Farallon National Wildlife Refuge
Bird Mitigation Research Trial

Application to National Marine Fisheries Service for an Incidental Harassment Authorization for Marine Mammals

Applicant: United States Department of the Interior
U.S. Fish and Wildlife Service
San Francisco Bay National Wildlife Refuge Complex
Farallon National Wildlife Refuge

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(1) PROJECT DESCRIPTION

This project describes a bird mitigation trial proposed for a two to four week period from November 1 2012 to January 31, 2013. The purpose of the trial is to assess potential bird hazing methods that could be used to minimize the risk of rodent bait ingestion by non-target species during a possible future house mouse (*Mus musculus*) eradication proposed by the USFWS for the South Farallon Islands of the Farallon National Wildlife Refuge (FNWR) (37° 41'55 / 123° 00'10") (Figure 8). The technique used to remove mice from the Farallon Islands is likely to involve the broadcast of rodent bait, as that is the only method that has ever been successful at eradicating mice from islands of this size.

House mice were introduced to the South Farallon Islands during the 19th century and the islands have experienced considerable ecosystem degradation as a result of their presence. On the South Farallon Islands, introduced house mice appear to be indirectly impacting the breeding success of burrow-nesting seabirds (Ainley and Boekelhide 1990; Sydeman et al. 1998; Pyle 2001). Half of the world's population of Ashy storm-petrels breeds on the Farallones, and this IUCN endangered species has experienced a 40% population decline in recent years and has not yet recovered. Additionally, several hundred petrels are being killed each year as result of the presence of introduced mice.

The presence of invasive mice on many islands throughout the world has resulted in direct and indirect impacts to nesting seabirds, eggs and chicks. Removing house mice would not only protect the Ashy storm-petrel and other seabirds, but would also assist in the recovery of the native plants, as well as aid in the survival of other island endemics such as the Farallon camel cricket (*Farallonophilus cavernicola*) and the Farallon arboreal salamander (*Aneides lugubris farallonensis*).

Invasive house mice have also recently been identified as vectors of diseases that have caused mass mortalities of marine mammals in island populations of fur seals (de Bruyn et al. 2008). This project would benefit the Farallones' marine mammals by removing the mice that are potential vectors for such diseases and die offs, as well as assist in the restoration of the natural island environment. This hazing research trial could also aid the marine mammals by allowing researchers to develop, test and identify bird hazing methods that would be the least impactful to the marine mammals present during the mouse removal operation.

Although the proposed mouse eradication would likely be carried out during the fall when most gulls and breeding seabirds are absent, some roosting Western gulls (*Larus occidentalis*) will still be present on the island during the fall (primarily at night). Gulls present in the area of rodent bait application could be at risk of ingesting toxic bait. In addition, the presence of these individuals could affect the success of the mouse eradication, as the goal of 100% mouse removal could be jeopardized if gulls were to take bait that is intended for mouse consumption. For these reasons, the USFWS is considering developing mitigation efforts that include a bird hazing program. The proposed bird hazing program for the mouse eradication will be developed based on techniques that have been tested and

successfully used to haze gulls from airfields, reservoirs and landfills over recent decades, as well as novel and innovative tools still in development.

As part of the USFWS' ongoing island restoration effort, a field trial using a non-toxic bait pellet with a biomarker was conducted on Southeast Farallon Island during November 2010. During the trial some Western gulls demonstrated an interest in the non-toxic cereal pellets. A limited gull hazing trial was conducted as a follow-up in January 2011 by USDA-APHIS, PRBO, and Island Conservation staff in which several gull hazing techniques were tested in limited areas over a brief period. The methods and results of this pilot study are summarized in Appendix A. As a condition of the trial, the hazing techniques used (lazers, spotlights, biosonics, effigies, distress calls, and kites) and the areas hazed were conducted to avoid disturbance to marine mammals. As a result, the areas hazed were limited in extent and excluded many tools such as human encroachment, pyrotechnics, and air cannons that are likely to incidentally disturb marine mammals.

While a great deal was learned during the 2011 pilot trial, it was not possible to test the efficacy of gull hazing methods over the entire island or for the length of time that would be required during an actual removal operation. The potential for habituation of gulls to hazing strategies needs to be addressed and site-specific hazing technologies must be tested. A two to four week trial is proposed to test the effects of the hazing techniques on the roosting gulls and the marine mammals on the island. In order to meet the goals of the hazing trial, some marine mammals are likely to be incidentally disturbed as researchers assess the tolerances and habituation behavior of marine mammals on the island.

