Press, Marcus Koenen	Revised format, added and clarified analyses, clarified reports and contents.		1.2
1.2	September 2009	D. Press, M. Koenen	Revised by adding updated graphics and new information from power analyses. Removed unnecessary text.	Final protocol submission.	1.3
1.3	November 2009	K. Freeman, D. Press	Changed tables and figures to a modular numbering system, added a literature cited section, additional minor edits.	Formatting requirements.	1.4
1.4	December 2009	D. Press	Minor grammatical edits.	Comments from Penny Latham.	1.5

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This SOP details annual and long-term reporting requirements for the pinniped monitoring program. Data summary descriptions and long-term analytical methods are described for each of the documented report types.

1.0 Peer-Reviewed Harbor Seal Reports

1.1 Annual Harbor Seal Report

The annual report is a summary of the field season and includes direct counts of seal population numbers (maximums), number of pups produced, mortality events, disturbances, and any natural history items of note. Because harbor seal monitoring is currently funded by the I&M program, we provide details of data summaries that will be produced annually for this program. The data summaries are presented as they apply to the monitoring objectives.

Details for generating the harbor seal summary survey and disturbance measures using the project database are described in SOP 3 (Data Management). See especially Section 2.4 Data Reporting Tools. Examples of recent harbor seal annual reports are posted to the SFAN internet site: http://science.nature.nps.gov/im/units/sfan/vital_signs/pinnipeds/HarborSeals.cfm .

Objective 1a. Determine the long-term trends in population size and seasonal distribution of harbor seal populations at primary sites in the SFAN parks during the breeding and molt seasons.

Annual measures produced for each monitored location include (see Table SOP 4.1):

- breeding season maximum count of adults and immatures combined
- breeding season maximum count of pups
- molting season maximum count of adults, immatures, and pups combined

As an index of the total population size, the maximum counts for each location are summed and reported separately for the breeding and molting seasons (Table SOP 4.1). Graphs of the maximum total count for each year are developed for the breeding and molting seasons to compare the data across years (Protocol Narrative, Figure 4).

Reporting the maximum count data for each location monitored (Table SOP 4.1) will provide an understanding of how the harbor seals are distributed throughout PORE and GOGA during the field season. In addition, the narrative text of the annual report will highlight changes in how the harbor seals are distributed within a location and will identify significant new areas that harbor seals are utilizing during the breeding and molting season. Overtime, this information will show the expansion and contraction of colonies and will allow for adaptive management as needed.

Objective 2a. Determine long-term trends in reproductive success of harbor seals through annual estimates of pup production at PORE and GOGA.

For each location monitored, the maximum pup count is reported from the breeding season surveys (Table SOP 4.1). As an index of annual pup production of the entire study area, the maximum pup counts for each location are summed to create a maximum total of harbor seal pups (Table SOP 4.1). Annually, a graph is developed that displays the maximum pup count per location for all monitoring years.

Additional reporting that relates to harbor seal reproductive success includes the maximum dead pup count per location (Table SOP 4.1) and the first reported date of harbor seal pupping for the year.

Objective 3. Determine the long-term trends in sources, frequency and level of effects of natural and anthropogenic disturbances on harbor seal haul out use and productivity.

An annual summary of disturbance sources (e.g., motorboat, human, vehicle, aircraft, etc.) is presented by reporting, for each source, the number recorded and the percent of the total number of disturbances for the season (Table SOP 4.2). This data is presented for all monitoring years for comparison purposes. The average values across all years are also reported (Table SOP 4.2).

Table SOP 4.1. Example of survey summary data of harbor seal colonies for the 2008 season. All reported numbers reflect the maximum number seen during a single census (Flynn et al. 2009).

Location	Max # adults in breeding season[1]	Max # Pups in breeding season	Max # seals in molting season[2]	# Surveys		Max # Reds[3]	Max # Shark Bites[3]	Max # Dead Pups[3]
				Weekday:	27			
Bolinas Lagoon	272	153	405	Weekend:	9	12	2	2
				Weekday:	18			
Double Point	496	328	904	Weekend:	21	7	4	6
				Weekday:	24			
Drakes Estero	627	341	1342	Weekend:	17	11	5	5
				Weekday:	32			
Duxbury Reef	32	3	96	Weekend:	10	0	0	0
Point Reyes				Weekday:	6			
Headlands	142	64	97	Weekend:	1	0	0	0
				Weekday:	21			
Tomales Bay	382	118	380	Weekend:	12	15	1	1
				Weekday:	17			
Tomales Point	384	154	577	Weekend:	12	6	2	1
				Weekday:	21			
Point Bonita	164	10	152	Weekend:	6	7	2	0
TOTAL	**2499**	**1171**	**3953**		**254**	**58**	**16**	**15**

[1]Max # Breed = adults and immatures during the breeding season, March 1 to May 31.
[2]Max # Molt = all age classes during the molting season, June 1 to July 31.
[3]The Max # Red, Shark Bites, and Dead Pups are the maximum number observed March 1 to July 31.

Table SOP 4.2. Identified sources of disturbances (head alert, flush, flush into water) for Marin County locations, from March 1st to July 31st, 2000—2008 (Flynn et al. 2009).

	Motorboat		Non-Motor Boats		Vehicle		Dog		Aircraft		Human		Bird		Unknown		Other		Total
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
2000	14	11.3	9	7.3	0	0.0	0	0.0	14	11.3	23	18.5	19	15.3	43	34.7	2	1.6	**124**
2001	14	10.8	12	9.2	2	1.5	1	0.0	4	3.1	45	34.6	9	6.9	28	21.5	15	11.5	**130**
2002	19	12.1	15	9.6	9	5.7	0	0.0	9	5.7	48	30.6	11	7.0	39	24.8	7	4.5	**157**
2003	13	9.8	20	15.0	3	2.3	0	0.0	10	7.5	38	28.6	10	7.5	32	24.1	7	5.3	**133**
2004	2	2.2	9	9.7	7	7.5	1	1.1	2	2.2	35	37.6	7	7.5	23	24.7	7	7.5	**93**
2005	9	7.3	14	11.4	1	0.8	2	1.6	10	8.1	43	35.0	10	8.1	31	25.2	3	2.4	**123**
2006	14	8.9	16	10.2	5	3.2	1	0.6	8	5.1	57	36.3	13	8.3	35	22.3	8	5.1	**157**
2007	29	13.8	21	10.0	14	6.7	2	1.0	14	6.7	70	33.3	13	6.2	45	21.4	2	1.0	**210**
2008	11	10.2	10	9.3	5	4.6	0	0.0	4	3.7	51	47.2	5	4.6	18	16.7	4	3.7	**108**
Average	**13.9**	**9.6**	**14.0**	**10.2**	**5.1**	**3.6**	**0.8**	**0.5**	**8.3**	**5.9**	**45.6**	**33.5**	**10.8**	**7.9**	**32.7**	**23.9**	**6.1**	**4.7**	**137**

A bar graph is developed to report the rate of disturbances (number of disturbances per hour of survey) for each monitoring location (Figure SOP 4.1). The disturbance rate data is also presented for all monitoring years for each location.

Additionally, the narrative text of the annual reports highlights specific disturbance events and management issues that were cause for concern during the field season for each monitored location.

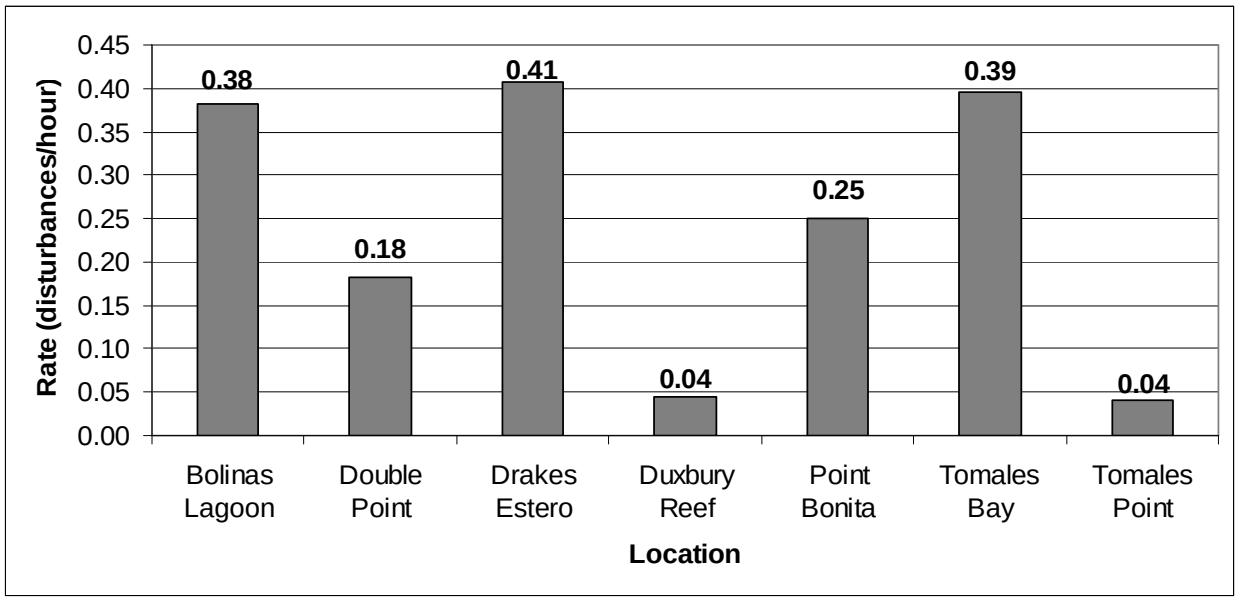

Figure SOP 4.1. Rates of disturbances per hour at Marin County locations from March through July in 2008. Only actual disturbances (head alert, flush, flush water) were used, and survey time is based on observation time for all complete surveys (with or without disturbances) (Flynn et al. 2009).

1.2 Five-Year Trend Report

Every five years, a longer report will be developed to provide information and interpretation on population trends. In addition, the reports are designed to evaluate the current monitoring efforts and make recommendations for protocol changes if they are needed. An example of a five-year report (Allen et al. 2004), summarizing the status and trends of the breeding populations of harbor seals, is posted to the SFAN internet site:
http://science.nature.nps.gov/im/units/sfan/vital_signs/pinnipeds/HarborSeals.cfm

1.2.1 Census Data

As noted for the harbor seal annual reports, several data summaries are developed each year for each location and for all sites combined, including:

- breeding season maximum count of adults and immatures combined
- breeding season maximum count of pups
- molting season maximum count of adults, immatures, and pups 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 1.65 times the maximum onshore number of adults/immatures, pups, and individuals during molting (Harvey and Goley 2005; Lowry et al. 2005; Carretta et al. 2007). This correction factor is also used in statewide surveys. National Marine Fisheries Service (NMFS) is developing a new estimator for California based on mark-recapture of harbor seals statewide in California (M. Lowry, NMFS, pers. com). The I&M five year reports will apply the appropriate correction factor for long-term harbor seal population trends.

To determine long-term trends in population size and productivity, the maximum count from each colony, multiplied by the 1.65 correction factor, is evaluated by regression (linear or non-linear) analyses (versus year) as described in Sydeman and Allen (1999) (Figure SOP 4.2). This results in one data point per colony per year for the analyses. As recommended in Appendix A, the harbor seal monitoring program will focus on detecting a 27% decline in adults over a period of three years using six of the primary pupping sites (Tomales Bay, Tomales Point, Point Reyes Headlands, Drakes Estero, Double Point, and Bolinas Lagoon). For harbor seal pup production, the program will focus on detecting a 36% decline over a period of four years. Trends in harbor seal counts and pup production will take longer to detect for individual sites (Appendix A). Nevertheless, the five-year trend reports will consider site-specific changes in the harbor seal population to see if any trends are apparent.

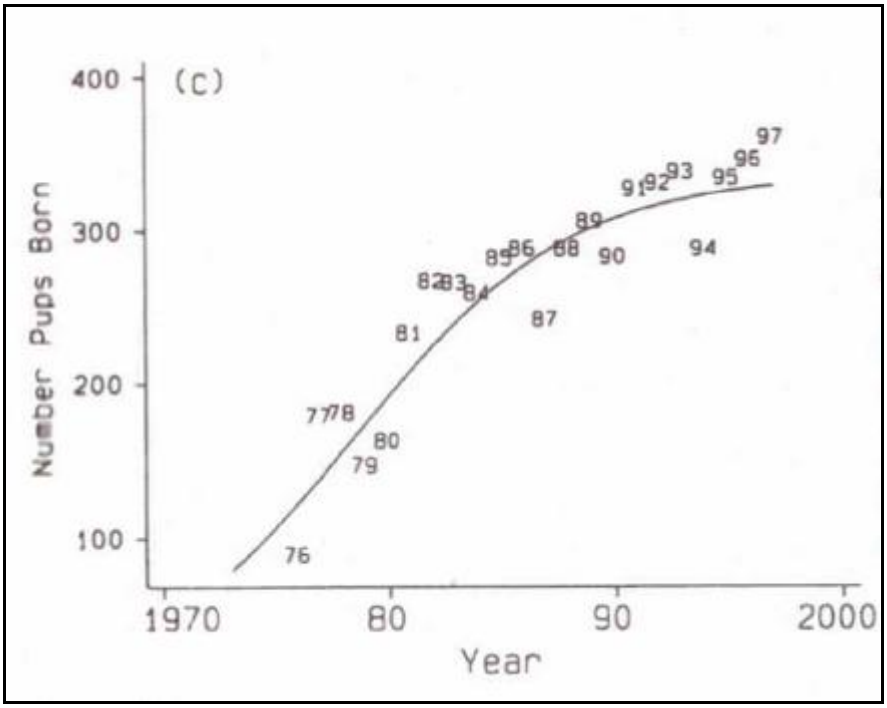

Figure SOP 4.2. Example of harbor seal trend analysis from Sydeman and Allen (1999).

Both population and productivity trends are analyzed to report the rate of change and whether it is significantly different from zero (Caughley and Birch 1971; Zar 1984). Because seal count

data will likely be non-normal, counts will be log-transformed to induce normality. If log-transforms do not normalize the data, poisson or negative binomial error terms will be used to control for non-normal data with non-constant variance. In addition to colony specific regressions, route regressions (Elzinga et al. 1998) will be used to evaluate the population trend for the entire SFAN harbor seal population. This consists of individual regressions from each colony being combined to report a mean slope, standard error, and statistical significance for all the colonies. A report of the statistical power of the regression will also be presented with the regression results.

1.2.2 Disturbance Data

Five-year reports will summarize changes in distribution over the five year period. This data may show the expansion and contraction of colonies over time and will allow for adaptive management as needed. Data will be presented as a map of all SFAN colony sites with time series and regression results (described in previous paragraph) overlain on the map. This will allow managers to determine which sites are increasing, decreasing or are stable, and any potential relationships or patterns that affect groups of sites that are close to one another. Regressions on the population data over time will be conducted for the five years since the last analysis and for the entire dataset, thus providing information on recent trends in the data versus the complete long-term trends.

Disturbance data are summarized every five years using the following measures:

- source of disturbance: annual tally of sources of disturbance (e.g., motorboat, human, vehicle, aircraft, etc.) for each location and for all locations combined.
- rate of disturbance: number of disturbances per hour of survey for each location.

The analysis will explore changes in both disturbance rates and the composition of disturbance sources over time. Care will be taken to evaluate the survey effort and site coverage of the datasets used when interpreting trends. When sample size allows, variability among years will be evaluated by site. Rate of disturbance will be explored for changes through time using binomial tests on human disturbance sources versus total disturbance sources. In addition, ANOVA or Generalized Linear Models (GLM) will be applied to test for differences in disturbance rates between years (pooling all sites and at each individual site), differences in weekday and weekend disturbance rates, and differences in disturbance between sites.

The effects of disturbance on population size and pup production can be tested using GLMs following methods developed by Becker et al. (2009). GLMs will be run using factors that may affect population size and productivity, such as year since the most recent El Niño event, and density-dependence due to total counts in the region in order to test the relative influence of disturbances to the harbor seal population.

1.2.3 Data Synthesis

To the greatest extent possible, trends of key parameters (e.g., population size, disturbance, and productivity) will be assessed within the context of other biological, oceanographic, or climatic indicators monitored by the NPS or partners (e.g., El Niño Southern Oscillation (ENSO), changes in beach profiles, nearshore current patterns). Examples of these types of analyses include Allen et al. (1989) and Sydeman and Allen (1999) where ENSO effects were documented in relation to pinniped productivity. Larger scale analyses such as these will not

necessarily occur within every trend report, but will occur as needed, as datasets become available, or as dataset become robust enough to incorporate into these types of analyses.

1.3 Report Formats

The annual and five-year trend reports will follow the format of the Natural Resource Technical Report (NRTR; http://www.nature.nps.gov/publications/NRPM/index.cfm) series. The series is used to disseminate the peer-reviewed results of scientific studies in the physical, biological, and social sciences for both the advancement of science and the achievement of the National Park Service's mission. The NRTR typically follows the "Introduction - Methods - Results - Discussion" type organization that is standard for many scientific journal publications and technical reports. Reports should be direct and concise.

2.0 Other Harbor Seal Reports

2.1 Harbor Seal Weekly Breeding Summary

Graphs presenting the attendance of harbor seals at PORE and GOGA is produced weekly. The graphs 1) illustrate the maximum weekly count of adults/immatures combined and maximum pups for each monitoring location (Figure SOP 4.3), and 2) illustrate the counts of adults/immatures and pups across all sites combined over the course of the monitoring season (Figure SOP 4.4). In addition, photos, natural history notes, and monitoring guidance to the volunteers are included in the weekly update. The purpose of the update is to brief the superintendents, the park interpretation staffs, volunteer monitors, and the public regarding the status of the harbor seal monitoring season. The weekly updates are posted to the SFAN internet site: http://science.nature.nps.gov/im/units/sfan/vital_signs/pinnipeds/HarborSeals.cfm

2.2 NMFS Reports

The parks are monitoring and conducting research under a NMFS Office of Protected Species permit. The research at the parks is conducted in cooperation with PRBO Conservation Science, who is conducting research on pinnipeds on the Farallon Islands NWR. Research on harbor seals tagged in San Francisco Bay in collaboration with The Marine Mammal Center study also occurs under this permit. Permit reports are due annually and permit renewals are required every five years. The NMFS reports include information on number and species of seals tagged (tag number, location of tag, location of tagging event, date, and age-sex of individual), resighting records of tags from non-PORE sites, any tissue collected, and the number and species of seals and sea lions disturbed during research activities. The PORE Science Advisor is the NPS lead on developing the NMFS report and works in collaboration with PRBO Conservation Science and The Marine Mammal Center.