Proposed Activities

Any of the following gull hazing techniques are likely to be used during the proposed trial to haze roosting birds (primarily gulls) from the Farallon Islands: lasers, spotlights, pyrotechnics, biosonics, predator calls, air cannons, Mylar tape, small helicopter, human presence, kites, radio-controlled aircraft, and trained dogs (with proper certification/vaccination records).

While all of these techniques may not be available, funded or used in the trial, they are all potentially effective methods being considered to reduce non-target bird (gull) mortality, as well as to maximize the likely success of the eradication operation. Up to five researchers will be present on the islands to implement the hazing trial, as well as to monitor pinniped disturbance. Since the trial is intended to allow researchers to test an array of gull hazing techniques, it is not possible to specify the exact protocol that will be implemented on the ground. For this reason, researchers will carefully monitor take of marine mammals and adjust the research trial to minimize disturbance of marine mammals. Research and monitoring will be conducted by a team of researchers comprised by USFWS, Island Conservation and PRBO Conservation Science biologists who are trained and experienced at conducting such activities and monitoring marine mammal activity on the island.

The use of some or all of these methods could potentially result in the incidental harassment of marine mammals on FNWR. The following tools are not listed in any particular order:

1. **Lasers**: Two different handheld lasers could be used during the course of the trial: red or green Avian Dissuader ® (50mW) and handheld green laser pointer (5mW). These lasers will likely be used during pre-dawn hours (~5h30-7h00) to haze gulls already settled on the island. Use of the laser is fairly simple and involves shining the beam briefly in a sweeping motion at the gull roost, which instigates a flight response in most birds, as the intensity of the beam likely triggers a reflexive response that keeps birds from gazing directly at the sun. The lasers are not directed at marine mammals' eyes and they are not known to react to this type of use. Once gulls are no longer spending the night on the island, the lasers will be used to haze gulls attempting to land on the island just prior to sunrise. Lasers will also be used in the evenings (~1630 -1800 h) to enhance the use of pyrotechnics and reach areas that are not readily accessible or could not be hazed with pyrotechnics due to the presence of marine mammals. Two short nighttime (20h00-23h00) laser sweeps of 30-60 minutes could be attempted on each island to haze any gulls that might settle back on the island during the course of the evening. The effective range for this method will be estimated by using a Leica® 1200 Rangemaster to determine distances.

   The use of lasers is considered one of the more potentially effective hazing methods as it can be done at a distance, is very effective on birds at night, and does not appear to affect pinnipeds, Lasers would not be shined directly at any marine mammals (or humans) for any sustained period of time (i.e., no more than incidentally). The Avian Dissuader web-site (www.avian dissuader.com) has additional statistics on the safety and allowed uses of the tool. The only disturbance to marine mammals likely to occur from lasers would be the direct result of a researcher using the laser near pinnipeds in an effort to haze the gulls. In such cases researchers would approach the area slowly to allow the marine mammals to adjust to their presence or slowly relocate. Because lasers can be used at great distances, this is considered an unlikely scenario and measures will be taken to avoid marine mammal haul-outs and disturbance to marine mammals. Lasers will be used as much as possible; however, they are only effective at night.

2. **Spotlight**: One or 10-million candlepower spotlights could be used during pre-dawn hours (0530 -0700 h) to haze gulls already settled on the island. Once gulls no longer spend the night on the island and their presence is restricted to marine ledges, the spotlight may also be tested to haze gulls intermittently settling on ledges. Two short nighttime (2000 -2300 h) sweeps by gull roosting areas may be attempted in order to haze any gulls that might have settled back on the island during the course of the evening. No disturbance to pinnipeds is expected to occur as the beam would not be directed at pinnipeds. In the case of incidental illumination, the hand-held beam would sweep swiftly past them, even if they were adjacent to roosting gulls. The spotlight beam, while bright, is not so focused that it would cause retinal injury.

3. **Biosonics**: Up to three Bird-Guard broadcasting units (bird distress calls) could be used on each island to deter gulls from alighting on the island, as well as encourage them to flee if they are already present. Speakers may be placed in locations which allow access. Additionally, up to 3 Bird Gard® SUPER PRO systems could be used to cover problem gull areas on each island. A number of electronic chips with both gull distress and predator calls could be used. The bird calls themselves are naturally occurring sounds and are not expected to cause harassment of pinnipeds. Given that the bird calls used should be familiar sounds to the islands pinnipeds, no

pinniped disturbance is expected. The placements of the speakers are not likely to cause marine mammal disturbances either, as they can be placed in many different areas to avoid haul-out sites. At most, a brief disturbance might be possible if the only place to locate a speaker system is near a haul-out site. If this unlikely case develops, then the area will be approached slowly and cautiously to avoid any stampede or unnecessary disturbances.