2.3 I&M Updates

Interesting findings and project highlights are disseminated once or twice per season through the monthly I&M Update. This one-page monthly report series is distributed throughout the network

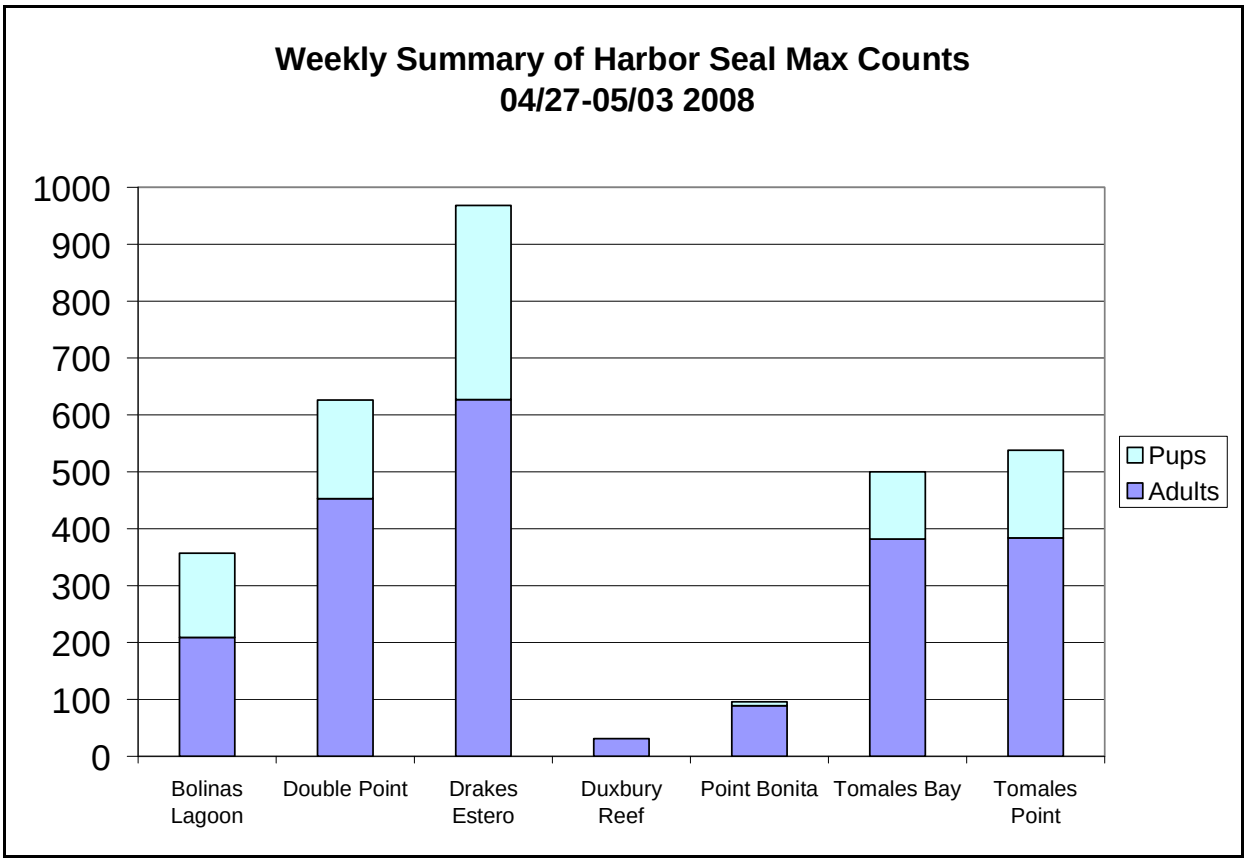

Figure SOP 4.3. Example graph from the harbor seal monitoring program weekly updates reporting maximum counts per location.

to summarize ongoing monitoring work. Highlights are presented in short paragraphs (3-4 sentences) with photographs.

2.4 Executive Briefing

At the end of each breeding season (harbor seal and northern elephant seal), an executive briefing will be updated and reposted to the I&M website. The briefing is a two-page summary of pinniped monitoring and provides information to internal staff.

2.5 Regional Population Trends

To contribute to statewide surveys and to evaluate the SFAN sites in context of the larger population, standardized estimates of total population are also calculated. Data (population counts and population index) collected at PORE and GOGA are combined with surveys conducted in San Francisco Bay and Sonoma County to produce an annual regional population estimate. Regional surveys are scheduled by the PORE Science Advisor so that they coincide with surveys at PORE and GOGA. The PORE Science Advisor is the lead on evaluating regional trends in the harbor seal population data.

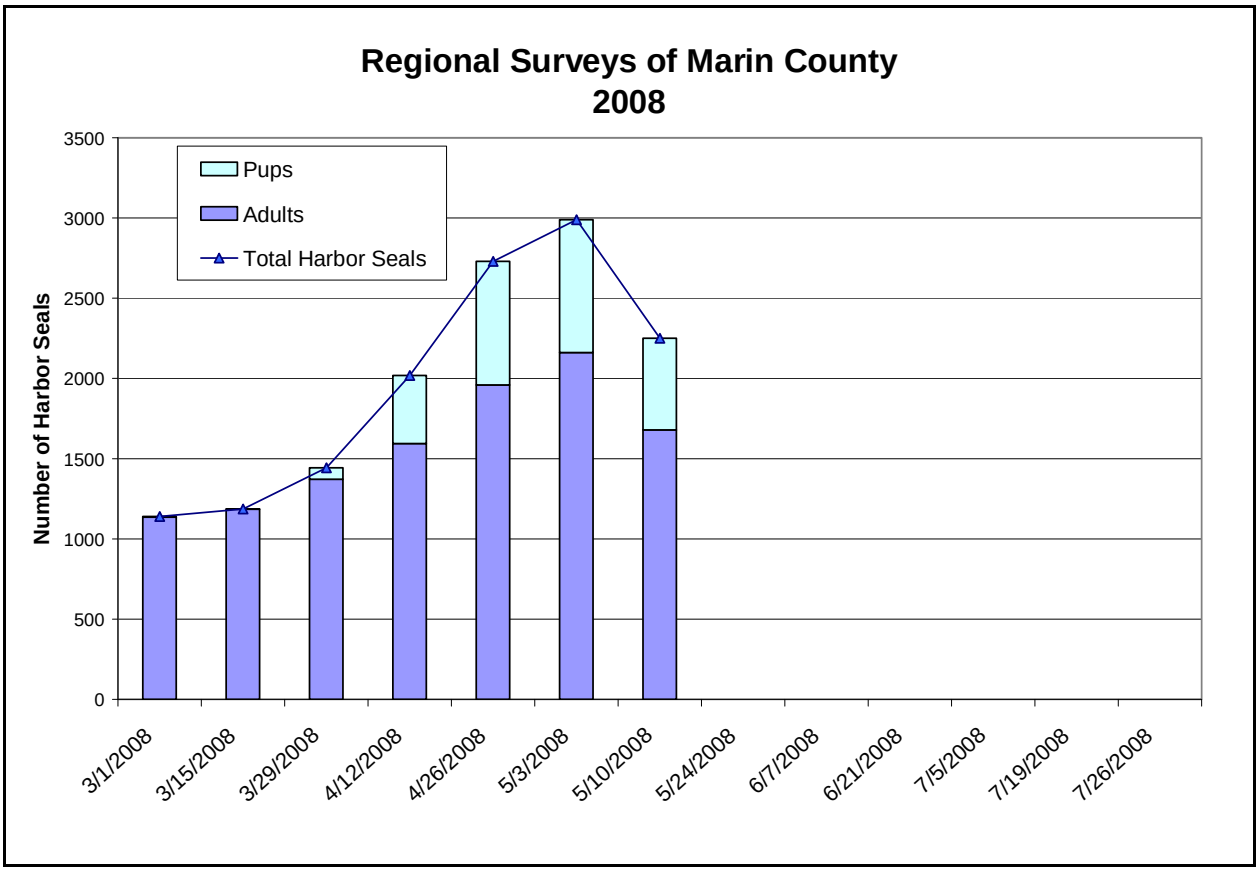

Figure SOP 4.4. Example graph from the harbor seal monitoring program weekly updates reporting total counts of all sites combined during the course of the monitoring season.

3.0 Northern Elephant Seal Reports

The harbor seal reports listed above are produced using data collected through the I&M program. Because of limited funding, the northern elephant seal reports below are supported through data management efforts and technical assistance but are not primary tasks of the I&M program staff. They are listed here to serve as a documentation of reports that are produced by the parks and supported by I&M. If I&M funding becomes available to support these monitoring efforts, additional information will be provided on data analyses and reports.

3.1 Northern Elephant Seal Weekly Breeding Summary

Graphs presenting the attendance of northern elephant seals at PORE during the pupping/breeding season are produced weekly. The purpose of the updates are to brief the superintendent, the park interpretation staff, volunteer monitors, and the public regarding the status of the northern elephant seal breeding season. The digital graphs presents the previous and current year weekly maximum counts for all northern elephant seals, cows, and pups/weaned pups (Figure SOP 4.5). One set represents all colony sites and another set is produced for North Drakes Beach colony where the majority of public interaction and docent work occurs. Any

notable natural history observations or resighting of tagged individual northern elephant seals are included. The weekly updates are posted to the SFAN internet site: http://science.nature.nps.gov/im/units/sfan/vital_signs/pinnipeds/ElephantSeals.cfm

3.2 Northern Elephant Seal Reports

In 2007, a two-year northern elephant seal report was produced using the NPS Natural Resource Report Template (Protocol Narrative, Table 1; Adams et al. 2007). Annual and long-term trend reports will likely remain consistent with this report format, which emphasized northern elephant seal population and productivity estimates.

3.2.1 Population Estimates

Annual and long-term trends of northern elephant seal population size are reported by age and sex class using direct counts. Breeding population estimates are based on maximum survey counts for northern elephant seals by sex, age group, and colony (Adams et al. 2007). During the breeding season, not all age classes are present on the beaches so accurate total population size counts are not possible. In addition, during surveys, some northern elephant seals, especially sub-adult males, are in the water and cannot be counted. Consequently, 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 NMFS estimates the elephant seal population size by using raw pup counts multiplied by the inverse of expected ratio of pups to total animals (McCann 1985). Boveng (1988) and Barlow et al. (1993) recommend using 3.5 as an appropriate multiplier for a rapidly growing population such as the California stock of northern northern elephant seals. The PORE population estimates are based on the pup count multiplier (3.5) used with the maximum total of pup and weaned pup counts by colony or sub-site. NMFS is currently reviewing this multiplier and may provide new guidelines in the future. SFAN contributes data to NMFS for an annual national population estimate (Barlow et al. 1993; Carretta et al. 2002; Carretta et al. 2007).

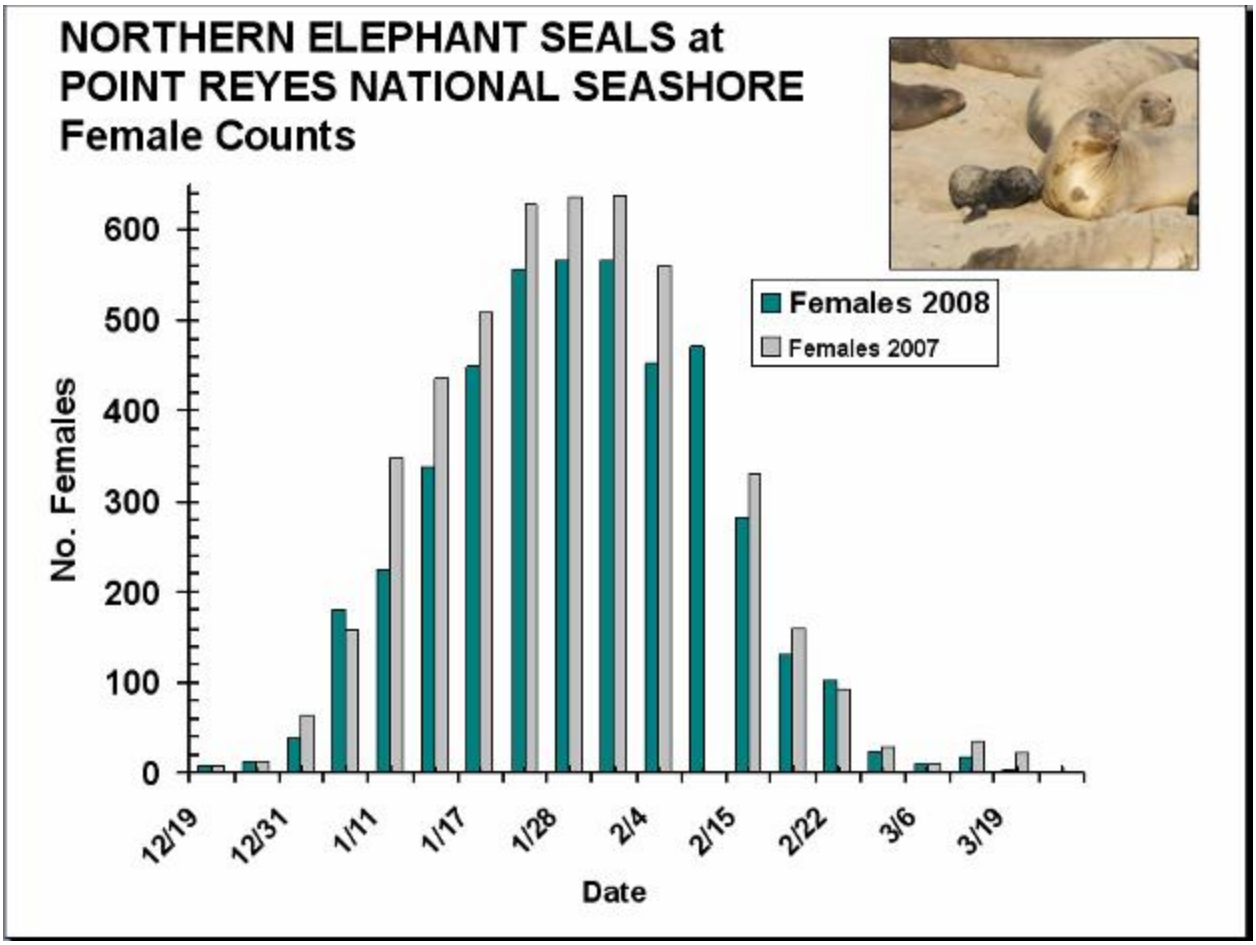

Figure SOP 4.5. Example graph of northern elephant seal cows produced for the weekly updates.

Details for generating the northern elephant seal maximum population counts using the database is described in SOP 3: Data Management. See especially Section 2.4 Data Reporting Tools. An example of population size summary data for the northern elephant seal monitoring program is in the protocol narrative, Table 1.

3.2.2 Productivity Estimates

Annual productivity is reported as an index of annual reproductive success using direct counts of females, pups, and applying correction factors. An example of productivity summary data for the northern elephant seal monitoring program is in the protocol narrative, Table 1. The productivity index is calculated from the following formula (Lee 2006):

$$\frac{\text{Maximum count of weaned pups and pups}}{\text{Adjusted maximum count of females}} = \text{Productivity Index}$$

The index is calculated for colony sites and the entire PORE population. The total number of breeding females is estimated using the maximum count of adult females during peak pupping adjusted to include the adult female counts 33 days prior to and 33 days after the peak count for each colony site (Protocol Narrative, Table 1; Adams 1994; Le Boeuf and Laws 1994). 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 prior to pupping +27 days nursing period; Le Boeuf and Laws 1994). The assumptions of this method to determine productivity are that observers are able to capture the high count of pups plus weaners and adult females during the bi-weekly surveys and that female natality is unknown but relatively stable across years. The index reflects productivity only and not mortality (dead pups are included in the total) that occur at the breeding site.

Other northern elephant seal monitoring programs use site specific natality rates (proportion of females giving birth) to estimate pup production. The natality rates correspond to reported values for an expanding (93% at Año Nuevo) and stable (98% at 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, SFAN has decided to not use a natality rate since not all PORE northern elephant seal colonies are at the same growth point (e.g., some are expanding and some are stable). We also present raw count data in reports for which new productivity values can be estimated when more recent data is available.

3.2.3 Trend Analyses

Rates of change in the northern elephant seal population will focus on adult female counts and pup production. Cow adults will be used as a proxy for total breeding population size because northern elephant seal males, particularly sub-adults, are highly mobile during the breeding season, which can result in them being double-counted. The maximum count of pups plus weaners for each colony provides an estimate of actual pup production.

A power analysis (Appendix B) indicates that for all sites combined, monitoring effort has an 86% chance of detecting a 36% decline in cows over 4 years. For pups, an 83% chance of detecting a 41% decline can be realized after 5 years. Increases are easier to detect, generally having 0.1 - 0.2 higher power. Site specific trends will take longer to detect, but will be explored for Point Reyes Headlands, North Drakes Beach, and South Beach separately. Methods for exploring long term trends in the northern elephant seal population will be similar to those already described for harbor seals.

Long term trends in productivity and weaning success will also be explored over time. Weaning success can be estimated by comparing the total number of pups born with the total number of weaned pups remaining at the end of the season. Because pups begin dispersing from the beaches where they were born near the end of the breeding season and can be washed to other sites by storms, trends in productivity and weaning success will be evaluated for the entire population rather than by individual colonies.

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SOP 5. Revising the Protocol
Version 1.4

Revision History Log:

Previous Version #	Revision Date	Author	Changes Made	Reasons for Change	New Version #
	Sept. 2007	Marcus Koenen	Adapted from SFAN Water Quality Protocol		1.0
1.0	Sept 2007	Dawn Adams	Added App. A with reviewers comments and response	In prep for submitting to PWR.	1.1
1.1	June 2008	Dawn Adams, Marcus Koenen	Remaining comments addressed	In prep for submitting to PWR.	1.2
1.2	September 2009	D. Press, S. Allen	Completed Appendix. B with reviewers comments and response. Updated MVT.	In prep for final submission to PWR.	1.3
1.3	November 2009	K. Freemam, D. Press	Changed tables and figures to a modular numbering system. Additional minor edits.	Formatting requirements.	1.4

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Tables

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Table SOP 5.1. Master version table and current SFAN pinniped protocol documents.....196

This Standard Operating Procedure explains how to make changes to the Pinniped Monitoring Protocol Narrative for the San Francisco Bay Area Network (SFAN) and accompanying SOPs, and track those changes. Editors of the Protocol Narrative or any one of the SOPs need to follow this outlined procedure in order to eliminate confusion in how data is collected and analyzed. All observers should be familiar with this SOP in order to identify and use the most current methodologies.

1.0 Revision Procedures

1. The Pinniped Monitoring Protocol Narrative for the SFAN and accompanying SOPs has attempted to incorporate sound methodologies for collecting and analyzing pinniped data. However, all protocols regardless of how sound require editing as new and different information becomes available. Required edits should be made in a timely manner and appropriate reviews undertaken. The Protocol Narrative is a general overview of the protocol that gives the history and justification for doing the work and an overview of the sampling methods, but that does not provide all of the methodological details. The Protocol Narrative will only be revised if major changes are made to the protocol. The SOPs, in contrast, are very specific step-by-step instructions for performing a given task. They are expected to be revised more frequently than the protocol narrative.

2. All edits require review for clarity and technical soundness. Small changes or additions to existing methods will be reviewed in-house by SFAN staff. However, if a complete change in methods is sought, than an outside review is required. Regional and national staff of the National Park Service (NPS) with familiarity in pinniped monitoring and data analysis will be utilized as reviewers. Also, experts in pinniped research, monitoring, and statistical methodologies outside of the NPS can be utilized in the review process.

3. Document edits and protocol versioning in the Revision History Log that accompanies the Protocol Narrative and each SOP. Log changes in the Protocol Narrative or SOP being edited only. Version numbers increase incrementally by tenths (e.g. version 1.1, version 1.2, etc.) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0, etc.) Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number.

4. Narrative and SOP updates may occur independently. That is, a change in one SOP will not necessarily invoke changes in other SOPs; a narrative update may not require SOP modifications. The program tracks the narrative and SOP version numbers in a Master Version Table (MVT) (Table SOP 5.1), which is maintained in this document (SOP 5). Anytime a narrative or an SOP version change occurs, a new Version Key number (VK#) must be created and recorded in the MVT, along with the date of the change and the versions of the narrative and SOPs in effect. The VK number increments by whole integers (e.g., 1, 2, 3, 4, 5). The protocol narrative, SOPs, and data should not be distributed independently of this table.

5. Updates to the MVT and changes to the Protocol Narrative or SOP must be provided to the SFAN Data Manager for inclusion in the master version table database and the metadata record. In addition, the database may have to be edited by the Data Manager to accompany changes in the Protocol Narrative and SOPs.

6. Post new versions on the website and forward copies to all individuals with a previous version of the effected Protocol Narrative or SOP, including pinniped project staff from Golden Gate National Recreation Area and Point Reyes National Seashore. Archive older versions of the protocol narrative and SOPs on the network archive server under the pinniped vital sign folder.