4. **Pyrotechnics:** Bird bombs, CAPA charges, screamers, and screamer-bangers could be used to deter gulls during daylight hours. Sounds are rated at 100-130 decibels (depending on specific product). Use of these products immediately adjacent to marine mammal haul-outs could cause some harassment; therefore, so their use will be limited in these areas. It is likely that the pinnipeds might become habituated to their use at a distance over time. Because the sound pressure thresholds for pinnipeds are in the 90-100 decibel level, however, they will not be used directly over a major haul-out site. Placement and use of these units will be so as to avoid exceeding the hearing threshold for marine mammals.

5. **Zon gun:** Zon gun air cannon will be used to deter problem birds. This involves a propane canister which charges a cylinder to produce a loud sound periodically. If pyrotechnics prove to be effective and do not appear to affect marine mammals, this technique may be trialed. Sound levels can be set for between 100-125 decibels. Placement and use of these units will be in an effort to avoid exceeding the hearing threshold for marine mammals.

6. **Helicopter**: A helicopter will be used during the trial haze to gulls in remote portions of the islands in addition to other operational purposes including: the simulation of several aerial movements that might be used during the mouse eradication. These activities may include:
    A. Perimeter monitoring flights around the islands to determine the location and numbers of gulls and pinnipeds in remote areas that cannot be viewed from Southeast Farallon Island observation points;
    B. Moving and deploying personnel and equipment to and from areas inaccessible by foot;
    C. Conducting radio-telemetry flights to examine movement patterns of gulls, as well as the efficacy of hazing.

    To avoid or minimize pinniped disturbance, helicopter flights in areas where pinnipeds haul-out will use a slow sequential approach of decreasing altitude in order to habituate the marine mammals to the sound and noise, as has been done successfully during rodent removal operations on Anacapa Island in 2001-2002 and on Rat Island in 2009.

7. **Human Movements**: Accessing areas on West End Island in order to investigate possible gull roosting areas, to haze gulls, and to monitor pinniped responses to hazing activities. Up to five researchers and hazers may be needed to conduct the trial.

8. **Kites and Radio-controlled aircraft**: The use of 5-10 predator kites (such as Eagle or Helikites) or radio-controlled toys may be effective in hazing gulls. Several kites may be used to assess their potential in windy and windless settings. A number of kites are available, including traditional kites (relying upon wind to lift) in the form of predators, 3-D predator shaped kites, and Helium-powered kites (requiring no wind). Most kites can be used to haze

gulls at a short distance. This technique will be used sparingly near harbor seals, as they may be more easily spooked by kites than other species. If a kite or aircraft falls into a haul out area, then it will either be 1) left in place if it cannot be retrieved safely or without causing major pinniped disturbance (e.g., stampede of large numbers of animals) or 2) retrieved using a slow methodical approach to avoid major disturbances or injuries to those marine mammals present. Retrieval could occur at a later time when pinnipeds are either absent or in lower numbers.

9. **Mylar tape:** Bamboo poles measuring approximately six feet with 1-meter lengths of 1" mylar tied to the tops of them could be placed in areas popularly used by gulls. Strips of mylar measuring 1-1.5 meters could be tied to two pieces of monofilament strung between bamboo poles, with the distance between the monofilaments being approximately four meters.

10. **Trained Dogs**: Well-trained herding working dogs (eg. border collies, etc) have been utilized to haze birds in certain areas and can cover a large amount of terrain over a long period of time without having any impacts on the environment that foot traffic might. Any dogs used for this purpose would have the necessary immunizations and certificates to ensure that no diseases are transmitted between dogs and pinnipeds, or any pinnipeds are harassed.

(2) DATE AND DURATION OF GULL HAZING ACTIVITIES AND SPECIFIC LOCATIONS

The projected time for the gull hazing activities would be a 2 to 4 week window sometime between November 1, 2012, and January 31, 2013. The timing will be dependent on seasonal variations in weather, effectiveness, gull abundance and distribution on the island, access to the island, equipment, funding, staff, and permits required (see Appendix A for a list of permits known to be required). Transport to the island via boats and/or helicopters are also dependent on weather conditions. The duration of the gull-hazing activities would be approximately 2-4 weeks, depending on how quickly it can be established that gulls could be regularly hazed from the island. It is expected that after most gulls have been hazed from the islands repeatedly for a period of days, that daily hazing of much lower intensity would only be needed to keep hazed gulls from returning to roost on the islands. After hazing operations cease, it is expected that most resident as well as many non-resident gulls will quickly return to normal behavioral patterns on the island. The results of this trial will be used to inform hazing operations that may be used during a proposed future mouse eradication project.

The anticipated marine mammal disturbance from project activity could potentially occur on all marine mammal haul-out areas on the South Farallon Islands.

(3) SPECIES AND NUMBERS OF MARINE MAMMALS

The number of individual marine mammals and the species that could be potentially harassed by gull hazing activities on the South Farallon Islands are summarized below. Values were calculated based on weekly pinniped counts conducted in November from 2006-2011, since November generally had the largest counts for the November to January period (Table 2, Figure 1; PRBO unpublished data).

Avg *indicates the average number of individuals counted during this period, and* ***Max*** *represents the mean of the annual Maximum numbers for this period:*

Northern elephant seal (*Mirounga angustirostris*) (Avg: 264; Max: 328)
Harbor seal (*Phoca vitulina richardii*) (Avg: 45; Max: 81)
Steller sea lion (*Eumetopias jubatus*) (Avg: 45; Max: 56)
California sea lion (*Zalophus californianus*) (Avg: 2,533; Max: 3,538)
Northern fur seals (*Callorhinus ursinus*) (Avg: 69; Max: 109)

(4) DESCRIPTION OF STATUS, DISTRIBUTION, AND SEASONAL DISTRIBUTION OF THE STOCKS OF MARINE MAMMALS LIKELY TO BE AFFECTED

This gull hazing research trial is scheduled for the fall of 2012, which is outside the breeding season for all of the pinniped species found on the Farallon Islands. Pregnant Northern elephant seals will begin to arrive on the islands towards the end of December to early January. If hazing operations occur during the elephant seal pupping period, researchers will actively avoid harassing any pregnant females or pups during this research trial by having the PRBO pinniped biologist identify and map where these individuals are prior to commencing hazing operations so they can be avoided as much as possible. All breeding elephant seals and pups will be monitored during hazing operations to determine if any disturbance occurs. If disturbance occurs, activities will be discontinued or modified to avoid any additional disturbance.

The following is a summary of the status, distribution, and seasonal distribution of the stock of marine mammals likely to be affected by research activities. Figures 2-6 in the Appendix illustrate the haul out areas on the South Farallon Islands for each species:

Northern Elephant Seal: The Northern elephant seal breeding population is distributed from central Baja California, Mexico to the Point Reyes Peninsula in northern California. Along this coastline there are 13 major breeding colonies. The Northern elephant seal was exploited for its oil during the 18th and 19th centuries and by 1900 the population was reduced to 20-30 individuals on Guadalupe Island (Hoelzel et al. 1993, Hoelzel 1999). As a result of this bottleneck, the genetic diversity found in this species is extremely low (Hoelzel 1999). The recent formation of most rookeries indicates that there is no genetic differentiation among populations. Although movement and genetic exchange occurs among colonies, most seals return to their natal site to breed (Huber et al. 1991). Recolonization of their former breeding range progressed north from the San Benito, Cedros, and Guadalupe Islands off Baja California to the most recent northernmost breeding site at Point Reyes Headlands. Although growth rates as high as 16% per year have been documented for elephant seal rookeries in the U.S. from 1959 to 1981 (Cooper and Stewart 1983), much of this growth was supported by immigration from Mexico. The highest growth rate measured for the whole U.S./Mexico population was 8.3% between 1965 and 1977 (Cooper and Stewart 1983). A generalized logistical growth model indicates that the maximum population growth rate is 11.7% (SE=2.7) (Carretta et al. 2011).

A complete population count of elephant seals is not possible because all age classes are not ashore at the same time. Elephant seal population size is usually estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals (McCann 1985).

Stewart et al. (1994) used McCann's multiplier of 4.5 to extrapolate from 28,164 pups to a population estimate of 127,000 elephant seals in the U.S. and Mexico in 1991. The multiplier of 4.5 was based on a stable population. Boveng (1988) and Barlow et al. (1993) argue that a multiplier of 3.5 is more appropriate for a rapidly growing population such as the California stock of elephant seals. Based on the estimated 28,450 pups born in California and this 3.5 multiplier, the California stock was approximately 101,000 in 2001 (Carretta et al. 2002). The population on the Farallon Islands has declined by 3.4% per year since 1983, and in recent years numbers have fluctuated between 100 and 200 pups (PRBO, unpubl. data).

Elephant seals congregate in central California to breed from late December to March. Females typically give birth to a single pup and attend the pup for up to 6 weeks. Mating occurs after the pup is weaned by attending males. After breeding, seals migrate to the Gulf of Alaska or deeper waters in the eastern Pacific. Adult females and juveniles return to terrestrial colonies to molt in April and May, and males return in June and July to molt, remaining onshore for around 3 weeks.