Table SOP 5.1. Master version table and current SFAN pinniped protocol documents.

Document Name	Current Version	Version Date
SFAN Pinniped Monitoring Protocol	3.01	November 2009
SOP 1: Harbor Seal Field Surveys	1.4	November 2009
SOP 2: Northern Elephant Seal Surveys	1.4	November 2009
SOP 3: Data Management	1.4	November 2009
SOP 4: Data Analysis and Reports	1.4	November 2009
SOP 5: Revising the Protocol	1.3	September 2009
SOP 6: Safety Procedures	1.1	September 2009

Appendix SOP 5A. 2004 Peer Review Comments and Response from Protocol Authors.

A draft of the Pinniped Monitoring Protocol was submitted and reviewed by two researchers in 2004. In 2007, review comments were incorporated into the protocol. This appendix summarizes the major deficiencies and suggested corrective actions noted by the reviewers. This summary does not include layout, grammatical, spelling or table/figure change edit recommendations. The text in italics represents the changes made to the document based on the reviewers' comments. Hard copies of reviewer comments are on file.

Review #1: Dr. David Ainley, H.T. Harvey and Associates, 983 University Avenue Building D, Los Gatos, CA 95032. Phone (408) 458-3200

Indicator of Ecosystem Condition

- Needs to be better organized to be referred to when justifying the protocols.
- What questions can be answered by this protocol? For example, regime shifts data is apparently going to be collected but not clear how or why. Prey availability is also discussed but issue is not addressed later. Suggest to expand section.
    - *Prey availability text expanded within Indicator of Ecosystem Condition section*
- Use of term pinniped guild not appropriate. Species discussed are in different ecological guilds.
    - *Term changed to assemblage within document.*
- Use of the terms colony versus rookery vs haul-out. Make consistent and put in glossary.

Monitoring Questions

- Indicated earlier that interested in short- and long-term effects, but didn't include a question that addressed changes in phenology, which could change due to food or climate and has been linked to climate in other vertebrates. Suggest that place importance on phenology as a parameter to be measured. Could expand on mention of it made in population ecology section under Sampling Design and Parameters monitored.
    - *Phenology objective added under Harbor Seal and Elephant Seal-specific monitoring objectives.*
- Other monitoring questions should link directly back to the discussion in the Indicators of Ecosystem Condition section.
- Pinniped guild section rough and should be placed earlier in document, i.e. before indicators of ecosystem condition.
    - *Section moved.*
- Diet and tissue analysis for pollutants mentioned in population ecology section under Sampling Design and Parameters monitored, but no mention of tissue analysis for stable isotopes and fatty acids. Important and viable technique for the program.
    - *Not added as a parameter monitored.*

Specific Programs Section

- Discussion for each species begins with reference to monitoring objectives using numbers not used in the earlier section
    - *Format has been changed.*

- Not clear how data are being gathered on climate phenomena.
    - *Climate data collected on datasheets as indicated. This data is used for qa/qc, not for data analyses. Climate data for analyses comes from established weather stations (e.g. NOAA).*

- Include trend graphs of certain parameters in species account sections (appendix)
    - *Species accounts appendix was removed.*

Review #2: Dr. James Harvey Review, Moss Landing Marine Lab., 8272 Moss Landing Rd., Moss Landing, CA 95039 (831) 771-4434:

This is a more substantial review and his notes are 7.5 pages long and referenced to the PWR checklist.

<u>Overall comments</u>
- Need more rationale on survey design and periodic analysis to test effectiveness.
- More citations for the factual statements in text.
    - *Additional citations added to support statements.*

<u>Monitoring Questions and Objectives</u>
- MMPA restricts harassment of marine mammals and should be used as a rational for the harbor seal disturbance monitoring objective.
    - *Additional text added to Enabling Legislation section to connect MMPA restrictions to the protocol objective.*
- Discuss coordination of sampling and data sharing at PORE and GOGA.
- Conceptual models represent ecosystem function to understand the components, interactions and what data is missing. Seems premature to include the model at this point in the monitoring program.
    - *Model required for protocol by NPS but moved to an appendix.*
- General management issues not useful; include specific issues (i.e. contaminants and effects on wildlife).
- Good summary of previous monitoring but lacking thorough description of data and findings.
    - *Additional results added from recent reports and publications.*
- Protocol specifies condition/trend and % change threshold, but does not provide rationale for values and basis for sample design. Some objectives don't have thresholds.
- Could improve historical perspective discussion of importance in regional and national context.

<u>Methods and Implementation</u>
- Some monitoring questions are complex and specific and not obviously answered by protocol.
    - *Caveat added that these questions are not addressed by this protocol.*
- Sampling disturbance and environmental information does provide some background to assess changes in pinniped populations, but consider an assessment of prey resources by integrating fishery data from other sources.
    - *Brief amount of text added to Indicator of ecosystem condition section that identifies ways of assessing prey availability.*

- Sample unit is a survey and should be more clearly defined in the protocol. Explain that sampling is random in time, why it is non-random in space, and how the 2 hour count is sufficient to count all pinnipeds in area.
- Regarding use of maximum counts, discuss rationale for use of max instead of average (also in SOP 9) and use of correction factor. Need assessment of quality of counts/measurement error.
- Use past data to assess power of statistics to resolve effect size and whether stated levels of change are actually detectable. Look also at variability within a site as well as among sites or years to establish amount of surveys needed.
- Tag sighting protocols should include resight bias, tag loss, and how potential biases will be minimized or are irrelevant.
    - *Some discussion of tag loss rate and resight biases added in eseal Methods section.*
- More detail needed in SOP 10 regarding process to make changes to SOPs and if future sample design analysis could result in changes to survey scheme.

<u>Data Management and Reporting</u>

- No clear description of who will enter data.
    - *Roles and responsibilities are now explained.*
- Discuss audience for annual and 5-year reports, who is responsible for producing reports, when disseminated and list of recipients.
    - *This information is now presented in the protocol narrative.*
- Discuss how data may be used in peer-reviewed papers and other communication.
    - Reporting section has been expanded. Peer review follows NPS NRPM standards.
- Improve map legibility by producing location maps without topographic information.
    - *New maps added.*
- Consider creating a separate dataset of counts from other surveys conducted by researchers to be used for comparison (CDFG, MLML, SFSU, etc.).
    - *This will be incorporated into trend reports and through work by partners as described.*

<u>Personnel and Operations</u>

- Describe process if had a reduction in volunteer labor.
    - *This has never been an issue in this area and was not included in the protocol.*
- Include training manual in protocol.
    - *More information on training is presented and is available upon request.*
- Describe facilities, vehicles, and offices needed for project.
    - *More information on personnel and operations has been included.*
- List contributions from partners and cooperative agreements in place.
    - *Partners are listed. There are no current cooperative agreements.*
- Expound on content of periodic reviews – should assess adequacy of frequency and timing of surveys. Should also be an assessment of quality of counts and attempt to reduce variability among and within observers.
    - *This section has been expanded.*
- Need more clarification on the budget and justification.

- *Much more information on budget has been included.*

Appendix SOP 5B. 2009 Peer Review Comments and Response from Protocol Authors.

A draft of the Pinniped Monitoring Protocol was submitted to Dr. James Agee, PWR Protocol Review Coordinator, and Dr. Penny Latham, PWR Regional I&M Coordinator in June 2008. Dr. Agee forwarded the protocol to two anonymous peer reviewers (R1 and R2). In 2009, review comments were incorporated into the protocol. This appendix summarizes the deficiencies and suggested corrective actions noted by the reviewers. The text in italics represents the authors' changes to the document based on the reviewers' comments. Hard copies of reviewer comments are on file.

PWR Protocol Review Checklist

Protocol Name: Pinnipeds Monitoring Protocol
Science Reviewer: James K. Agee Admin. Reviewer: Joel Siderius
Red Text=extended comments.

	Overall Organization and Presentation of Protocol Narrative
YES	1. Is the overall monitoring protocol well-organized with sections clearly delineated?
In-part	2. Does the protocol have a title page with authors' names, protocol version number and date? (Protocol version numbers should be constructed to allow for both major and minor changes.) Is there a Table of Contents, abstract, and the three basic sections: 1-Narrative, 2-Standard Operating Procedures (SOPs), and 3-Supplementary Materials or Appendices recommended in the NPS standards published by Oakley et al. 2003 (http://science.nature.nps.gov/im/monitor/protocols/ProtocolGuidelines.pdf).
YES	3. Is there a complete and accurate table of contents with page numbers? (Chapters should be paginated consecutively, i.e. Chap. 1 (pp. 1-20), Chap. 2 (pp. 21-28), Chap. 3 (pp. 29-44), etc. to allow for modular updates.)
Mostly	4. Are the tables and figures clearly labeled and understandable?
YES	5. Is the protocol bound so that it lies flat, preferably in a 3-ring binder?
	A. Background and Objectives (Chapter 1)
Yes	1. Does the protocol narrative provide a rationale or justification for why a particular resource or resource issue was selected for monitoring? Is the history and background for this resource issue well-referenced with supporting literature cited?
In-part	2. Does the protocol narrative discuss the linkages between this and other monitoring projects?
YES	3. Does the protocol narrative describe how monitoring results will inform management decisions?
Yes	4. Does the protocol narrative contain careful documentation of the monitoring objectives or monitoring questions being asked?
Yes	5. Does the protocol narrative identify specific measurable objectives such as thresholds or trigger points for management actions?
	B. Sampling Design (Chapter 2)
Yes	1. Is there a clear and logical rationale for selecting the sampling design over others?
Yes	2a. Were the criteria for site selection clearly discussed including stratification, spatial design, and whether this monitoring will be co-located and/or integrated with other VS monitoring protocols? (See Checklist, Section 1A2.)
Yes	2b. Has the target population or "sampling frame", and the sampling units, been identified? In other words, is the desired level of inference clear?

Yes	3. Is the sampling frequency and replication identified?
Yes	4. Is the timing of sampling defined?
In part	5. Are the location of sampling sites clearly identified?
In part	6. Is the level of change that can be detected for the amount or type of sampling being instituted identified? (See Checklist, Section 1A5.)
	C. Field Methods (Chapter 3)
In-part	1. Are preparations for the field season and equipment setup included? Are requirements for permitting and compliance discussed?
Yes	2. Does the protocol include clear and detailed information on taking measurements with example survey forms included? (Protocol variables and measurements may be discussed in detail in a SOP. A complete set of forms should be included in either the supplementary materials or a SOP.)
In part	3. Is the method of access for sampling sites provided?
NA	4. Is there an overview of procedures for establishing, monumenting, and maintenance of plots discussed in one or more SOPs?
NA	5. Does the protocol include details for the post-collection processing of samples or vouchers?
Yes	6. Does the protocol include procedures to be followed at the end of the field season?
	D. Data Handling, Analysis and Reporting (Chapter 4)
YES	1. Does the protocol provide an overview of the process for entering, editing, and storing data, identification of database software, and whether the database is consistent with the recommended I&M database template structure? (For water quality protocols, see specific water quality guidance in Part B or WRD's General Comments 15, and checklist items in Section 2, items 8-10, below.)
N.A.	2. Are quality assurance (QA) and quality control (QC) procedures presented for the various levels of data collection and analysis? (See water quality Part B guidance or General Comments 15 as appropriate.)
Yes	3. Is the data structure clearly presented and sufficient to capture the required information to meet the stated goal? Is there an overview of the database design?
Yes	4. Are there recommendations for routine data summaries and statistical analysis to detect change?
YES	5. Is there a recommended reporting schedule?
In-part	6. Is there a recommended report format with examples of summary tables and figures?
Yes	7. Is there a recommendation for long-term trend analysis (e.g. every 5 or 10 years)?
Yes	8. Does the protocol narrative include an adequate description of metadata and data archival procedures?
Yes	9. Does the protocol narrative describe the frequency of testing and review of protocol effectiveness?
	E. Personnel Requirements and Training (Chapter 5)
YES	1. Does the narrative include a listing of the personnel and describe their roles and responsibilities, and qualifications?
Yes	2. Does the protocol include a discussion of training procedures for personnel?
	F. Operational Requirements (Chapter 6)
In-part	1. Are facility, vehicle and equipment needs identified?
In-part	2. Is there a summary of key partnerships with agencies, organizations and individuals that are part of the monitoring program and a description of their contribution? Is there a list of relevant cooperative agreements and other partnership agreements, if applicable?

YES	3. Is a schedule for the annual fieldwork and administrative needs required to implement this protocol included?
Yes	4. Is there an overall budget that summarizes the annual and periodic costs of implementation of the protocol? Does it seem reasonable?
YES	5. Does the staffing plan and budget demonstrate that adequate resources have been allocated to data management, analysis, and reporting activities (ca. 30% are recommended)?
	G. Literature Cited (Chapter 7)
In part	1. Are the literature citations relevant, sufficient and consistently formatted?
	Standard Operating Procedures (Selected essential SOPs in addition to those mentioned in the narrative outline are identified in the checklist below. For Water Quality protocols, Part B Guidance or WRD's General Comments 15 should be consulted when developing SOPs.)
In-part	1. Is there a table of contents for the SOPs?
YES	2. Are changes to each SOP clearly identified with a title, version number **or** revision date, and page numbers? Changes to protocol modules (Chapters or SOPs) should be reflected in the overall protocol version number and protocol revision history log either through a minor or major revision; however, you may also wish to develop a numbering scheme for SOPs, e.g. SOP 1.00, 1.01…
YES	3. Is there a SOP with instructions for revising the protocol and a revision history log?
YES	4. Is there a SOP with instructions for preparation before the field season? Is there a SOP with instructions for procedures and equipment storage during and after the field season? (Also see numbers 10 and 11 below.)
Yes	5. Is there a SOP for training field personnel?
Yes	6. Is there a SOP that clearly defines protocol variables and how to measure them? (See Checklist, Section 1C2.)
In-part	7. Are there clear and detailed driving and other navigational instructions to sampling sites?
Yes	8. Are the details of Data Management identified in one or more SOPs? Topics to be included are at minimum identified in Section 1D and may include customized data management routines. Specifically for water quality monitoring data, does the SOP specify how data will be reported to WRD for entry into the Environmental Protection Agency's STORET database?
N.A.	9. For water quality monitoring and other monitoring as appropriate, is there a quality control SOP associated with each protocol that adequately documents QC objectives for measurement sensitivity (detection limits), measurement precision, measurement systematic error (bias as percent recovery), data completeness (including adequacy of planned sample sizes and statistical power – this topic may be in the SOP on Sampling Design), and (if applicable for lab measurements only) blank control? Are instrument calibration details included either in the QC SOP or in a separate calibration SOP?
N.A.	10. For water quality protocols, is there a SOP that includes an explanation of how data comparability (a quality assurance basic) was considered in choosing which protocols and chemical labs to utilize? Do protocol SOPs contain enough field and lab method details to allow others to determine if data produced is comparable enough to other regional data sets to be considered credible by regulatory agencies interested in the data?
N.A.	11. Do aquatic protocol SOPs adequately describe the details of all Sampling Protocols (Field and Laboratory), as well as equipment needs and operation, sampling techniques, sample preservation and handling and logistics?
Yes	12. Are all major procedures required for the protocol sufficiently explained? Are any SOPs missing?

Yes	13. Are the literature citations with the SOP relevant, sufficient and consistently formatted?
	Supplementary Materials or Appendices
N.A.	1. Is there a table of contents with Section 3 – Supplementary Materials that clearly identifies the materials provided in this section of the protocol?
N.A.	2. Are the supplementary materials relevant, sufficient and consistently presented? Consistent formatting is desirable, but not always possible.
Yes	3. Are data collection forms provided either in this section or in an SOP?
No	4. Is there a section for the Administrative Record that provides the history of protocol development and refinement? A summary event table is highly recommended in addition to the supporting materials required in the Protocol Review File Checklist, e.g. the initial study plan or protocol development summary, the results of protocol development studies, peer review comments and responses during the development phase, and/or any published protocol on which a major portion of the methodology included in this protocol is based. (The published protocol may be presented either in Section 2 or Section 3 depending upon its contribution to the current protocol.)

Extended Administrative Review Comments

General/Editorial Comments

1. Pg iii-xiii. The only bold text should be the Heading 1's. i.e "1.0 Background Objectives" on pg iii should not be bold.

Fixed.

2. The "Table of Contents" should be changed to "Contents" on pg iii. And on pg iv and henceforth it should read "Contents (continued)"

Fixed.

3. pgs v, vii, ix, xi, xiii, xv, Do not need to be blank, they should be deleted.

Fixed.

4.The Tables of Contents, Figure, Tables, should have "Page" right justified on the top of each page. See below for example.

Contents

Page

Exhibits..... v
Executive Summary..... vii

Fixed.

5. Page 1, should be paginated.

Fixed.

6. Page 1, my non-scientific opinion is that "pinnipeds" should be defined. I guess it is a suborder? Or is it a superfamily? (PRC Note: this is done in glossary, but it might help the average reader to put it in the text)

A short definition was added as the first sentence of paragraph 2 in the Executive Summary.

7. Use Scientific Names only once.

Extra uses of scientific names have been removed.

8. Elephant and Northern Elephant appear to be used interchangeably? I assume they are the same. Make usage consistent.

All references to the species now standardized to "northern elephant seal" in the protocol narrative and SOPs.

9. A summary table of all the relevant Pinnipeds would be helpful somewhere in Section 1.1 or 1.2. Maybe include name, scientific name, range, status…… etc.

Because we have pared down the protocol to just harbor seals and elephant seals, we do not feel that a summary table as described is warranted. Paragraphs and two maps were added to Section 1.1 describing the ranges of northern elephant seals and Pacific harbor seals.

10. Dovetailing with Comment 9 above, the 2nd to the last paragraph in Section 1.1 is out of place.

This paragraph fits in nicely with the paragraph before it and after it. The paragraph identifies the pinniped species that occur at PORE and GOGA, which seems relevant for this background section.

11. Multiple references should be separated by semicolons, oldest to newest.
Ex. (Wakeley 1954; McManus 1957).
DOUBLE CHECK THROUGHOUT ENTIRE DOCUMENT

Fixed.

12. Pg 8, reference for NPS-75 should be (NPS 1992).

Fixed.

13. pg 10, the quotes should be indented.

Fixed.

14. pg 31. The first two sentences of Section 3.1 are not informative. It seems like 5/9 sites are on trails. Then 4/9 are off trail, though it says "counting locations are typically located off trail"

This section is in reference to both harbor seal and elephant seal counting locations. Our tally is that 4 of 12 counting sites are off trail, so we retained the language as is. We removed Sea Lion Overlook from the list of publicly accessible sites in the second sentence since this site was in reference to the All Species component of the protocol, which we have removed.

15. pg 37, should read section 4.5.1 not **4.51**

Fixed.

16. Table 4, goes for multiple pages so the caption should be included on all pages with the word "continued"

Fixed. This table is now Table 2.

17. Pg 55. 4th reference does not look right with two last names, Maybe it needs a hypen?

The reference for Allen Miller was left as is at the author's request.

Chapter 7 should be the literature cited

Fixed.

The glossary should be an appendix.

Fixed.

Overall Organization and Presentation of Protocol Narrative

2. No date is presented in the title page, just XXXX 2008.

Completed on submittal of final protocol.

SECTION 1.A Background and Objective

2. Section 1.4 explains why the NPS selected pinnipeds and how pinniped monitoring is linked to a larger NPS program. However, there is not mention of any other SFAN vital signs. It would ideal to mention how pinniped monitoring is linked to other SFAN vital sign monitoring. (PRC Note: These other signs ARE mentioned on page 11)

As noted by the PRC, links to other monitoring programs, both NPS and non-NPS, are discussed in Section 1.4.3 Indicator of Ecosystem Change.