Pacific Harbor Seal: Harbor seals are one of the most widely distributed northern hemisphere pinnipeds and are found in coastal, estuarine, and sometimes fresh water of both the Atlantic Ocean and Pacific Oceans. There is considerable regional genetic differentiation between harbor seal populations as they are generally limited in migratory movements; they will on occasion travel as much as 300 – 500 km in search of food or breeding areas. Presently, there are three recognized stocks along the U.S. mainland (California, Oregon and Washington Coast, and Washington Inland Waters). There is some question whether the San Francisco Bay population may be a separate stock based on genetic analyses (D. German, Sonoma State University, pers. comm.); however, at this time it is still considered part of the California stock. There is some limited movement among stocks; however, only a small portion of harbor seals move outside state waters (Lamont et al. 1996). In California, approximately 400-600 harbor seal haul out sites are widely distributed along the mainland and on offshore islands, including intertidal sandbars, rocky shores, and beaches (Hanan 1996; Lowry et al. 2005).

Harbor seal pupping is clinal along the U.S. west coast. The timing of birth in *P. v. richardii* varies in a significant unidirectional latitudinal cline, extending between Baja California and the west coast of Washington (Temte et al. 1991). In central California, harbor seals breed annually from March through May and molt in June and July. Females give birth to a single pup and attend the pup for around 30 days, at which time they wean pups. Mating occurs in the water around the time of weaning. Harbor seals are resident year round at terrestrial colonies; however, juveniles may disperse to other colonies ranging up to ~ 500 km. Individual adult seals may also migrate widely from breeding colonies.

Given the wide distribution of harbor seals it is not surprising that their population trends vary widely. Harbor seal populations in the Eastern North Pacific along the West Coast of the United States are all increasing. Along the coast of Washington and Oregon harbor seals increased in number at a rate of between 4 to 7% per annum with an estimated population of over 30,000 (Jefferies et al 1997). When a logistic model was fit to the Washington portion of the 1975-1999 abundance data, the resulting estimate of RMAX was 18.5% (95% CI = 12.9-26.8%) (Jeffries et al. 2003). When a logistic model was fit to the Oregon portion of the 1977-2003 abundance data, estimates of R_{MAX} ranged from 6.4% (95% CI = 4.6- 27%) for the south coast of Oregon to 10.1% (95% CI = 8.6-20%) for the north coast

(Brown et al. 2005). Until a combined analysis for the entire stock is completed, the pinniped default maximum theoretical net productivity rate (R_{MAX}) of 12% is be used (Wade and Angliss 1997). Additionally, along the California coast harbor seal numbers have increased at 3.5% per year 5 with a minimum size of the California harbor seal population of 31,600. (Hanan 1996, Carretta et al. 2011) Brown et al. (2005) estimated a population of 10,087 harbor seals in Oregon; however there is not current evidence of minimum abundance of this stock since researchers have not been able to survey for several years. The most recent population estimate for California based on mark-recapture analysis 43,449 based on a correction factor of 1.65, and the population at Point Reyes was estimated to be 7,524 for the molt season based on the same correction factor (Lowry et al. 2005, Manna et al. 2006).

California Sea Lion: California sea lions range from southern Mexico up to British Columbia and breed almost entirely on islands in southern California, Western Baja California and the Gulf of California. In recent years, California sea lions have begun to breed annually in small numbers at Año Nuevo Island and South Farallon Islands, California. One abandoned pup was found at Point Reyes National Seashore at Wildcat Beach in 2003. This species is separated into three recognized stocks based on three geographic regions (U.S. stock, Western Baja stock, and the Gulf of California stock; Lowry et al. 1992). Some movement has been documented between these geographic stocks, but rookeries in the U.S. are widely separated from major rookeries of western Baja California, Mexico (Barlow et al. 1995). Commercial harvest of the species in southern California and Mexico reduced the population to approximately 1,500 individuals by the 1920s. Since the passage of the Marine Mammal Protection Act in 1972, the California sea lion population has steadily increased along the West Coast of the United States (Carretta et al. 2002).

The California sea lion has the largest population of any sea lion species and is the only sea lion whose population is showing a healthy growth rate of 6.52% per annum; this growth rate is calculated without pup counts from El Nino years. Net production between 1980 and 2001 averaged 15.1%. Annual incidental takes in fisheries is approximately 915 individuals; however, the population is growing by 8.2% per year and fishing mortality is declining (Barlow et. al 1995). The current U.S. population estimate is 238,000 (Carretta et al. 2011), with an additional 44,000 to 53,000 animals in Mexico (Aurioles-Gamboa and Zavala-Gonzalez 1994).