SECTION 1.C Field Methods

1. No mention of compliance in Chapter 3. Perhaps since, the volunteers are just observing and not sampling anything, no permits are needed. But it would behoove the author to address compliance, likely in Section 3.1. The compliance section 6.5 should be in Chapter 3.

Compliance is relative to the logistics and management of the monitoring program and is therefore correctly placed in Chapter 6: Operational Requirements rather than Chapter 3: Field Methods. We clarified that a permit is required for both harbor seal and northern elephant seal monitoring.

SECTION 1.D Data Handling

6. No examples of figures or tables are mentioned or shown. Ideally these would be in Section 4.6.1

Section 4.6.1 is part of the Reporting section, not Data Handling. Table 4 is referenced in this section. The reader is directed to SOP 5: Data Analyses and Reports, where more tables and figures are found.

SECTION 1.F Operation Requirements

1. Vehicle needs are not address in Section 6.3. Though tables 7&7 identify budget line items for vehicles. Section 6.3 should clarify the vehicle situation.

Added paragraph on the vehicle situation to Section 6.3.

2. Section 5.4 needs to be in Section 6.

As suggested, Section 5.4 Partners and Collaborators is now Section 6.6.

Section 2 SOP's

SECTION 2

1. An additional list of SOPS would be helpful, especially since page 68 is clearly the end of the narrative. (PRC Note: I agree here, had a hard time referencing them).

The protocol SOPs have been included with the protocol narrative, thus creating one large document. The SOPs therefore are now listed within the Table of Contents.

7. I see lots of maps, but I cannot find driving directions to the sites in SOP 1,2,3.

Detailed directions were added to SOP 1 for each harbor seal survey site. The maps and aerial images in SOP 2, which include the major road names and an inset map, provide adequate directions to the northern elephant seal monitoring sites. SOP 3 was removed from the protocol.

I would suggest that the map on page 22 of the narrative be included in each of the Appendixes B's for SOP's 1,2,3. Otherwise the maps in SOP's 1,2,3 are too localized.

Because the SOP's have been added to the protocol narrative, thus creating one large document, the above suggestion would result in repeating the same figures in one document. Instead, we have provided references to the maps in SOP's 1 and 2. SOP 3 has been removed from the protocol.

PRC Comments

P34: "Digital photos WILL be labeled…"

Sentence changed to read, "Digital photos will be labeled …."

Many problems with Literature Cited:

P2: Is Hastings et al. 2002 really Hastings and Sydeman 2002? Keep "et al.s" to three or more authors.
P2: Miller et al. 1983 missing from lit cited.
P2. CDFG 2001 missing from lit cit
P3: Allen et al 1996 missing from lit cit
P11: Sydeman et al. 1999: really Sydeman and Allen?
P11: Keiper 2005 is Keiper et al. 2005
P11: Womble et al. 2006: really Womble and Sigler?
P18: Allen et al. 1983 really Allen and Huber?
P20: Risebrough 1978 is Risebrough et al. 1978
P20 and 31: Allen et al. 1984 not in lit cit
P38: Caughley 1971 and Zar 1984 missing from lit cit
P39: Adams 1993 and LeBoeuf and Laws 1994 missing from lit cit
P55: There are a number of references here that I did not find in the text: Adams 1994, Allen et al. 1985, Barlow et al. 1994, Epstein et al. 1998, Francis and Hare 1994, Geraci and Lunsbury 1993, Hanan 1996, Harvey 1987, Harvey and Goley 2005, Lowry et al. 2005, Miller 1983, NPS 1980 and 1992.
P56: Becker et al. in press needs a journal listed.
P57: Eberhardt et al needs a issue and page number for Wildlife Monographs
P57; Geraci and Lounsbury (if kept) need initials.

Fixed.

Reviewer #1 (R1)

Background. Pinnipeds have been selected by the NPS as focal species for determining the condition of PORE and GGNRA as parks, their associated marine habitats, and their ecosystems in general. Goals of the SFAN Pinniped Monitoring Plan are as follows:

1) Determine pinniped status and trends, using Harbor Seal (HASE) and northern elephant seal (NESL) as key species
2) Determine the seasonality of pupping events (presumably to look for changes that may be related to climate change?)
3) Determine the annual reproductive success/productivity of HASE and NESL in PORE and GGNRA
4) Determine the effects of natural and human disturbance (in particular on HASE) in these parks.

Review. The protocol is based on a long-term research program implemented by the lead author of the plan (S Allen), and has been in place since the early 1980s. The pinniped program involves a large group of collaborating organizations and individuals, making it a complex undertaking. The monitoring will also involve the public as volunteer data collectors. Overall, the plan is sound, and the methods appropriate, tested and true. I do wonder how effective volunteers are (and what happens if they drop out?), but probably this has been going for years and is unlikely. I provide some suggestions and criticisms below in the spirit of improving the protocols, and thinking "outside the box" a bit. Most of these comments are about some bigger issues. The work of these authors in preparing the protocol has obviously been substantial, and they have done an excellent job overall on all the technical details.

1) Data to date (and in the future) is to be stored in a relational ACCESS database. This is not a particularly sophisticated way to manage these data, but it is a reasonable place to start. What next? I was also surprised to see no specifics in the protocol about releasing these data to the public. Certainly, a portion of these data should be made publically available as soon as possible, and some parameters should be updated and released annually, presumably on the PORE and GGNRA websites.

   Microsoft Access is the current database standard adopted by the NPS Inventory and Monitoring Program. The reviewer is correct, however, that Microsoft Access will has its limits, particularly in regard to file size, the ability to track changes to the data, and to set detailed user controls. In the future, if necessary, the database will be upgraded and managed in SQL Server. Modifications to the appropriate data management sections of the protocol will be made if and when the database is upgraded to SQL server or another database platform.

   In regards to public release of the data, SOP 4 Data Management provides information on data distribution. Although the actual data will not be posted on-line, a database metadata record will be posted and maintained at the NPS Data Store with the appropriate contact information. The data will be provided to the public upon request. A summary of the data distribution section in SOP 4 has been added to the protocol narrative.

2) Honestly, it is not entirely clear why pinnipeds were selected as focal species, aside from the fact that solid long-term data exists. As I read about the Vital Signs program, I wondered about other taxa....indeed, marine mammals are not mentioned. What about landbirds? Or amphibians? Or, more to the point, why pinnipeds?

   Section 1.4 provides explicit rationale for selecting pinnipeds as an I&M vital sign. However, we did add an additional bullet item to the reasons to monitor pinnipeds listed in this section, noting the direct application to NPS management decisions. Other marine mammals (ie. cetaceans) were not selected as vital signs primarily because the NPS does not have the ability to manage transient cetaceans within their coastal waters. Additional information can be found in the SFAN Vital Signs Monitoring Plan (Adams et al. 2006), which notes that cetaceans ranked 60 of 63 vital signs during the SFAN prioritization

process. Information about the other vital signs selected for monitoring, including landbirds and amphibians, can also be found in the SFAN Vital Signs Monitoring Plan and at the SFAN website. R2 noted that our rationale for selecting pinnipeds for monitoring was "clearly and completely presented".

3) The monitoring plan references a long history of many excellent publications. In addition, apparently some new analyses were conducted, specifically to support aspects of the monitoring protocols (e.g., a power analysis on the frequency of surveys; Becker 2008). Becker's analysis shows no more than an 80% chance of detecting a 40% decline in HASE abundance over 5 years, and 45%-87% chance of detecting a 50% decline in NESL over the same period (if I am reading this correctly). This was a bit difficult to understand as written, but a question remains: is this sufficient in terms of management? I'm not sure that more surveys could be realistically accomplished (this analysis was based on 2 surveys/week, which seems like a maximum), so was this an exercise to determine the power in doing what is being done? If so, that is fine, but it should be stated as such.

   Becker re-ran the analysis for harbor seals for this draft of the protocol. The previous power analysis incorporated all counts per location during the peak of the breeding season for each monitoring year. The final harbor seal power analysis (Appendix A) prepared for this draft of the protocol only uses the maximum counts from each location per year. And to further clarify, a power analysis for northern elephant seals was not submitted in the peer-reviewed protocol draft, but was prepared for this draft (Appendix B).

   The harbor seal power analysis indicates that current monitoring efforts have a 90% chance of detecting a 27% decline in overall population counts over only 3 years. 25% percent declines take more time to detect for individual colonies, especially pups. In the case of northern elephant seals, current monitoring efforts have an 86% chance of detecting a 36% decline in cows over 4 years. For pups, an 80% chance of detecting a 41% decline would be realized after 5 years. As with harbor seals, declines take longer to detect at individual colonies.

   The power analyses were performed to determine if the current monitoring efforts are sufficient to determine trends in the populations that are meaningful to management and to identify the limitations of the data. We do not perceive the analyses as simply an exercise to determine the power in doing what is already being done.

   In the end, we feel like the short number of years that it will take to detect significant population-level changes for all sites combined provides opportunities for timely responses, either as direct management actions or through additional research. Although significant trends at individual sites take longer to detect, this is primarily a function of the variability in the data set rather than a function of effort. In further regards to effort, the power analyses only employ maximum counts and the monitoring programs are specifically designed to ensure that frequent surveys occur during the peak of the breeding seasons.

4) Moreover, and more to the point, these populations (NESL especially) are growing like gangbusters, and pup production (number of pups born) appears to be increasing annually (these are obviously correlated), so why would the "management objectives" be stated in terms of population decline? Seemingly, this makes little sense given the well-documented history of population increases which continue to this day. The interesting questions from a management perspective (and the ones that might be realistic within the next 5-10 years for these species/populations, and could be addressed in a power analysis) have to do with chances of detecting slowing of the population growth rates, not declines. Indeed, if there was any cessation of population growth in any given year, it should (and presumably would be) of great interest to park management. Also, perhaps the power analysis on productivity would be more revealing, but unfortunately it was not clear whether this analysis was on the number of pups born or the proportion of pups successfully weaned – the latter would be particularly interesting. If it was on the number of pups born, I would say the management question is again suspect, as it is for population abundance as well (and the power analysis does not say much that is different). Let me also say, I am not a big fan of this kind of power analysis as it is often based on an untenable assumption regarding the variance structure of dataset. How does one know that the variance won't change in time? Given these growing populations, etc. it is likely that it will, thereby compromising these results.

   Times series plots indicate that harbor seal populations within the SFAN have remained steady over the past decade (Appendix A), and we therefore feel justified in considering our ability to detect trends in terms of declines. For northern elephant seals however, we have modified our approach to consider both increases and declines. Positive and negative trends in northern elephant seals are explored in the power analysis and the subsequent management objectives have been modified.

   The power analyses were conducted on the number of pups born. Determination of weaning success of harbor seals is beyond the capabilities of this monitoring program as is would require an intensive tagging/resighting program. Weaning success for northern elephant seals can be evaluated by comparing the total number of pups born with the total number of weaned pups remaining at the end of the season. Due to movements of the weaned pups around the Point Reyes Headlands, we could only look at weaning success for the entire populations and not for individual colonies. Weaning success will be evaluated in future annual and trend reports.

   The reviewer is correct regarding the limitations of power analyses in general. Appendices A and B both discuss the pitfalls and assumptions of the power analyses. Temporal autocorrelation is particularly problematic for the northern elephant seal analysis. Nevertheless, the analyses provide critical insights into the ability of these two monitoring programs to track meaningful populations trends.

5) Given the depth of available datasets, I would have liked to see more analysis of the observations at hand. In particular, a more comprehensive update of the analyses presented (for the PORE populations) originally presented by Sydeman and Allen (1999)

would have been appropriate, and could have been used to answer some of the key questions, such as: what are the current population trajectories for HASE and NESL in PORE? Are there indications of population stabilization? If there are, at what point may these populations reach carrying capacity (or an upper inflection point)? These questions have important implications for the monitoring program, yet were not addressed. Some basic population modeling would also be useful for designing (and implementing) this program.

The analyses requested by R1 are more appropriate for an in-depth analysis and synthesis report, as described in Section 4.6.1. Once the protocol is completed, the SFAN hopes to begin development of a synthesis report that builds upon Sydeman and Allen (1999) using the last decade or more of available data.

6) It was stated that all NESL weaners were tagged between 1988 and 1998, and most were tagged thereafter, but what is the point of this tagging program without a commitment to re-sighting (no funding means no resighting?), a difficult and costly activity? How will resighting data be taken and used? If there is no real plan for funding this program and re-sighting specifically, perhaps it is not necessary to tag as much, unless it is necessary for determining NESL productivity. I'm not sure if it is, but in any case perhaps this could be clarified.

   Section 2.6.1 discusses the importance of the northern elephant seal (NESL) tagging and resight data to the broader research community. The data set is available to the NPS to explore in regards to dispersal, site fidelity, and colony expansion, although no plans for data analysis are currently in place since this is an unfunded program. Even without I&M funding, PORE will likely continue to resight and tag NESL weaned pups using park staff and trained volunteers.

7) It is intended that Information from continuing HASE and NESL surveys will be used in "adaptive management" and decision making in these parks, as well as, generally speaking, to proxy the health of the habitats and ecosystems these species inhabit. In terms of adaptive management, I have no concerns with this – indeed, I am aware of myriad decisions for park management that on the surface would seem simple enough, but in reality are quite complex, and often involve difficult value judgments (e.g., to promote NESL or snowy plover recovery?). Having up to date population data would aid in making these tough decisions. However, with respect to using these population data as indicators to the health of park habitats and ecosystems, I am not so convinced. First and foremost, marine mammals are not nearly as useful as indicators of marine ecosystems as are, for example, seabirds. There are some data/papers on mammals as indicators of marine ecosystems, but they were not referenced. More importantly, however, is the fact that most marine mammals are recovering from exploitation, and thus do not track environmental and ecosystem variability very well. This is because their populations are often far below carrying capacity, and are generally increasing (as is the case here). Second, population-level data generally does not resolve on an annual (or sub-annual) temporal scale, and yet that is the scale often desired of an indicator. Third, if this is an important goal, I think the authors should try to be as specific as possible about what the

indicators are actually indicating...for example, what do HASE population numbers indicate about marine conditions and/or food web variability? In this regard, in looking at the time series, I would suggest that HASE pup production numbers and "weaning success" possibly would be good indicators. AS NESL cows do not feed during the pup-rearing period, this species/parameter would not be that useful in this context. Moreover NESL numbers just seem to be increasing, regardless of temporal environmental variability, so I question the use of this species as an indicator of anything other than itself. HASE on the other hand clearly do show some responses to the environment. Some additional research and summaries (as suggested above) might be needed to flush this out in more detail, but it seems HASE pup production and weaning success (if one could get at this) would provide information not only on HASE in these parks, but also something about the ecosystem.

Pinnipeds were selected as indicators of ecosystem condition because 1) they respond quickly to short term environmental changes such as to El Nino and harmful algal bloom events (Allen et al. 1989; Sydeman and Allen 1999; Pettee 1999; Sholin et al. 2000; Dierauf and Gulland 2001); 2) they are sentinels to changes in climate because of changes in their distribution, abundance and reproductive success which can be measured locally and regionally (Dierauf and Gulland 2001; Le Boeuf and Crocker 2005; Ragen et al. 2008; Lee and Sydeman 2009); 3) other parks and agencies, including Channel Islands National Park, the California Department of Fish and Game and National Oceanic and Atmospheric Administration, monitor pinnipeds as one of several marine indicators of marine ecosystem condition, providing opportunities for regional collaboration and analysis; 4) monitoring several colonies at PORE and GOGA has allowed biologists to distinguish broad-scale environmental effects, such as climatic events and human-caused disturbances, on individual colonies

During El Nino events in the past 20 years, harbor seal reproduction and population numbers declined significantly and elephant seal pup mortality increased significantly at Point Reyes (Allen et al. 1989; Pettee 1999; Sydeman and Allen 1999; Becker et al. 2009). Thus, monitoring reproductive success, pup mortality and population numbers of apex predators provide ecosystem level effects on the frequency and intensity of El Nino events and into other climate anomalies that cascade through ecosystems. Monitoring several marine indicators including prey and predators provide better understanding about how marine ecosystems function and how resilient they are to disruptions such as climate change.

The parks also monitor pinnipeds to guide management actions. In addition to changing population size, a change in the distribution of pinnipeds at the parks may influence management decisions. For example, new elephant seal sub-colonies forming in locations where the public congregates or where endangered species such as western snowy plovers breed, may require management intervention. Similarly, disturbance of harbor seals at specific locations may not affect population numbers but may affect where seals, particularly females and pups, are distributed and thereby influence pup survival.

8) The protocols mention using timing of pupping (seasonal parturition dates?) to monitor climate change, but I don't think there is any indication that timing in HASE, or especially NESL, is responsive to climate. If there is compelling data on this topic (e.g. relationships between pupping dates and temperature, or something climatological), it should be included. The other issue here would be age structure. If there were changes in timing over the past decades, one would need to determine if this was due to changes in climate or changes in population age structure. In pinnipeds, it has been shown that older females generally breed earlier within each season. These populations have effectively grown from zero (in the mid-late 1970s/1980s to present), so changes in age structure would be the most parsimonious explanation for a trend in timing if one was found. Frankly, I was a bit surprised to see this emphasis on timing. It could be good, but if the park wants to emphasize this parameter, it is imperative that some background analyses are conducted first.

   Peer review of an earlier draft of the protocol by Dr. David Ainley in 2004 emphasized the importance of phenology. Phenology was added as a parameter to be measured at Dr. Ainley's request. The frequency and timing of both harbor seal and northern elephant seal surveys already capture important phenological events, such as the date of the first pup or maximum molt count, so adding phenology did not equate to an increase in field effort.

   The scientific literature clearly documents that shifts in the phenology of many plant and animal species over the last decades is related to climate change (Visser and Both 2005). In regards to marine mammals, studies from the Arctic region are most relevant, having documented climate change impacts on abundance, distribution, migrations, and phenology of both pinnipeds and cetaceans (Laidre et al. 2008; Moore 2008). In regards to harbor seals and northern elephant seals, our biggest concern is that climate change shifts in the abundance and timing of prey availability will affect breeding and, in the case of elephant seals, migration (Edwards and Richardson 2004).

   Phenology was highlighted as monitoring question rather than a specific, measurable monitoring objective. Although our data set may not be robust enough to link changes in phenology to climate change, our data set will add to a much larger data set that may be analyzed in cooperation with other agencies and universities.

9) Steller's Sea Lions (STSL) and California Sea Lion historically used these parks, and are mentioned in the Protocols. There is good historical accounting of these species, but they are generally not included in the plan. This is a bit strange as STSL is an endangered species. Then again, until they return to PORE in greater numbers, how much monitoring can be done?

   California Sea Lions are still found at PORE and GOGA, while Steller's Sea Lions still occur only at PORE. Neither species, however, breeds in either park. PORE staff conduct regular monitoring of all pinnipeds at the Point Reyes Headlands (see Section 2.6.2), including these species, but that is not part of the formal I&M monitoring program.

10) I'll mention this again -- HASE are really the focal species as NPS has dedicated resources to this study. I'm not sure that the focus on NESL can be sustained without resources...as a volunteer program can only go so far...but it is necessary as this is the species that will cause more management issues with its continuing population expansion to new areas and probable interactions with the public. Somehow this funding deficiency should be addressed in the protocols.

    Because it is our hope that the NESL monitoring program will be funded in the future either by PORE or through the I&M program, we have kept NESL in the monitoring plan. We have addressed reviewer comments by adding a power analysis and data reporting and analysis sections for NESL to the protocol. The protocol will serve to fully direct NESL monitoring efforts, whether it be a volunteer based program or fully funded.

Reviewer #2 (R2)

I made comments as I went along, using the 'track changes' feature in MSWord; some of these comments refer to the four specific "Process" questions, but others are more minor and refer to clarity etc. (PRC Note: the separately attached Word draft is labeled with a person's name who was not the reviewer).

Overall comments: Based on the background materials on the CD, this document has been reviewed (by David Ainley and Jim Harvey?) and revised before, and I felt that this was reflected in the very complete nature of the current version. The document reflects the authors' extensive experience with monitoring and managing pinnipeds in the SFAN. The protocol describes how data will be collected, clearly and (for the most part) in detail, which will ensure compatibility of data across years etc. In addition, the protocol clearly describes how change will be detected. I would recommend doing a power analysis for the elephant seal (and if possible, the all species) protocols, in addition to the one already completed for the harbor seal protocol. I also was curious about how condition/trend management objectives thresholds for population declines (p. 14) were determined, as they seem high to me, especially in light of the report's statement that if these thresholds are surpassed, management action might be initiated, and that action would in many cases simply be to initiate further research into the possible causes of the declines. Are these threshold levels standard to pinniped management in the U.S.? Of course, this may simply reflect my bias towards exercising caution in these types of situations.

Following guidance from the PRC, we have included a power analysis for northern elephant seals. See Protocol Section 2.5.2 and Appendix B.

In regards to the thresholds identified in the condition/trend management objectives, the threshold levels have been modified based on the power analyses for harbor seals and northern elephant seals (Appendices A and B). If any of these thresholds are surpassed, we feel strongly that, at the very least, research should be initiated to determine the

cause, especially of a population decline. Management actions may then be taken if warranted.

My comments related to the four specific review questions are summarized below:

1. **Background and objectives**:
   1.1. Background and history: well presented overall, with information on legal protection (and why that was instituted), current population status and trends, and ongoing monitoring. Included examples of current management issues (e.g., disturbance by visitors, El Nino influences on pup production, etc.). Focus was on northern elephant seals, with less data on harbor seals and very little on the other species (csl, nfs, etc.) Perhaps add more information on current distribution, with accompanying maps? (There are haul-out site maps in Section 2, Sampling Design, but **if** a description of current distribution is meant to be part of background etc., it would be clearer to include distribution maps here).

   Paragraphs and two maps were added to Section 1.1 describing the ranges of northern elephant seals and Pacific harbor seals.

   1.2. Rationale for selecting pinnipeds for monitoring: clearly and completely presented, I thought – clear statement of NPS I&M Program overall goals, and nice, concise numbered list of reasons why pinnipeds were specifically selected for monitoring. Fairly detailed section of legal mandates for protection also included.
   1.3. Measurable objectives: presented clearly as a numbered list of 'specific monitoring objectives'. All are measurable (e.g., population trends), although it may be quite challenging to analyze the data on disturbance levels, changing effects of disturbance, impacts etc. I had some questions about how threshold levels (e.g., for % population declines) were determined, as this did not seem to be stated in this section of the report. I did see objectives and questions in this section, but not testable hypotheses (at least not clearly identified as such).

   The threshold levels written into the protocol result from our power analyses of our northern elephant seal and harbor seal data. Text was added to Section 1.5.3 to emphasize that the thresholds reflect the change that our monitoring data is capable of detecting and that the levels are sufficient from a management perspective.

   The specific monitoring objectives were crafted based on guidance from the NPS Inventory and Monitoring Program. In conjunction with the threshold levels, the monitoring objectives may be approached as testable hypotheses for long-term analyses.

2. **Sampling design chosen**
   2.1. Rationale for design and site selection/replication in space and time: while the methods were very clearly described, there were some points where the rationale for selecting these methods seemed a bit thin. For example, "sampling design theories were applied to determine the frequency and timing of seasonal surveys" (p. 17) seems vague to me.

Presumably the power analysis came into play here somewhere, but this is not specifically referenced in this section?

Efforts have been made to explain more clearly the rationale behind our field methods. The above noted sentence has been removed. We emphasize that because we can survey all of the harbor seal and northern elephant seal breeding sites in a timely manner, no statistical sampling techniques are required to monitor the pinniped populations. We further note that based on our power analyses, the frequency and timing of our surveys have the ability to detect meaningful trends over time.

2.2. Site selection: the "population" being sampled is not defined specifically, but presumably is all seals (of a given species) within park boundaries. Also, I think a figure (e.g., a map showing study area, primary and secondary sites distinguished) would have been great to include here. The lack of a stratified design (beyond "primary" vs. "secondary" haul-out sites) was explained earlier in the report.

We have modified 2.2 Study Area and Site Selection to better outline the differences between what are considered primary and secondary sites. We have also clarified that our monitoring efforts are focused on primary sites where it is possible to count all individuals. Secondary sites are not monitored, but some ancillary data may be collected at these sites by I&M staff or volunteers. It is not really practical to list or map the number of secondary sites at PORE and GOGA. Secondary habitat is really any part of the coastline that is not a primary site. Because the primary sites encompass the vast majority of harbor seals and northern elephant seals during their respective breeding and molting seasons, we feel justified in describing our counts as censuses of the population. Because female northern elephant seals only give birth and mate in large colonies without returning to the water for approximately one month, these counts, which serve as the basis for our long-term trend analyses, can truly be described as censuses.

2.3. Sampling frequency and replication: clearly described for the most part (the "other species" category is only described briefly and are only counted at one site – perhaps because this is the only site they are regularly seen at? this wasn't explained in this section)

This section related to the frequency and timing of all pinniped species surveys has been removed from the protocol.

2.4. number/location of sampling sites: very clearly and simply described (essentially, "we count them all"), and included maps

2.5. Level of change that can be detected: based on a power analysis for harbor seal survey methods (81% likelihood of detecting a 40% decline over 5 yrs); power analysis has not been done for elephant seal or all species survey methods, and so these sections are less robust. The assumption for the elephant seal surveys is that the current level of surveying has been sufficient, but this is less convincing than the section incorporating a power analysis. The authors note that a power analysis may be done in the future for northern elephant seals and other spp; I would recommend that if possible, it be done prior to

finalizing the monitoring protocol, or, that plans to do one in the near future be incorporated into the methods.

A power analysis for northern elephant seals has been included in the protocol, thereby justifying our field methods and guiding our ability to detect trends. The all species monitoring program was removed from the protocol.

3. **Appropriate methods for sampling design chosen**
   3.1. Data collection methods: are described in detail, with sample data sheets, site maps, etc. included. Data methods are appropriate for monitoring purposes. I am often concerned about observer variability and/or observer bias when volunteers are used, but it sounds like volunteers are extensively trained (for one entire season) before being allowed to collect data independently.
   3.2. Post-collection processing: Not really applicable as no tissue samples etc. are regularly collected. However, data entry, proofing, data and report archiving, etc. are described.

4. **Data analysis techniques –** as discussed earlier, a power analysis has been conducted for the harbor seal monitoring program; I would recommend that (if at all possible given lack of funding) it also be done for the elephant seal and all species monitoring programs.

   A power analysis for northern elephant seals has been included in the protocol, thereby justifying our field methods and guiding our ability to detect trends. The all species monitoring program was removed from the protocol.

   4.1. Metadata procedures: applicable data standards used (for GIS datalayers etc.) are noted, and (when an official standard does not exist, such as is the case for natural resource databases and spreadsheets), the protocol states that SFAN will "complete the NPS Metadata Profile to the greatest extent possible to document the annual and master pinniped back-end databases". I assume that use of the NPS Metadata Profile will ensure that data is collected consistently and is compatible (or at least usable) by other parks, researchers, etc.

   As noted in the metadata section, the NPS metadata profile is based on the FGDC standard. More information regarding our metadata procedures are included in SOP 4 Data Management. We have updated the SOP and noted that the metadata is developed in the standard XML format and can thus be imported into other metadata programs.

   4.2. Database design: a relational database is used (MS Access), with an overview of the database included in the main report body, and additional detail in the Data Management SOP. It is difficult for me to assess this database without really "seeing it in action" (i.e., sitting down at a computer and having someone walk me through it), but it sounds sufficient.
   4.3. Data entry, verification and editing: quality control measures, etc., are described in an overview in the main report body, with additional data provided in the Data Management SOP. Data is entered within a week of collection (ideally, data would be entered on the same day, based on my own experience, but this is not always feasible I

suppose). The potential for error in the volunteer data collection is addressed, which is good.

4.4. Routine data summary procedures and statistical analyses to detect change, and methods for longer-term trend analysis: yearly reports are produced, containing data summaries for the counts, disturbance data collection, etc, with trend analyses done every 5 to 10 years. Change for harbor seal population is monitored using published regression models for monitoring population change. I have used a similar method for assessing change in seal populations, and like it because it is very straightforward and easy for readers and the general public to understand, unlike some of the more sophisticated time-series analysis methods preferred by some authors. Impacts of disturbance on population size and productivity will be analyzed using GLM's, in a method based on an in-press publication. Change for elephant seal numbers are assessed using direct counts, allowing calculation of indices of population trends. Description of how productivity indices are calculated is included. I did not see any mention of how "all species" data would be analyzed?

The all pinniped species component of the protocol has been removed from the protocol.

Statistical methods are sound and have the benefit of being relatively "user-friendly", making them more likely to be used by managers in other coastal areas, for purposes of comparison between pinniped populations.

Review Comments: Penny Latham, 1/05/2009

This was a very nicely done and well-edited protocol. (I don't think I saw ANY typos at all!!) I'd like to thank the authors and previous editors and reviewers for their contributions as this round of review went very well. I'd also like to apologize for the delay. Although this protocol review was sent to me in December 2008, the ensuing holiday prevented my reviewing the materials until now. I agree with the other reviewers decisions and feel that most of the important issues related to the protocol have been mentioned in those reviews; however, there are a few additional points that I would like to make.

1. The majority of editorial problems arose due to pagination issues relative to the NRRS Instructions to Authors (IA) guidance. (This has been updated as of 12/30/2008.) There are three main problem areas: how to organize the SOPs, the Table of Contents, and the instructions regarding the page that First Order Headings should be placed on. Contributing to the confusion about how to number the sections of the protocols is Question 1 in Section 2 of the Checklist that asks about TOCs for SOPs. The IA states that the document pages must all be consecutively numbered and all sections of the document (including Figures and Tables) need to be identified in the Table of Contents. There seem to be two primary ways to deal with the organizational issue: Put everything into one document and number all the pages, tables, and figures consecutively or separate the SOPs and narrative into two volumes each with its own TOC. Unless the authors have a good alternative to providing unique page numbers, figures and tables that works for

the series, I would suggest considering one or the other of these approaches. However, all pages after the title page (unless otherwise directed in the IA, e.g. blank pages and cover pages) should have a number.

The protocol narrative, SOPs, and Appendices are now all organized into one document with pages, tables, and figures consecutively numbered. There is a TOC at the beginning of the protocol narrative and a separate TOC for each SOP.

On the back cover page, "Natural Resource Program Center" in the banner should be removed. In a previous review that I did for the network, I asked authors to insert this title because the template I was working from showed it there. However, I spoke with Jason Bennett about it, and it should be removed. The templates and instructions on the NRPM web site have been updated.

Fixed

All sections of the report should be identified with a page number in the Table of Contents(s). So this portion of the TOC will need to be added. Please note that SOP 7 is not currently listed in the TOC.

Fixed

2. All figures and tables should have numbered captions that can be included in a TOC. There are several figures and tables that have "informal" captions that should be formalized with a number.

   Fixed

3. The synthesized review from Dr. Agee mentioned clarification regarding the target species and monitoring objectives. I agree that this needs clarification. Apparently for now the parks have arranged that I&M will be responsible for monitoring harbor seals whereas PORE will monitor elephant seals as long as it is possible. Data management will be accomplished by I&M for both of these monitoring efforts. In addition to this there are "Other species" that are monitored. It's not very clear from the discussion the extent to which the park is monitoring elephant seals, but after discussion with the Network Coordinator, it is clear that the park is currently fully implementing this protocol as part of their contribution toward Vital Signs monitoring using volunteers (and has for many years). This should be clearer in the narrative.

   Section 1.5.4 has been modified and now more clearly indicates what monitoring is funded by the I&M program versus supported by the parks. With the addition of the power analysis for the northern elephant seal data, we have retained methods for monitoring this species in the protocol. Sections and the SOP related to "All Species Monitoring" have been removed.

4. On pg. 5, in the first paragraph under the figure, you state that the elephant seal population grew by almost 9% from 2005 to 2006 and reference Table 1. Perhaps I misinterpreted the table but population growth from the table seems to be about 18% (2100/1771). Did you mean from 2006 to 2007? Also the next sentence refers to the total population figures for 2005 and 2006. These are not the same figures as those in the table. I think you mean 2006 and 2007. Please check these figures.

   Data from Table 1 was reported in error. We have adjusted the first part of the paragraph and compared the 2005 population estimate with 2007, indicating a 29% increase. The paragraph now references the correct values and percent increase.

5. On pg. 9, there is a paragraph about the ESA to support choice of pinnipeds for monitoring; however, the only pinniped that is listed is the Steller Sea Lion which is not an official part of this protocol. You might expand on this paragraph to add more explanation or de-emphasize this aspect of justification for monitoring.

   The paragraph is primarily about the Marine Mammal Protection Act, which does apply to our selected monitoring program. References to the Endangered Species Act are made in regards to the selection of pinnipeds in general as an important resource to monitor, not specifically in regards to harbor seal or northern elephant seal monitoring. Steller Sea Lions are counted incidentally during our surveys, and that data is maintained within our database. Language regarding the ESA was not modified within the protocol.

6. On pg. 11, you mention linkages between fish assemblages and pinniped monitoring and list several important streams. Do these streams occur in the same watersheds where you are monitoring pinnipeds?

   Three of the streams monitored for salmonids by the SFAN I&M program flow into estuaries monitored for harbor seals. A sentence noting this was added to the protocol.

7. Along with Reviewer 2, I also wondered about the difference between primary sites, secondary sites, and their relationship to sampling descriptions that referred to “all”. It was often difficult to tell when you were referring to a census or sampling all the sites whether you meant just the “primary” sites or whether that included the “secondary” sites as well. If the secondary sites are not being monitored with any consistency, it will be hard to make the case that you are censusing the population (i.e. counting it all). It would be helpful if you could include a small table that showed “n” for primary and secondary sites and described the frequency with which you sample each. Reviewer 2 also suggested a map showing these 2 strata.

   We have modified 2.2 Study Area and Site Selection to better outline the differences between what are considered primary and secondary sites. We have also clarified that our monitoring efforts are focused on primary sites. Secondary sites are not monitored, but some ancillary data may be collected at these sites by I&M staff or volunteers. It is not really practical to list or map the number of secondary sites at PORE and GOGA. Secondary habitat is really any part of the coastline that is not a primary site. Because

the primary sites encompass the vast majority of harbor seals and northern elephant seals during their respective breeding and molting seasons, we feel justified in describing our counts as censuses of the population. Because female northern elephant seals only give birth and mate in large colonies without returning to the water for approximately one month, these counts, which serve as the basis for our long-term trend analyses, can truly be described as censuses.

8. The description of field methods on pgs. 31 (Harbor Seals) and 32 (Northern Elephant Seals) are not comparable in structure or style making it hard to compare the methodology between the two species. Pg. 31 has two additional sections on tagging HS that do not occur for NES. If you are not tagging NES it would be good to state that. Also the section on population counts for HS does not give any information about what is counted as does the corresponding paragraph on pg. 32. If the method is the same state it for Harbor Seals (the primary species for this protocol) and then state how it differs or is the same for NES. I would take a similar approach for each of the paragraphs on methods adding other information as needed.

   The comment above is incorrect. There are additional sections on tagging and resighting for northern elephant seals, not for harbor seals. However, we added in these sections for harbor seals just to clarify that this is not a part of the monitoring program although we do collaborate in these regards with outside researchers. Our method for population counts of harbor seals was clarified. The other methods sections were reviewed for consistency.

9. In Table 4, the periodicity for synthetic reports is 5-10 years; however, throughout the discussion of analysis and reporting in other sections and SOPs of the protocol, you generally state that such an analysis will occur every 5 years. I point this out in case this is something that you meant to change but didn't.

   Corrected Table 4 to indicate that synthesis reports will occur every 5 years.

10. Lit Cited: Other reviews have provided several comments. Also look for consistent use of initials as citations mix use of initials and complete first names. Manuscripts that still are being worked on are usually cited as (In prep).

    Fixed

11. In the TOC for SOP 2 there is a bookmarking error for one of the sections on pg. 4 of the SOP.

    Fixed.

12. In SOP 7, subsequent appendix captions reference northern spotted owls instead of pinnipeds.

    Fixed.

SOP 6. Safety Procedures
Version 1.4

Revision History Log

Previous Version #	Revision Date	Author	Changes Made	Reasons for Change	New Version #
	Nov. 2007	Dawn Adams	Created	To meet new formatting and content guidelines.	1.0
1.0	June 2008	Dawn Adams, Marcus Koenen	Layout, added emergency #s	Edited for peer review	1.1
1.1	September 2009	D. Press, M. Koenen	Formatting	To meet NRPM standards.	1.2
1.2	November 2009	K. Freeman, D. Press		Formatting requirements.	1.3
1.3	December 2009	D. Press	Reformatted headings and borders of JHA appendix.	Comments from Penny Latham.	1.4

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This SOP provides safety information related to monitoring pinnipeds at Golden Gate National Recreation Area (GOGA) and Point Reyes National Seashore (PORE).

Also see SFAN Field Safety SOP maintained on the GOGA Marin Headlands server (Inpgogamahe1\Divisions\Network I&M\Shared\Standard Operating Procedures\SFAN Field SOPs\Standard Operating Procedures) for information on:

- Emergency Procedures
- Emergency Contacts for PORE and GOGA
- Vehicle Safety
- Air Quality Guidelines
- Slippery Substrates
- Mandatory Safety Equipment
- Recommended Personal Gear

1.0 Weather and Field Attire

Summer conditions are often mild (between 60 - 80°F), but when conducting fieldwork along the coastal environment, it is important to dress appropriately for a range of weather conditions. Because of the possibility of encountering poison oak and general uneven terrain encountered off-trail, field personnel should wear long pants and high topped hiking boots. Leg gaiters are also recommended to reduce the exposure to poison oak and the risk of tick bites during surveys. Since surveys can last longer than anticipated, field personnel are encouraged to take extra food and drinking water into the field.

2.0 Field Hazards

Biting or stinging invertebrates (wasps, spiders, ticks) may be encountered. The bites or stings from these animals can be painful, but usually not fatal. If bitten or stung and painful swelling or an allergic reaction occurs, seek medical attention immediately. Check your clothing and exposed skins frequently when in the field for ticks and upon returning from the field, do a more thorough body search for ticks.

Poison oak is found throughout the owl habitat in the study area. Before doing any fieldwork personnel should become familiar with the dangers associated with exposure to this native plant. If exposure occurs wash thoroughly with soap and rinse with plenty of water upon returning from the field and then apply Tecnu® ointment (provided at headquarters). If a strong reaction occurs, seek medical attention and alert your supervisor as soon as possible.

Appendix SOP 6 A is the Job Hazard Analysis (JHA) done for the pinniped monitoring program. The JHA analyzes the duties, tasks, and potential hazards associated with the program, and addresses the hazards through safe work behaviors and procedures.

Appendix SOP 6A. Job Hazard Analysis (JHA) for Pinniped Monitoring Activities.