California sea lions give birth in May through July and breeding occurs in July and August. Females and pups are resident at breeding colonies year round and males migrate north to feeding areas from central California to British Columbia, Canada. During years of low food availability (ENSO), females and juveniles may also migrate north in search of prey, and in some particularly poor years (1997-1998), there can be mass mortality of pups at rookeries.

On the Farallon Islands, California Sea Lions haul out in many intertidal areas year round, fluctuating from several hundred to several thousand animals. The small number of breeding animals are concentrated in areas where researchers do not visit (PRBO unpublished data).

Steller Sea Lion: Steller sea lions breed from the Kuril Islands and Okhotsk Sea through the Aleutian Islands and the Gulf of Alaska, and south to central California (Merrick et al. 1987). The Steller sea lion was hunted during the sealing era for fur, hides, blubber, and other organs. More recently, Steller sea lions were harvested during a modern pup hunt that lasted from 1959-1972 in which approximately 45,000 pups were taken (Pasquel and Adkison 1994). At the cessation of the modern commercial hunting the Steller sea lion was found along the Pacific Rim from California to Japan with

approximately 70% of the population in Alaskan waters. Two separate populations are recognized within US waters: an eastern population that includes animals east of Cape Suckling, Alaska (144° W), and a western population that includes animals' west of Cape Suckling.

Despite the cessation of the commercial hunt, the Steller sea lion population has experienced a rapid decrease since the mid-1980s with the western population declining by >64% in the last 30 years (Loughlin et al. 1992). The western stock is declining at a rate of approximately 5% per year with a drop of approximately 80% of the total population since the 1960s. The number in 1989 was estimated at 68,094 individuals. This total includes 10,000 in Russia, 47,960 in Alaska, 6,109 in British Columbia, 2,261 in Oregon, and 1,764 in California (Loughlin et al 1992). Numbers in Alaska have been declining by 7.8 % since 1994 (National Marine Mammal Laboratory 1995) and have an average population growth rate of 3.1% in California (Le Boeuf et al. 1991, Ono 1993). Combining the pup count data from 2005-2009 (11,120) and non-pup count data from 2008 (31,246) results in a minimum abundance estimate of 42,366 Steller sea lions in the western U.S. stock in 2005-2009 (M. DeAngelis, NMFS, pers. comm.). Using the most recent 2006-2009 pup counts available by region from aerial surveys across the range of the eastern stock (total N=13,889), the total population of the eastern stock of Steller sea lions is estimated to be within the range of 58,334 to 72,223 (Carretta et al. 2011).

Steller sea lion numbers in California, especially in southern and central California, have declined from historic numbers. Counts in California between 1927 and 1947 ranged between 4,000 and 6,000 non-pups with no apparent trend, but have subsequently declined by over 50%, and were between 1,500 and 2,000 non-pups during the period 1980 to 2004 (M. DeAngelis, NMFS, pers. comm.). At Año Nuevo Island, a steady decline in ground counts started around 1970, and there was an 85% reduction in the breeding population by 1987 (LeBoeuf et al. 1991). Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable or increasing slowly since the 1980s.

On Southeast Farallon Island, California, the abundance of females declined an average of 3.6% per year from 1974 to 1997 (Sydeman and Allen 1999). Pup counts on the Farallon Islands have generally varied from 5-15 (Hastings and Sydeman 2002, PRBO unpublished data). Steller sea lions give birth in May through July and mating occurs a couple of weeks after birth. Non-reproductive animals congregate at a few haul out sites. Pups are weaned during the winter and spring of the following year.

In 1990, the Steller sea lion was listed as a threatened species under the ESA, and the western stock was listed as endangered in 1997. In the 1960s and 1970s the number of sea lions caught in trawl nets peaked, while present day numbers are low. California fisheries target several of the most important prey items for Steller sea lions and millions of metric tons of prey have been removed by fisheries in recent decades. Incidental mortality of Steller sea lions in fisheries was very low between 1990 and 2001 in California. Shooting of adults during fisheries interactions in central California have been documented by the Marine Mammal Stranding Network and one adult male was found shot at Point Reyes, California in the 1990s. In Alaska, there are also several processes that have been debated as contributing to the decline of the Steller sea lion population, including global climate change and killer whale predation (Springer et al. 2003).

On the Farallon Islands, Steller sea lion breeding colonies are strictly protected to reduce or eliminate risk of human disturbance; access to these areas is rarely permitted.