POINT REYES NATIONAL SEASHORE Job Safety Analysis	Job Title: Seal Population, Tagging and Resight Surveys page 1 of 3	Date: June 12, 2006 Analysis by: Heather Jensen, Dawn Adams, Jeannine Manna
Division: SCIENCE	Title of person (who does this job): Wildlife technician, Volunteer	Reviewed by: Sarah Allen
Location: Point Reyes National Seashore	Supervisor: Dave Press	Approved by:
Personal Protective Equipment: Thick pants, sturdy boots		
Training and/or certifications		Permits
A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Identify steps and sequence of work activities	Task: Identify hazards in each basic step. Site: Identify site hazards that could affect workers	Determine specific controls and safe behaviors for each hazard.
Office Work- Computer use for email and data entry	Muscle and eye strain, repetitive stress injury	Proper posture and use of ergonomic furniture Take breaks every hour
Travel to Field Locations in Vehicle	Driving hazards such as accident	Use defensive driving techniques Expect oncoming traffic on one-lane roads in park Be alert for foggy conditions Watch for cow, deer, elk and other wildlife, and adjust speeds to safely operate around areas of high use Obey traffic laws and wear seatbelt at all times Do not drive when fatigued, be familiar with route or prepare for unknown route Do not talk on radio or cell phone while driving

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Travel to Field Locations in Vehicle (cont.)	Driving hazards such as accident (cont.)	Do not put hot drinks on your lap Be familiar with the vehicle and its operation Check gauges, tires, wipers, fluids and replace when necessary Check vehicle has spare tires, jumper cable and jack with all parts.
Seal capture, handling or tagging	Seal bites while restraining Being charged by seals when tagging or moving within the colony Exposure to disease or blood borne pathogens when handling dead seals	After capture, control seal's head and flippers at all times. Keep head at a safe distance from team while handling Communicate location of seals clearly with your field partner, and have one person watching seals at all times Do not tag female seals; tag male seals only when they are asleep. Wear protective gear (gloves and mask) when handling dead seals to reduce disease exposure.
Hiking to work areas on trails, routes or off trail navigation	Getting lost or confused as a group, or losing a crew member	Have map and compass and other navigational aids and know how to use them. Travel together when off-trail Make sure all members of the team are aware of location, and can find route out if they are separated. When trail hiking, plan stops at trail junctions to regroup. Arrange meeting places and times -all crewmembers must wear a watch. Have travel and activity plan for each day and make sure it is understood by all crewmembers Stay in communication via radio or cell phone or stay in sight Carry radio and spare batteries If lost or disorientated, stay calm, look and listen for the ocean and other landmarks. Assess location by consulting map and landmarks, and proceed to nearest road or trail.

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Hiking to work areas on trails, routes or off trail navigation (cont.)	Getting lost or confused as a group, or losing a crew member (cont.)	Do not panic- Have a mental plan for what to do if lost If injured, stay put and radio or call dispatch.
	Problem when working alone (falling, lost)	Leave a travel/survey plan with a co-worker or responsible party who will notify proper authorities in the event of a disappearance. Carry a light source and extra batteries.
	Loose footing	When traveling in areas with steep or unstable terrain, stagger your positions so that you are not immediately below someone, yell "rock" if you dislodge one.
	Lightning storms	In the event of a lightening storm, turn your radio off, if near a vehicle, get entirely inside. If in the out of doors try to do the following: separate the group, get off ridge tops and away from trees, get as low as possible and if possible lie on conductive material.
	Wind storms	If it is windy enough to blow small twigs and branches out of the trees, try to get out of the woods or find an area away from hazard trees
	Exposure to cold, wet conditions	Wear proper equipment- and bring extra layers. Recognize the signs of hypothermia in yourself and others Carry and eat high-calorie foods, stay well-hydrated
	Exposure to heat and sun	Have hat, sunscreen and sunglasses
	Overexertion and dehydration	Recognize the signs of dehydration Take frequent rest stops (15 min per every 2 hours) and stay hydrated
	Injuries due to hiking (aches, sprains and blisters)	Pay attention to footing- plan ahead for the route to avoid steep, unstable terrain Use appropriate footwear, boots and socks. Prevent blisters and have blister treatments (moleskin, tape etc) accessible.

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Hiking to work areas on trails, routes or off trail navigation (cont.)	Injuries due to falling (lacerations, broken bones, head injuries) Injuries due to carrying a heavy pack	Pay particular attention to traveling on steep slopes, unstable terrain, through dense vegetation, and in foggy conditions. Practice fall- arrest techniques (roll on to stomach, dig elbow, feet and knees in). Have first aid kit, stabilize injured person, treat for shock and know how to initiate rescue via radio Reduce pack weights when possible Pay attention to how you put your pack on (avoid twisting motions- get help or place pack on surface or against tree) Make sure your pack is properly fitted and balanced Bring hiking poles to use to stabilize yourself in unstable or steep terrain.
Hiking to work areas on beaches and across streams	Exposure to high tides on beach, routes cut off	Check tides before going out and plan travel accordingly. If caught on beach on a rising tide, move as high up the cliff as possible, but in an area that you can be seen from above. Use alternate land routes if possible for one leg of the trip. Be careful on slippery logs, intertidal areas covered in algae, and watch footing on either side of stream or channel crossings. Adjust pace and footing to allow you sure footing as you move through the tidal zone. Don't allow incoming waves to rush you.
Working in the outdoors	Exposure to allergy causing plants and insects	Alert crew members to possible problems with allergens. Be alert for toxic plants and alert to common bee and wasp nesting habitat and activity-especially the person in front. Carry benedryl, epi-pen or other anti-histamine if you have known allergic reactions.

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Working in the outdoors (cont.)	Exposure to toxic plants	Avoid poison oak when possible. Wear long sleeved shirts, long pants, and hiking boots. Wash skin exposed to poison oak with Technu or other appropriate cleaner and change clothes if necessary at end of day/survey. Do not eat any fungi or plant unless you are 100% sure it is edible.
	Exposure to ticks	Wear proper attire (long sleeved shirts and long pants) and do frequent tick checks. If bitten by black legged tick, properly remove tick, save tick, send tick in for lab analysis, and monitor general health condition.
	Exposure to Giardia, E. coli and other pathogens	Do not drink any water unless it has been filtered, boiled or treated in some fashion Do not create more contaminated areas- urinate away from streams and water, dig a cathole for solid waste and bury toilet paper. Wash hands when possible and carry hand cleaner
	Improper nutrition due to inappropriate food choices	Bring a variety of healthy, nutritious food that will give you good energy during travel and work. Do not rely on sugar snacks.
	Loss of food to bears, ravens, raccoons, small animals	Prevent animals from getting into your food by not leaving you backpack open or accessible to animals.
	Cougar attack	If approached by cougar make yourself large and noisy, wave arms, yell, bang pots, grab a stick. Back away from cougars but do not turn and run, ever. If attacked, fight back
	Strange or aggressive human interactions	Terminate contact with visitor and leave the area, contact dispatch

A. SEQUENCE OF BASIC JOB STEPS	B. POTENTIAL JOB HAZARDS	C. SAFE BEHAVIORS- SAFE WORK PROCEDURES REQUIRED TO COMPLETE THE JOB/PROJECT
Working around seals on the beach	Injuries from seals	Alert dispatch to your presence on the beach (check in/out). Work in pairs, with one person as a safety spotter. Watch the surf zone for new seals arriving on the beach. Identify escape routes away from the seals and danger. Maintain safe distances away from the seals when not tagging.
	Disease transmission	Do not eat after handling seals. Wash hands with hand sanitizer initially and follow up with soap and water when you return from the field.
	Injuries from falling rocks and debris	Work in pairs, look above you periodically for deer, people, etc., that could cause a debris slide.

Appendix A: Power Analysis for the NPS San Francisco Bay Area Network Harbor Seal (*Phoca vitulina*) Monitoring Program.

Ben Becker
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Introduction

The National Park Service's (NPS) San Francisco Area Network (SFAN) Inventory and Monitoring (I&M) program is interested in estimating the statistical power (probability of detecting a trend, given one exists) of the harbor seal (*Phoca vitulina*) monitoring program at Point Reyes and Golden Gate NRA. To date, no formal power analysis has been done. Here, I use deterministic methods (software Trends; Gerrodette 1993; Taylor et al. 2007) and Monte Carlo simulations using the Software Monitor v7.0 (Gibbs 1995) to estimate the likelihood that the existing monitoring program will detect a 25% or 50% decline at individual colonies, and the number of years it would take to detect a 10% annual compounded decline for the six major colonies as a group, excluding Duxbury Reef and Point Bonita. These analyses should be considered for guiding purposes only.

Methods

Maximum counts for adults and pups from surveys during the pupping season were compiled from 2000 – 2008 for 8 colonies from north to south: Tomales Bay, Tomales Point, Point Reyes Headlands, Drakes Estero, Double Point, Duxbury Reef, Bolinas Lagoon, and Point Bonita. Because Duxbury Reef and Point Bonita are mainly molting sites with few pups, I used molting season maximum count data for this analysis.

The primary objectives were to use legacy data to (1) assess number of years needed to detect a 25% or 50% decline at any one colony, and (2) to assess power to detect declines among the six primary pupping sites. To assess the importance of temporal autocorrelation, autocorrelation plots of each time series were produced. I then performed linear regressions (with normally distributed errors) on maximum adult and pup counts (separately) during each pupping season from 2000 – 2008 at each colony. The standard error of the regression estimates and mean counts during the time series (Table 1) were used to develop a modified (detrended) CV for power analysis (Hatch 2003). I then used the power analysis software Trends (Gerrodette 1987) to assess power to detect trends at any given subsite. The Monte Carlo simulation software Monitor v7.0 (Gibbs 1995) was used to assess power to detect changes over the entire SFAN population during the pupping season, not including Duxbury Reef and Point Bonita (which are mainly molting sites). The Trends software is not designed to assess multiple sites at once, while the Monitor software can model multiple plots. Individual colony power analyses used the following assumptions: 1-tailed tests, linear population trends through time, a relaxed $\alpha = 0.20$, CV constant with abundance, and equal sampling intervals. The combined six colony power estimates were estimated using Monitor v7.0 and each colony was weighted by its relative mean

abundance during the 2000 – 2008 study period. The alpha was reduced to 0.10 for this analysis due to larger sample size.

Results

Time series of adult maximum counts are shown in Figure 1. Autocorrelation plots for maximum counts of adults at each of the eight colonies did not suggest that there was any temporal autocorrelation, as all values at lags 1-8 were far below significant, and always less than |0.4| (ns) at lag 1 (Figure 2). The coefficient of variation for pupping season adults (here considered as the standard error of the regression estimate / mean count during the study period) ranged from 0.10 (Tomales Bay adults) to 0.27 (Tomales Point adults) (Table 1).

All of the six pupping sites had an 80% chance of detecting a 50% decline in adults at any one colony within 2-5 years, not including the base year (Table 1, Fig. 3). Detecting an overall 25% decline in adults would always take at least 14 years, not including base year. 50% declines pups at each of the six pupping sites could be detected in 2-7 years, and 25% declines for pups would always take at least 14 years, except for at Bolinas Lagoon, which would only take 4 years.

Power was generally higher for both adults and pups for the six major SFAN pupping sites pooled (excluding Duxbury Reef and Point Bonita). Current monitoring effort had a 90% chance of detecting a 27% decline in overall population counts over 3 years (Table 2, Fig. 4). For pups, an 88% chance of detecting a 36% decline would be realized after 4 years. Thus, after only three years of monitoring (not including the baseline year) the current program is very likely to detect ~25% declines in both adults and pups.

Discussion

Statistical power to detect 50% declines at individual colonies for both adults and pups is quite strong, with 2-5 years for adults, and 2-7 years for pups, not including the base year. However, 25% declines will be much more difficult to detect at these sites. It is encouraging that pooled power at the six main pupping sites is quite good and would likely detect large declines in a matter of a few years.

It is important to acknowledge the pitfalls of power analysis estimates. In this case, the calculations make several assumptions that may prove to be untrue and could cause over or under estimates of power. If temporal autocorrelation within a site was present, then the estimates presented here are too optimistic. While there was no apparent autocorrelation in this nine year time series, this is a small sample size and correlation could have simply not been detected. Additional considerations are that CVs may well vary with population size as it does in many animal populations; however, the residual plots for the regressions did not show any patterns, suggesting that variance-mean relationships are stable within sites and with this dataset. A plot of standard mean counts versus standard errors among sites does show increasing variation – mean relationship, but this is to be expected and does not imply anything about within site processes. It simply indicates that colonies with more seals have larger standard deviations (which was modeled), not that standard errors change when a colony changes in size. Other issues in power analyses that may affect power estimates include erroneous use of simple coefficients of variation from a single year, which generally under estimates true variance (Hatch 2003). Here, I used the standard error of the regression estimate, which incorporates both within

year and between year variation, as well as removing any trend from the variance estimate. Therefore, this should also not be an issue with this dataset.

Acknowledgements

This report benefited from conversations with Sarah Allen, David Press, Dale Roberts, Heather Jensen, Dawn Adams, Bill Merkle, and Marcus Koenen. David Press and Dale Roberts provided harbor seal count data for analyses. Sarah Allen and David Press reviewed previous drafts of this report and their comments were incorporated.

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Taylor, B.L., M. Martinez, T. Gerrodette, J Barlow, and Y. N. Hrovat. 2007. Lessons from Monitoring Trends in Abundance of Marine Mammals. Marine Mammal Science 23: 157–175.

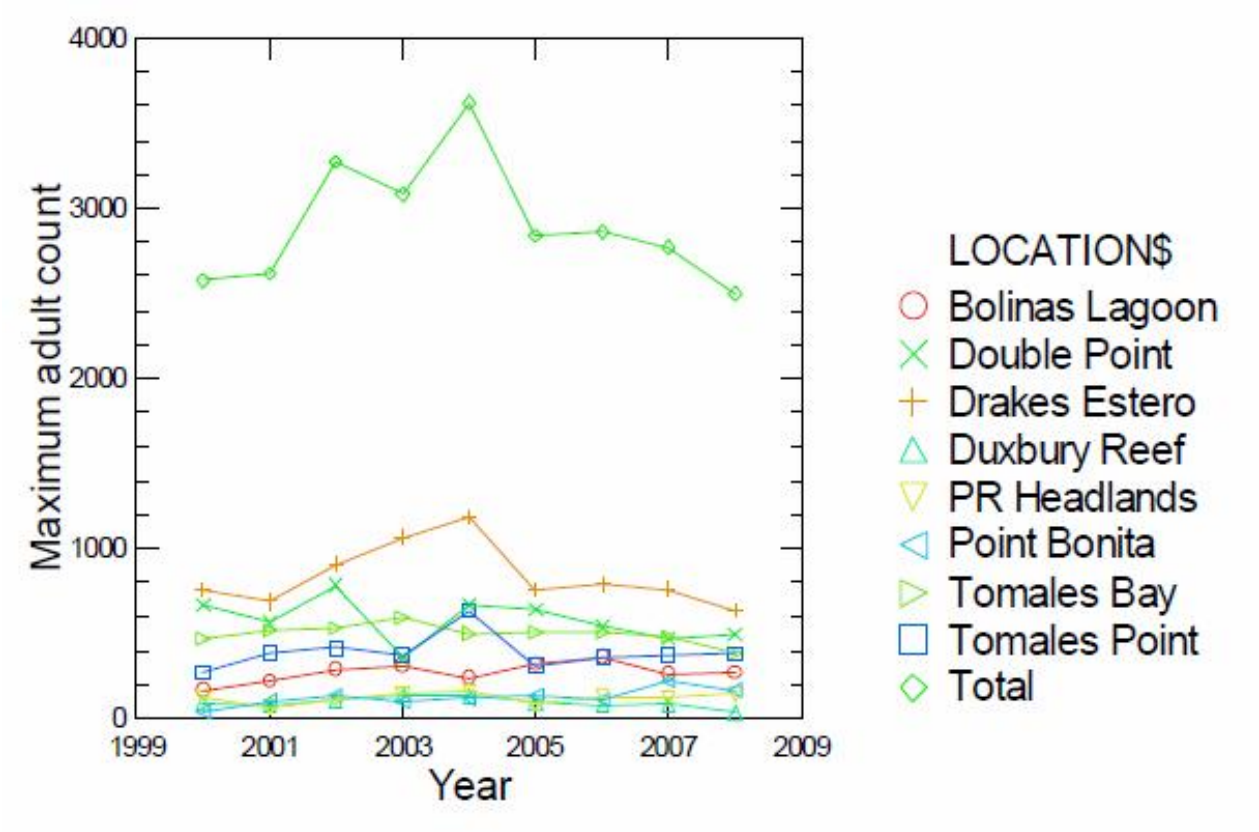
Table 1. Years to achieve 80% power to detect an overall 25% or 50% decline during the pupping season at SFAN harbor seal colonies. Alpha set at 0.2, 1-tail tests, CV assumed constant with abundance.

	Adults					Pups					
Site	Mean maximum count: 2000 - 2008	Std. error of the regression estimate	SE/Mean	Number of years to achieve 80% power to detect a 25% decline	Number of years to achieve 80% power to detect a 50% decline	Mean maximum count: 2000 - 2008	Std. error of the regression estimate	SE/Mean	Number of years to achieve 80% power to detect a 25% decline	Number of years to achieve 80% power to detect a 50% decline	Weight in 6 site model
Bolinas Lagoon	271	52	0.19	14	2	133	13	0.10	4	2	2
Drakes Estero	835	190	0.23	21	4	362	71	0.20	15	3	7
Double Point	574	124	0.22	19	3	288	92	0.32	ns	7	5
PR Headlands	119	30	0.25	25	4	47	9	0.19	14	2	1
Tomales Bay	497	52	0.10	4	2	153	35	0.23	21	4	4
Tomales Point	390	106	0.27	ns	5	159	49	0.31	ns	7	3
Duxbury Reef*	95	64	0.67	ns	ns	9	7	0.78	ns	ns	.
Point Bonita*	140	16	0.11	4	2	4	2	0.50	ns	20	.

*Duxbury Reef and Point Bonita data for adults from the molting season
ns: not solvable with Trends software. Assume greater than 30 years.

Table 2. Power to detect a negative trend for adults and pups at 6 pooled harbor seal colonies at PRNS. Years do not include baseline year. 6 core sites are DE,DP,TB,BL,TP, and PRH. Colonies weighted by mean maximum count from 2000-2008, 1-tail, 500 iterations, linear trend assumed, alpha = 0.10.

		Power	
Years	% decline	Adults	Pups
2	19	0.70	0.49
3	27	0.90	0.71
4	36	0.98	0.88
5	41	1.00	0.94



Firgure 1. Maximum adult harbor seal counts during the breeding/pupping season for PORE and GOGA monitoring sites.