Northern Fur Seal (San Miguel Island Stock): Northern fur seals range across the North Pacific Ocean and the Bearing Sea (Kajimura 1984 and Ream et al. 2005) and as far south as the Channel Islands in California (Kenyon and Wilke 1953). The majority of individuals (~ 70%) or 750,000 animals) breed on the Pribilof Islands off the coast of mainland Alaska (Testa 2007); however, there have been declines in the number of pups produced each year by as much as 50% from previous seasons (Towell et al. 2006). After extensive hunting in the late 1800's on the Farallon Islands (Starks 1922, Townsend 1931, Scheffer and Kraus 1964), the first pup in over 100 years was born there in 1996. By 2006, 80 pups were born and the Farallon Islands are again an established rookery (Pyle et al. 2001). Rookeries have also been reestablished at Bogoslof Island in the eastern Aleutians, Alaska and at San Migues Island, California (York et al. 2005).

Northern fur seals are pelagic, living the majority of their lives in the open ocean, and only use certain offshore islands for pupping and breeding. They rarely come ashore except during these times and are almost never seen on mainland beaches unless they are sick. Adult males establish territories in late May to early June and aggressively guard and herd up to 40 or more females. They typically remain at rookeries through August but may remain through November. Pregnant females arrive at the rookeries in June and give birth two days later. They nurse for about 10 days before returning to sea to feed for four or five days. After their initial feeding, females feed for eight to ten days and then return to nurse for one to two days until pups are weaned after four months. Breeding females may visit the rookery for up to six months (June to November). Pups may remain at sea for up to 22 months before returning to their natal rookery. Based on the 2007 count and the expansion factor, the most recent population estimate of the San Miguel Island stock is 9,968 (2,492 x 4.0) northern fur seals. Currently, a coefficient of variation (CV) for the expansion factor is unavailable.

Although the Farallones were a major northern fur seal breeding area before the arrival of hunters in the early 19th century, the species was essentially extirpated from the region by the second half of that century (Wilson and Ruff 1999). Not until 1996 did northern fur seals begin breeding again on the Farallones (Pyle et al. 2001), and each year since then they have bred in generally small numbers on West End Island during the summer. These numbers have increased substantially in recent years, with 282 animals observed in 2010 (PRBO, unpubl. data). Male fur seals generally come ashore in late May or June to prepare for the breeding season. Females come ashore in late June or July and give birth to one pup per year, and soon thereafter mating occurs (Wilson and Ruff 1999)

(5) TYPE OF INCIDENTAL TAKING AUTHORIZATION REQUESTED

This is a request for an incidental harassment authorization (IHA) for elephant seals, harbor seals, Steller sea lions, California sea lions, and northern fur seals at the South Farallon Islands. The proposed research and associated activities may result in "take by incidental harassment only" (Level B Harassment). An Incidental Harassment Authorization (IHA) is requested. All takes will involve incidental human presence or noise from gull hazing equipment used near pinniped haulout areas.

(6) NUMBER OF MARINE MAMMALS POTENTIALLY TAKEN AND FREQUENCY

Table 1 illustrates the number of individuals that we anticipate harassing over the length of the trial. Take numbers are listed as maximum numbers and represent the requested take for the duration of the trial; however, researchers will make every effort to minimize the take of pinnipeds which will likely result in fewer harassed individuals than listed below. Frequency of harassment will depend upon locations of gulls to be hazed and success of hazing operations. In hazing areas, pinnipeds could be disturbed as much as twice per day for the duration of the trials. However, this is unlikely since many Steller's on the islands do not haul out near typical gull roosts.

Table 1. Numbers of marine mammals that potentially could be incidentally harassed on the South Farallon Islands during the bird mitigation research trials, November 2012 to January 2013. Estimates are based on maximum counts from censuses in the month of November, 2006-2011 (calculated from data in Tables 2a-d; PRBO, unpubl. data), when the highest counts during the November to January period typically occur.

Species	Total #	# of Pups M / F	# of Subadults M / F	# Adults M / F not pregnant / F pregnant
Northern Elephant Seal	328	0/0	148/148	33/0/0
Harbor Seal	81	0/0	25/25	16/16/0
Steller Sea Lion	56	0/0	15/15	3/23/0
California Sea Lion	3,538	0/0	1,168/1,168	584/584/0
Northern Fur Seal	109	16/16	28/28	9/11/0

M= Male, F= Female

(7) ANTICIPATED IMPACT OF THE ACTIVITY

The only anticipated impacts would include the temporary disturbance of pinnipeds caused by gull hazing activities. This might alter behaviors and/or cause animals to flush from the area. Animals may return to the same site once researchers have left or discontinued hazing activities, or they may go to another haul out site, which will likely occur within 30 minutes (Allen et al. 1985). Long-term impacts of this take are likely to be minimal as very few breeding animals will be present in areas where takes may occur. For example, in November, only a small number of northern fur seal mothers and pups are expected to still be present. By this time, pups are highly mobile, including regularly entering the water, and are nearly ready to depart the colony. The few remaining adult females are nearing the end of their occasional nursing visits at the island. If trials extended into January, this would overlap the elephant seal breeding season. In this case, measures would be taken to avoid disturbance to breeding seals (see above). Most potential for incidental take will occur where gull roost sites overlap with the pinniped haul-out areas (Figure 7). It is expected that behaviors will return to normal after local hazing trials have ceased, and that flushed animals will either move to other undisturbed portions of the island or return to the affected haul out within hours.