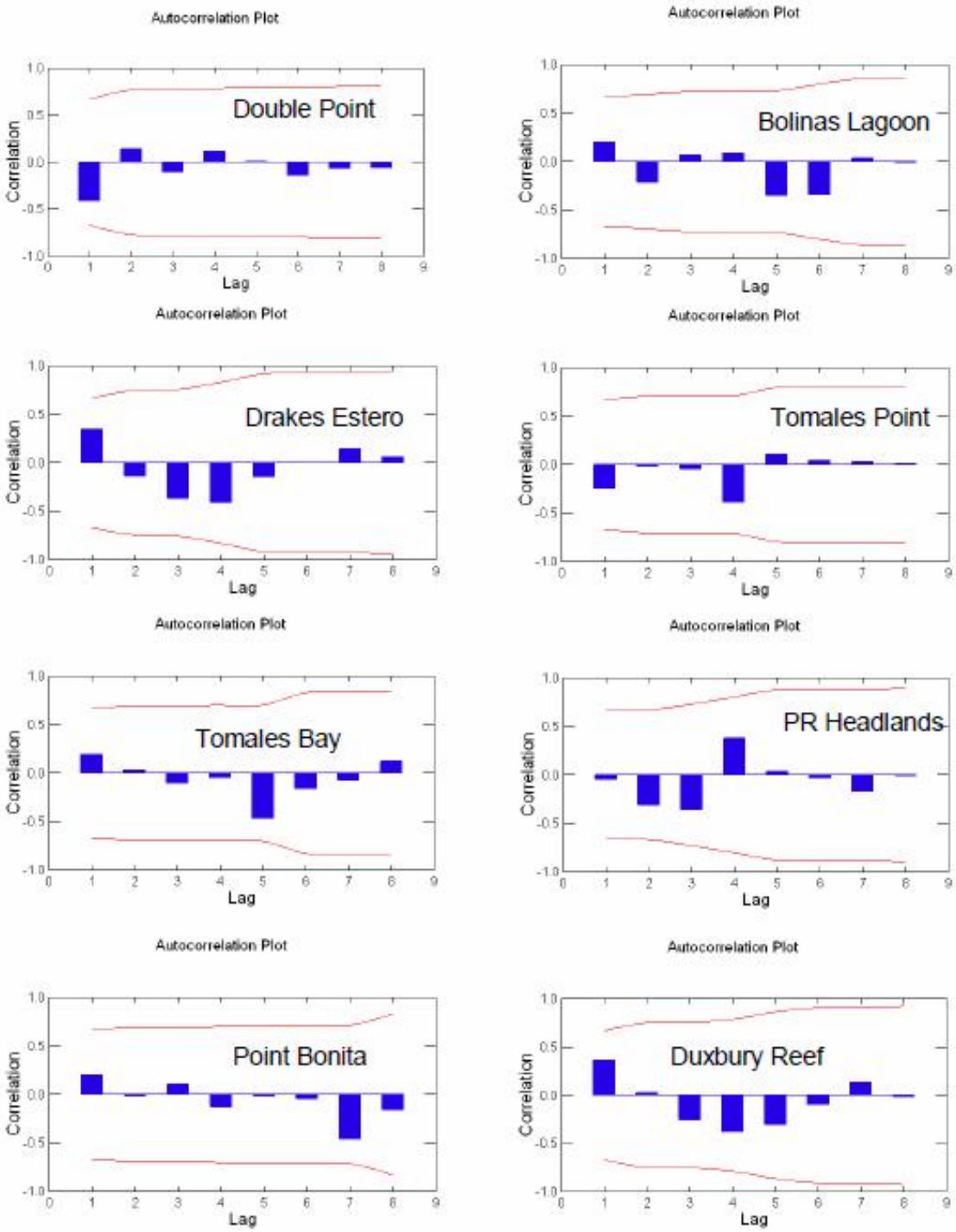


Figure 2. Temporal autocorrelation plots of maximum adults counts during the pupping season for 2000 – 2008. Although we have low sample size, there is nonetheless minimal evidence for temporal autocorrelation at lag 1 or greater. We therefore ran the power analysis without correction for temporal autocorrelation. Red lines indicate significance threshold.

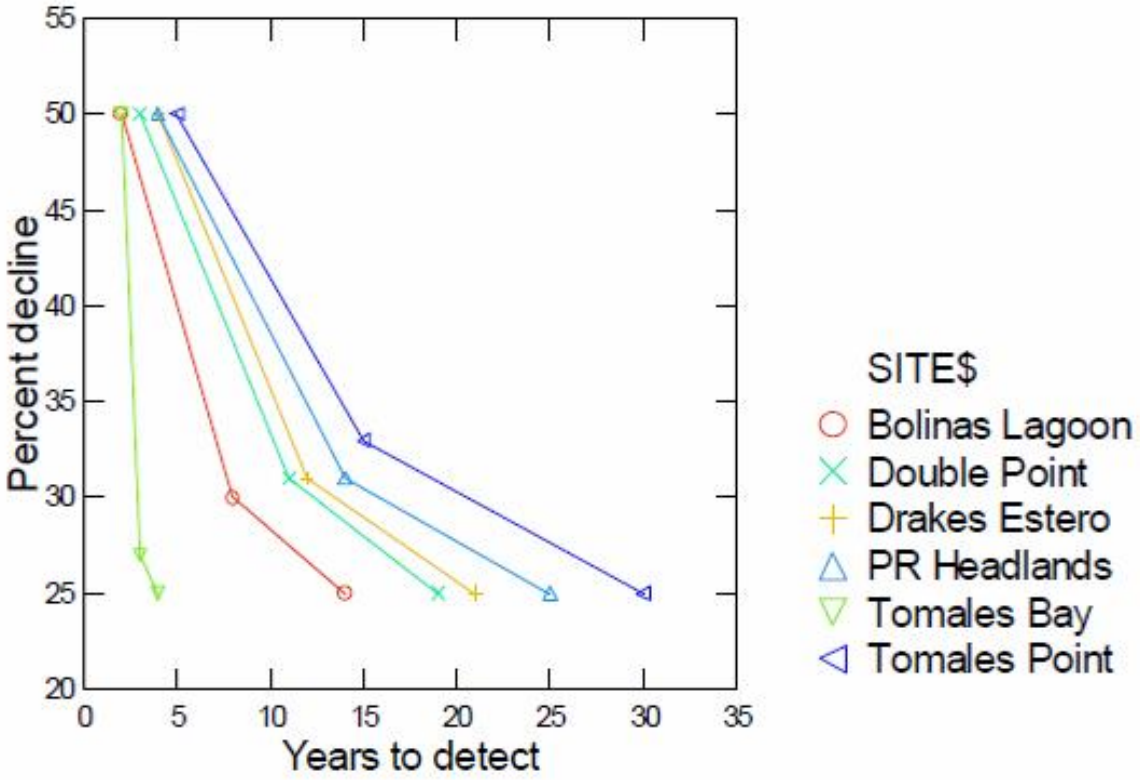


Figure 3. Number of years required to detect various percent declines at 80% power for the six harbor seal colonies. Linear fits between points likely slightly overestimate time needed to detect a trend.

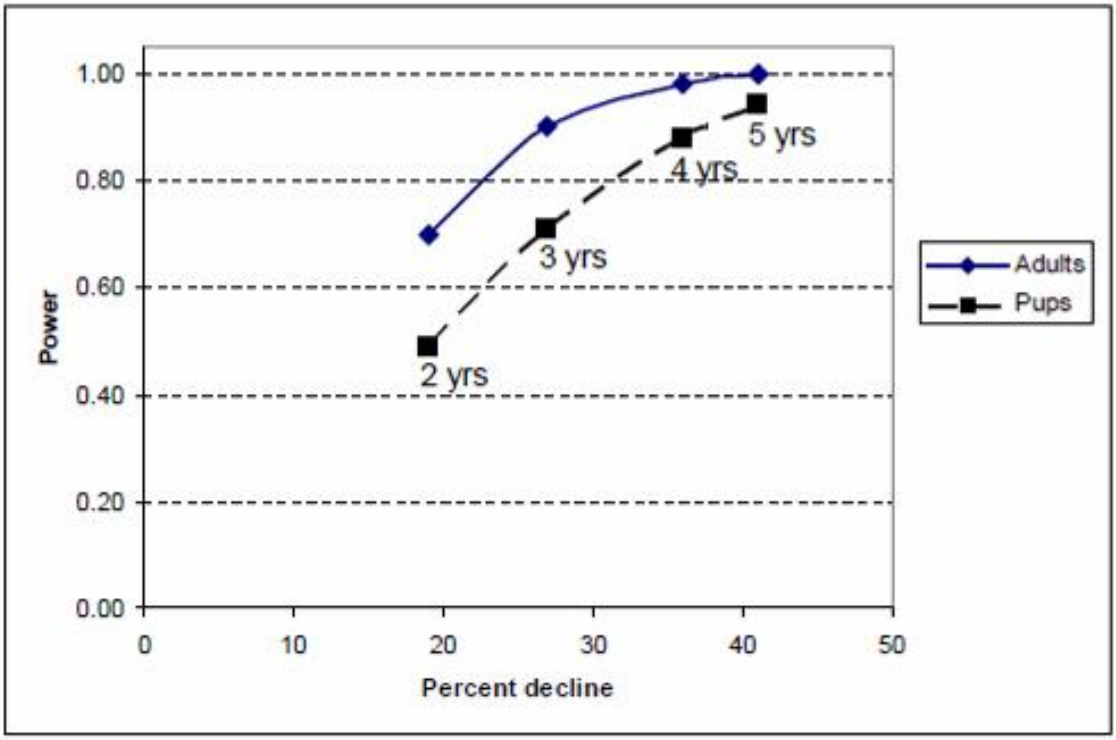


Figure 4. Graphical representation of Table 2. Power to detect 10% compounded annual declines in adults and pups in the six main pupping colonies and number of years required to detect the change. Number of years does not include the first year of monitoring.

Appendix B. Power Analysis for the NPS San Francisco Bay Area Network Northern Elephant Seal (*Mirounga angustirostris*) Monitoring Program

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Introduction

The National Park Service's (NPS) San Francisco Area Network (SFAN) Inventory and Monitoring (I&M) program is interested in estimating the statistical power (probability of detecting a trend, given one exists) of the northern elephant seal monitoring program at Point Reyes National Seashore. To date, no formal power analysis has been done. Here, I use deterministic methods (software Trends; Gerrodette 1993; Taylor et al. 2007) and Monte Carlo simulations using the Software Monitor v7.0 (Gibbs 1995) to estimate the likelihood that the existing monitoring program will detect a 25 or 50% decline at individual colonies, and the number of years it would take to detect a 10% annual compounded decline *or* increase for total maximum count. These analyses should be considered for guiding purposes only since many assumptions may be violated by the actual data.

Methods

Maximum counts for adult cows and pups+weaners from surveys during the breeding season were compiled from 1998 – 2009 for Point Reyes Headlands, South Beach, and North Drakes Beach, as well as the maximum count day for all colonies. Cow adults were used as a proxy for total breeding population size because northern elephant seal males, particularly sub-adults, are highly mobile during the breeding season, which can result in them being double-counted. The total number of breeding females is estimated using the maximum count of adult females during peak pupping adjusted to include the adult female counts 33 days prior to and 33 days after the peak count for each colony site. This adjustment takes into account females that depart early and those that have not yet arrived at the time of the peak count. The maximum count of pups plus weaners for each colony provides an estimate of actual pup production.

The primary objectives were to use legacy data to (1) assess number of years needed to detect a 25% or 50% decline at any one colony, and (2) to assess power to detect increases or declines among the 6 primary pupping sites when pooled. To assess the importance of temporal autocorrelation, autocorrelation plots of each time series were produced. I then performed linear regressions (with normally distributed errors) on maximum cow and pup counts (separately) during each pupping season from 1998 – 2009 at each colony. The standard error of the regression estimates and mean counts during the time series (Table 1) were used to develop a modified (detrended) CV for power analysis (Hatch 2003). I then used the power analysis software Trends (Gerrodette 1987) to assess power to detect trends at the three major colonies. The Monte Carlo simulation software Monitor v7.0 (Gibbs 1997) was used to assess power to detect changes over the entire SFAN population during the pupping season. The Trends software is not designed to assess multiple sites at once, while the Monitor software can model multiple

plots. Individual colony power analyses used the following assumptions: 1-tailed tests, linear population trends through time, a relaxed $\alpha = 0.20$, CV constant with abundance, and equal sampling intervals. The combined six colony power estimates were estimated using Monitor v7.0 but rather than using each colony separately, analysis was performed on the maximum daily count of all colonies.

Results

Both cows and pups+weaners tended to increase at most colonies, except Point Reyes Headlands, which has shown some leveling in recent years (Figs. 1 and 2).

The coefficient of variation for cows (here considered as the standard error of the regression estimate / mean count during the study period) ranged from 0.13 for the total population of cows up to 0.37 at South Beach (Table 1). Pups had a similar range from 0.18 to 0.42. The standard error of the regressions increased linearly with the mean. Temporal autocorrelation at lag = 1 was significant for two of the colonies, as well as all colonies combined (Fig. 3); nonetheless, the power analysis did not incorporate autocorrelation and some pitfalls of this are discussed below.

For cows, Point Reyes Headlands had an 80% chance of detecting a 50% decline in only 2 years, as well as the population as a whole. However, North Drakes Beach and South Beach would take 8-9 years to detect a 50% decline. Detecting an overall 25% decline in adults would always take at least 7 years for the population pooled (at alpha = 0.2 and 80% certainty). 50% declines in pups pooled could be detected in 2 years, and 25% declines for pups would take at least 12 years to detect. Figure 4 shows the power curves.

Using Monitor for all sites combined, monitoring effort had an 86% chance of detecting a 36% decline in cows over 4 years (Table 2). For pups, an 83% chance of detecting a 41% decline would be realized after 5 years. Increases were easier to detect, generally having 0.1 - 0.2 higher power. Thus, after only 4-5 years of monitoring (not including the baseline year) the current program is very likely to detect 36-41% declines or increases in both adult cows and pups (Fig. 5).

Comparison of adjusted cows versus pups+weaners indicate 80 pups for every 100 females on average for the total population from 1998 – 2009 (Fig 6). However, the individual colonies vary greatly with PRH having on average only 76 pups for every 100 females, and both SB and NDB having 98-99 pup+weaners for every 100 females (Fig. 6). The higher number of pups+weaners to cows at DSB represents dispersal of pups+weaners from the adjacent PRH due to overcrowding and storm-related events.

Discussion

It is important to acknowledge the pitfalls of power analysis estimates. In this case, the calculations make several assumptions that may prove to be untrue and could cause over or underestimates of power. The apparent temporal autocorrelation at two of the sites and the population as a whole may have inflated the predicted ability to detect trends, thus, the estimates at North Drakes Beach, South Beach, and the total population may be slightly optimistic. When these trends are actually tested, analysts should be careful to use Poisson (or similar count based) regression with autoregressive errors to account for this autocorrelation. Additional

considerations are that CVs may well vary with population size as it does in many animal populations, however, the residual plots for the regressions did not show any patterns of increasing variance (although there was some heteroscedasticity due to the increasing population with time), suggesting that variance-mean relationships are possibly stable within sites and this dataset. A plot of standard mean counts vs. standard errors among sites does show increasing variation – mean relationship, but this is to be expected and does not imply anything about within site processes, it simply indicates that colonies with more seals, have larger standard deviations (which was modeled), not that standard errors change when a colony changes in size. Other issues in power analyses that may affect power estimates include erroneous use of simple coefficients of variation from a single year, which generally underestimate true variance (Hatch 2003). Here, I used the standard error of the regression estimate, which incorporates both within year and between year variation, as well as removing any trend from the variance estimate. Therefore, this should also not be an issue with this dataset.

The pup+weaner:cow ratios and their variation through time (Fig. 6) may serve as a foundation to understanding those colonies that are better suited to pupping, as well as local movements of weaners and cows. The overall 0.80 cow:pup+weaner ratio is considerably lower than for Año Nuevo and SE Farallon Island rookeries (Huber 1987; Le Boeuf and Reiter 1988; Huber et al. 1991), where an estimated 97.5% and 93.2% of the females in residence give birth, respectively.

Finally, a new version of Monitor (Version 10.0) is in development (as of August 2009) and is expected to model temporal autocorrelation as well as autocorrelation among plots (colonies). I recommend reperforming these analyses with the updated software since there may be an autocorrelation issue for these eseal time series data (Fig. 3) that could overestimate power.

In summary, the monitoring program appears to have good power to detect population wide declines of >36% over 4 years. However, the significant interannual autocorrelation observed (likely due to the increasing population), may slightly overestimate power in this analysis.

Acknowledgements
This report benefitted from conversations with Sarah Allen, David Press, Dale Roberts, Heather Jensen, Dawn Adams, Bill Merkle, and Marcus Koenen. David Press and Dale Roberts provided elephant seal count data for analyses. Sarah Allen and David Press reviewed previous drafts of this report and their comments were incorporated.

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Taylor, B.L., M. Martinez, T. Gerrodette, J Barlow, and Y. N. Hrovat. 2007. Lessons from Monitoring Trends in Abundance of Marine Mammals. Marine Mammal Science 23: 157–175.

Table 1. Years to achieve 80% power to detect an overall 25% or 50% decline in Cows. Alpha set at 0.2, 1-tail tests, CV assumed constant with abundance.

	Cows						Pups / weaners					
Site	Mean maximum count: 1998 - 2009	Std. error of the regression estimate	SE/Mean	1998-2009 linear trend	Number of years to achieve 80% power to detect a 25% decline	Number of years to achieve 80% power to detect a 50% decline	Mean maximum count: 1998 - 2009	Std. error of the regression estimate	SE/Mean	1998-2009 linear trend	Number of years to achieve 80% power to detect a 25% decline	Number of years to achieve 80% power to detect a 50% decline
North Drakes Beach	102	35	0.34	+18/yr	ns	8	97	25	0.26	+17/yr	>23	5
PR Headlands	369	60	0.16	none	9	2	282	67	0.24	none	23	4
South Beach	19	7	0.37	+2/yr	ns	9	19	8	0.42	+2/yr	ns	12
Total*	531	68	0.13	+33/yr	7	2	430	76	0.18	+35/yr	12	2

ns: not solvable with Trends software. Assume greater than 30 years.
* Total includes minor subsites: Gus' cove, CRC, DSB

Table 2. Power to detect 10% annual trends for adults and pups at all combined Elephant seal colonies at PRNS. Years does not include the baseline year. 1-tail, 500 iterations, linear trend assumed, alpha = 0.20.

	Decline			Increase		
		Power			Power	
Years	% decline	Adults	Pups	% increase	Adults	Pups
2	19	0.52	0.41	21	0.59	0.44
3	27	0.66	0.58	33	0.85	0.70
4	36	0.86	0.71	46	0.97	0.89
5	41	0.93	0.83	61	1.00	0.98

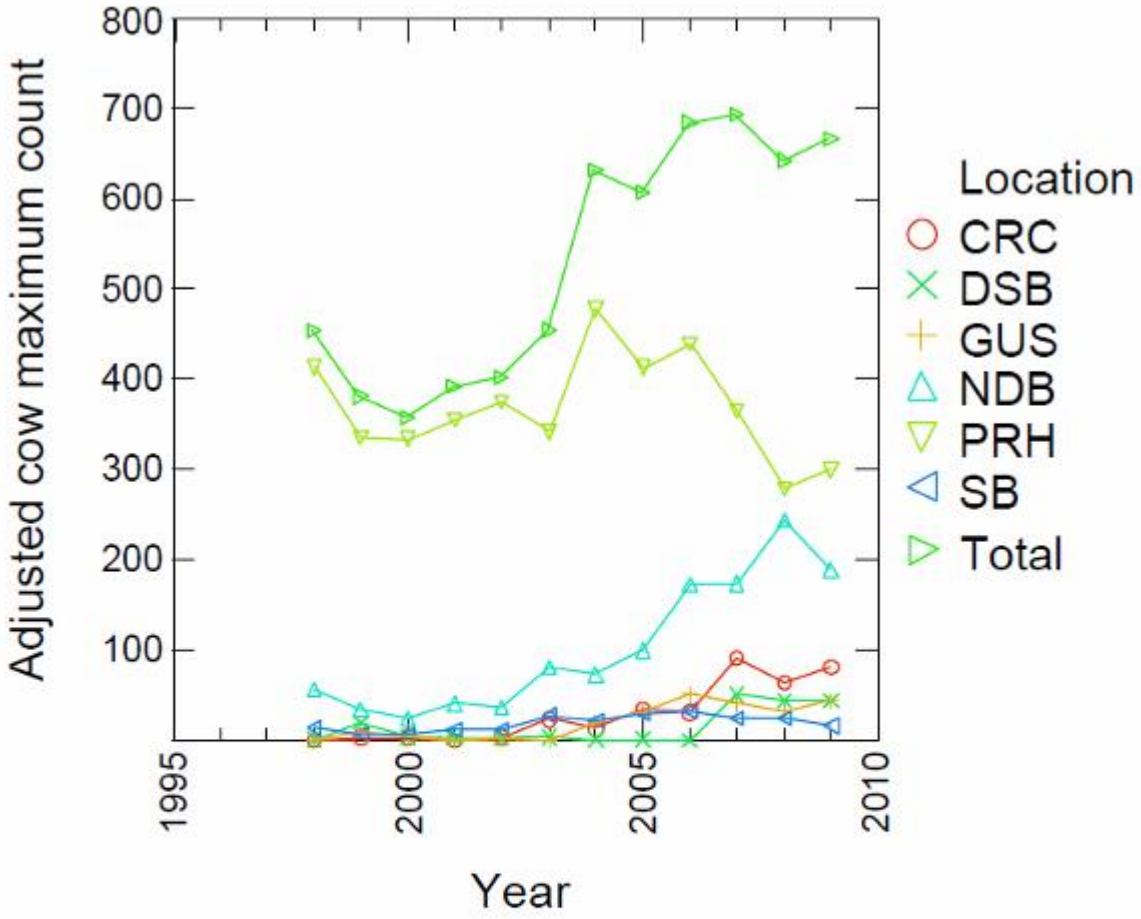


Figure 1. Adjusted maximum count by subsite of elephant seal cows from 1998 – 2009.

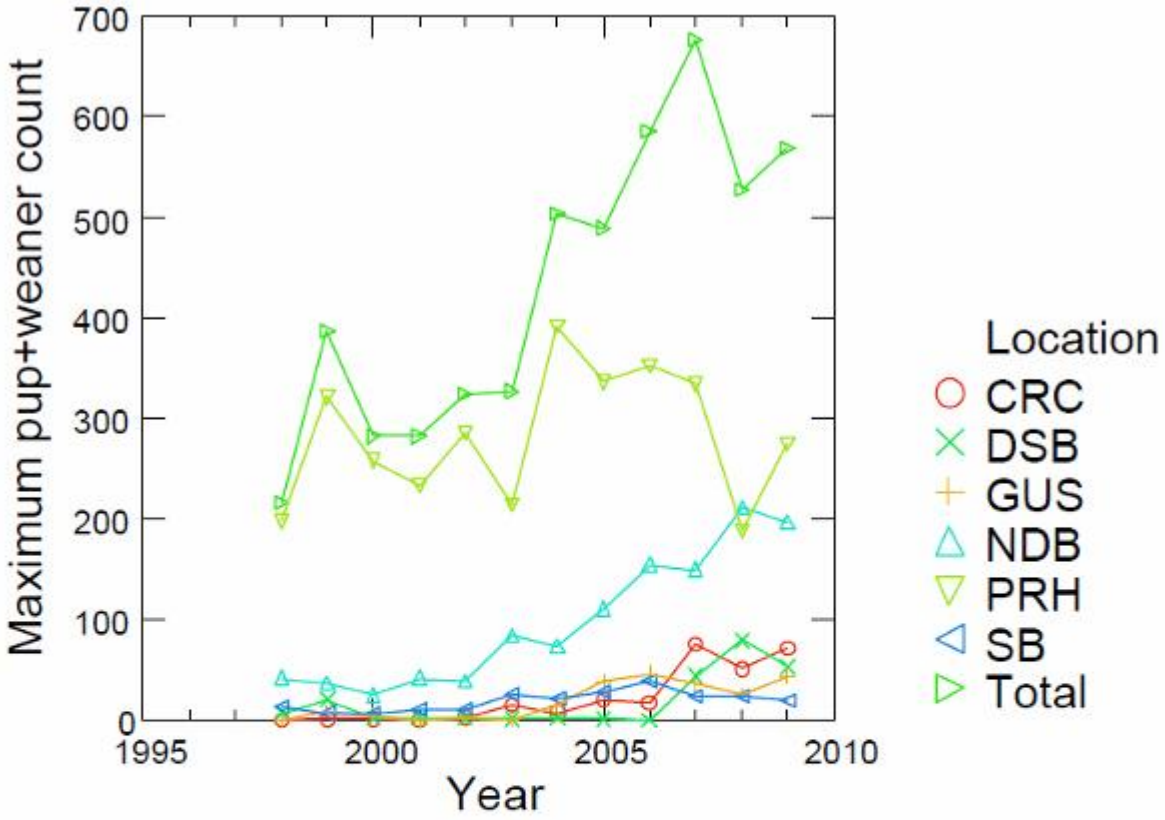


Figure 2. Maximum count by subsite of elephant seal pups and weaners from 1998 – 2009.

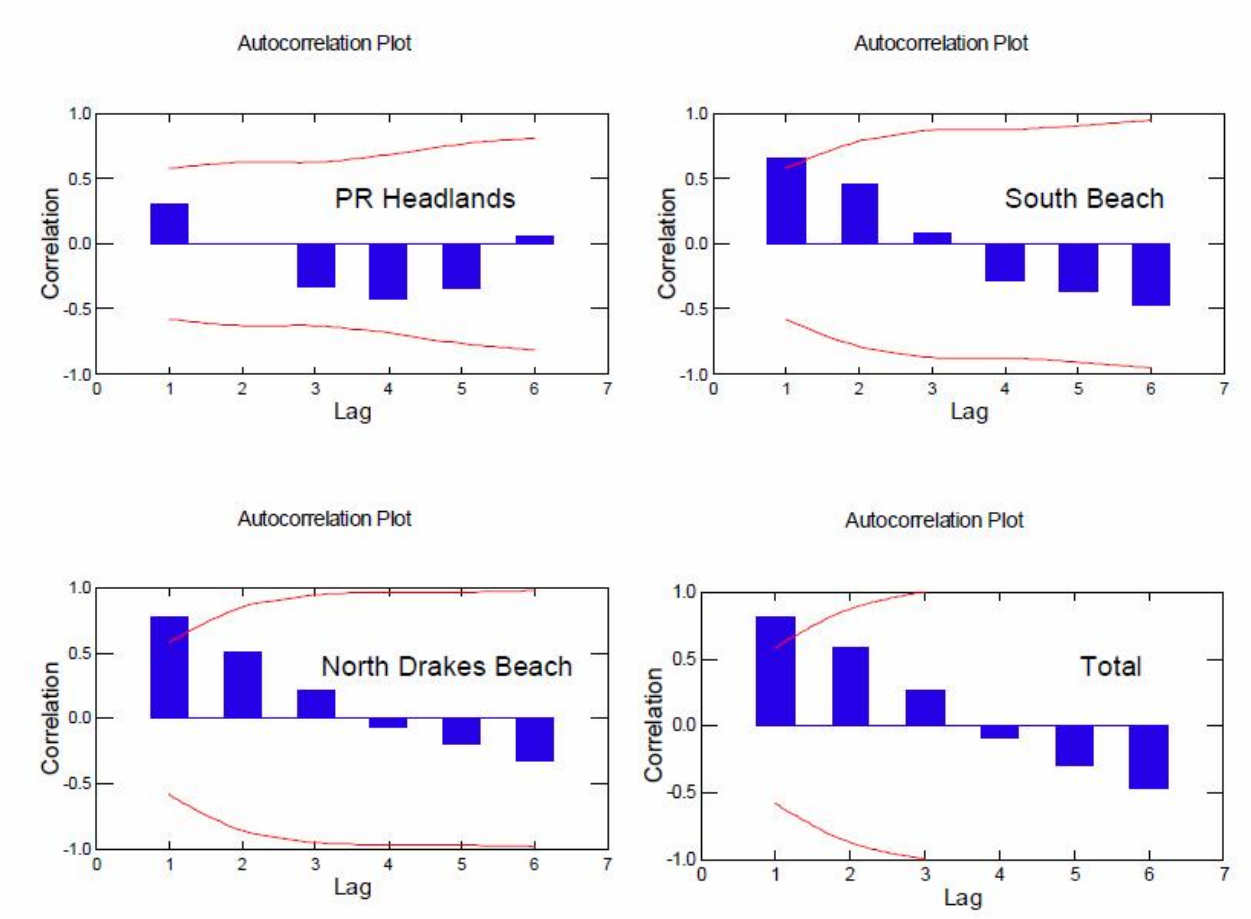


Figure 3. Temporal autocorrelation plots of maximum adult counts during the breeding season for 1998 – 2009. There is good evidence for autocorrelation at lag = 1 for two of the three sites, as well as the total count. However, this is likely because these populations are increasing (especially note the apparent decline to inverse autocorrelation). Note that the PR headlands which is no longer increasing does not exhibit temporal autocorrelation in maximum counts. Nonetheless, we ran the power analysis without correction for temporal autocorrelation. Red lines indicate significance threshold.

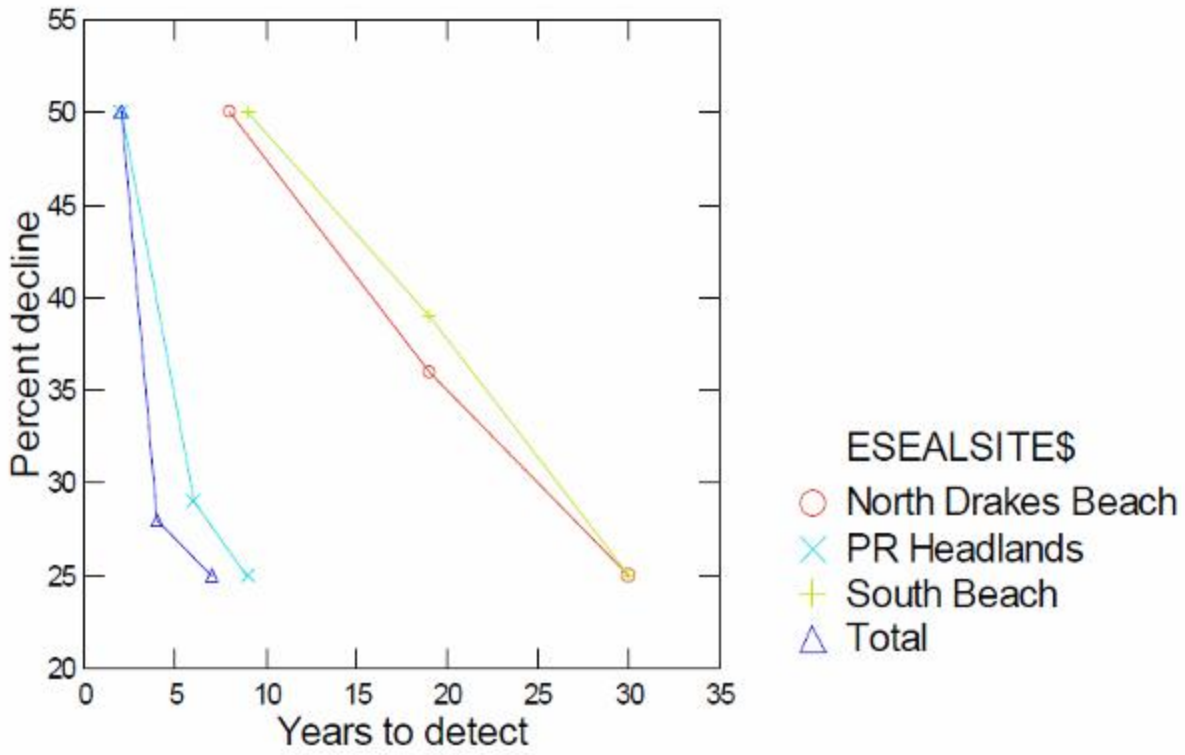
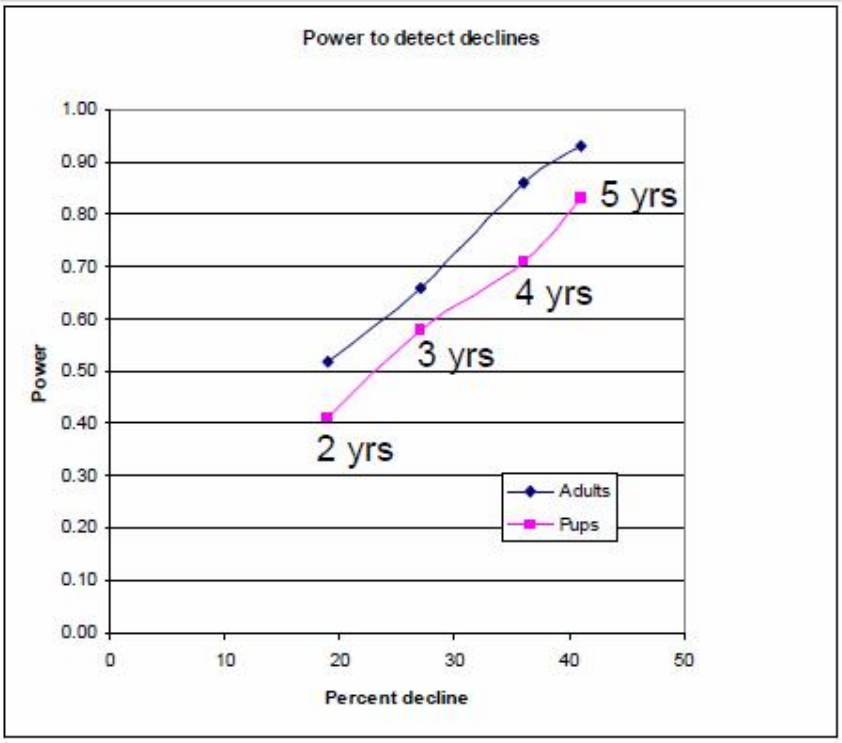


Figure 4. Number of years required to detect various percent declines at 80% power for the three elephant seal colonies, and the sites pooled. Linear fits between points likely slightly overestimate time needed to detect a trend.



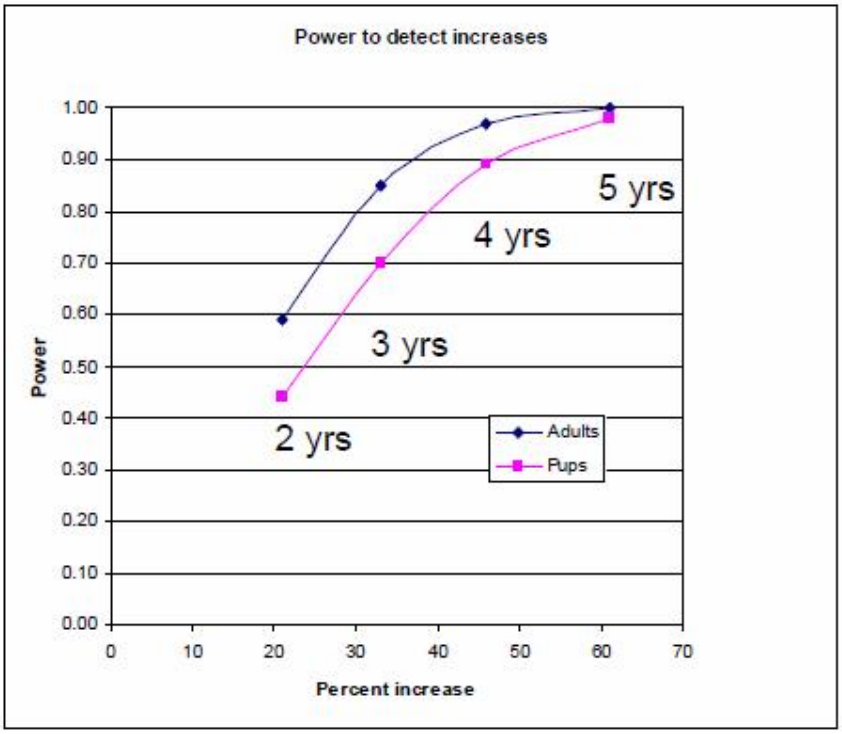


Figure 5. Graphical representation of Table 2. Power to detect 10% compounded annual declines or increases in adults and pups/weaners for the total elephant seal population combined and number of years required to detect the change. Number of years does not include the first year of monitoring.

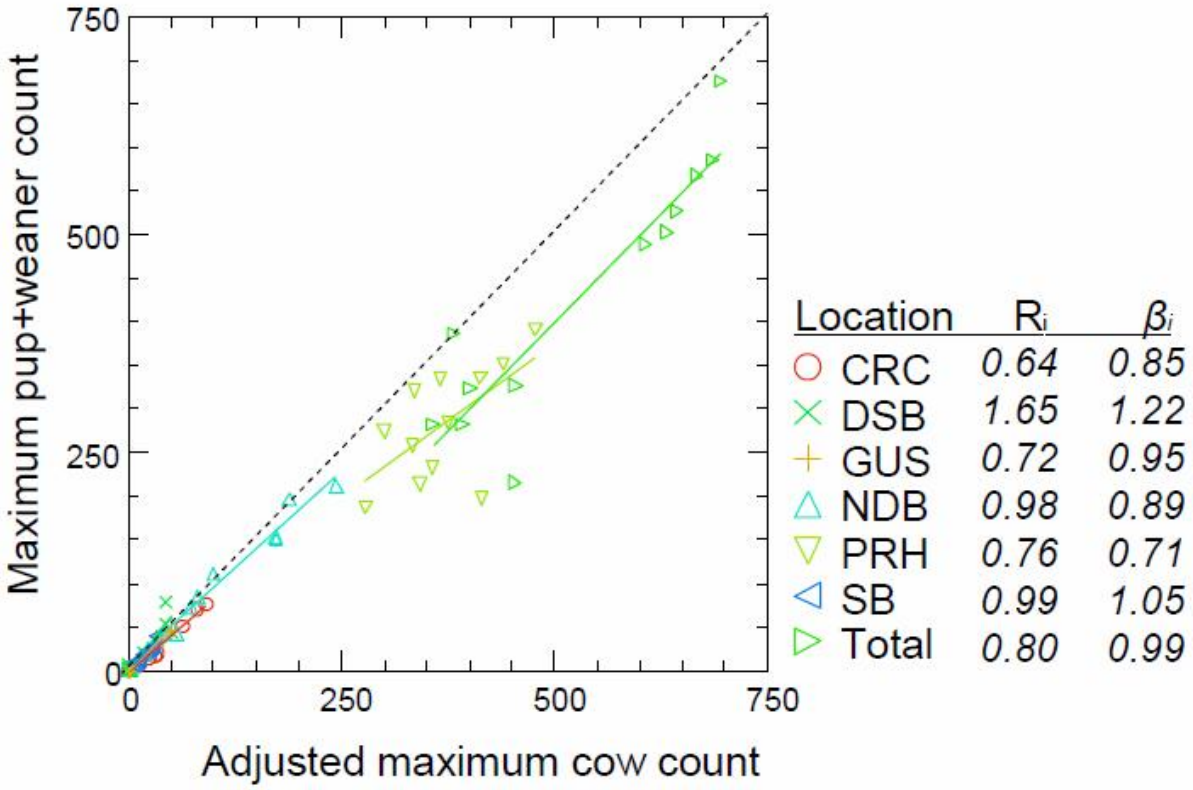


Figure 6. Adjusted maximum cow count versus maximum pup+weaner count. Each point is one year. R_i = ratio of max(pup+weaners) / max(adjusted cows). Regressions are linear. Regression coefficients (β_i) are all significant and represent how the mean R changes with increases in population size. $x = y$ line is shown for reference and points on this line indicate one pup for every cow.

Appendix C. Program Products

This appendix is a sampling of publications and other products produced or supported through data collected by long-term pinniped monitoring at Golden Gate National Recreation Area and Point Reyes National Seashore.

Peer-reviewed Publications

Adams D., H. Jensen, H. Nevins, K. Truchinski, D. Roberts and S Allen. 2007. Northern Elephant Seal Monitoring 2005-2007 Report, Point Reyes National Seashore. Natural Resource Technical Report NPS/SFAN/NRTR–2008/085. National Park Service, Fort Collins, Colorado.

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Moore, E., S. Lyday, J. Roletto, K. Litle, J.K. Parrish, H. Nevins, J. Harvey, J. Mortenson, D. Greig, M. Piassa, A. Hermance, D. Lee, D. Adam, S. Allen, and S. Kell. 2009. Entanglements of marine mammals and seabirds in central California and the north-west coast of the United States 2001-2005. Marine Pollution Bulletin 58:1045-1051.

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

Pettee, Jessica. 1999. Female Northern Elephant Seal Reproductive Success at Point Reyes National Seashore and Micro-habitat Features. M.S. Thesis, San Francisco State University.

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