It is expected that gull roost sites will be visited at a minimum 2 times per day by researchers for hazing or monitoring. In most locations researchers will be located >30 ft (10m) above or away from

any pinnipeds which may be hauled out. In addition, hazers will attempt to remain as far away from pinnipeds as possible, will attempt to stay concealed, or at minimum move in a crouched position to diminish disturbance to pinnipeds. Hazers will first attempt to haze the gulls without disturbing the pinnipeds, although in some instances disturbance to the marine mammals may occur. Most visits to these areas will be brief (~15 minutes), though gull and pinniped observers could be present in some locations for 2-5 hours daily if necessary. Most hazing is anticipated to occur during a 2-3 hour period before and after dawn, as well as 2-3 hours before and after sunset; however, sporadic gull hazing may occur as needed at any time of day or night. Figures 2-6 show the haul-out areas for the species of marine mammals on the FNWR.

Most pinnipeds will likely habituate to the bird hazing activities that will be used in their area. Island Conservation personnel have had experience with minimizing marine mammal disturbance from other island invasive removal operations we have conducted and assisted with and observed throughout the world (Anacapa Island, Rat Island in the Aleutians, and Lehua in Hawaii). It is likely that the Harbor seals will be a little skittish at first in responding to some activities, and the Steller's may react a little as well, but the other three species present will likely be much less reactive. While individuals of all species may lift their heads or possibly flush the first few days of hazing, it is likely that most will habituate to the activities after a few days, especially the California sea lions and Northern Elephant seals.

(8) ANTICIPATED IMPACT OF THE ACTIVITY ON THE AVAILABILITY OF THE STOCK OF MARINE MAMMALS TO SUBSITENCE USE

As there is no subsistence hunting of the stocks in question, no impact on subsistence uses are expected as the result of the proposed project.

(9) ANTICIPATED IMPACT ON HABITAT

Incidental marine mammal takes will not result in the physical altering of marine mammal habitat. No major breeding habitat will be affected by these activities.

(10) ANTICIPATED IMPACT OF LOSS OF HABITAT ON THE MARINE MAMMAL POPULATION

There is not expected loss or modification of habitat.

(11) AVAILABLILITY AND FEASIBILIY OF TECHNIQUES TO MINIMIZE IMPACTS

Prior consultations with NOAA Fisheries Service on marine mammal impacts on other rodent eradication efforts and trials have led to NMFS determinations that such aerial and hand-broadcast rodent eradication projects are "not likely to adversely affect" marine mammals (Hawaiian monk seals), and that marine mammals could actually indirectly benefit from the invasive rodent eradication (Lehua Island Ecosystem Restoration EA Section 7 Concurrence, Consultation No. I-PI-03-356-MMD 2005).

One of the major goals of this research trial is to assess how to best avoid impacts to marine mammals as a result of the proposed mouse eradication and associated mitigation activities. Towards this end, all possible measures will be taken to reduce marine mammal disturbance in order to accurately assess the impacts of various bird hazing techniques on the marine mammals that are present at this time of year.

The following proposed measures will be employed in order to avoid and minimize unnecessary interactions between researchers and marine mammals on the Farallon National Wildlife Refuge during the course of the Bird and Mammal Mitigation Trial. Many of these measures have been successfully employed in previous rodent eradication efforts where pinnipeds are present, following the Marine Mammal Protection Act of 1972, as amended (Anacapa Rat Eradication Final EIS 2001 and Rat Island Rat Eradication Final EA 2008 – copies available upon request):

- All project personnel will be briefed on proper conduct on the island and in marine mammal disturbance avoidance procedures, as specified below. People on foot will maintain a 100-foot buffer around marine mammals hauled out on the shoreline whenever possible. If it is anticipated that human presence could cause dispersal, humans will approach in a slow, crouched and calm fashion to limit the potential severity of the dispersal.

- A helicopter, if used, will first conduct a reconnaissance monitoring flight around Southeast Farallon (SEFI) and West End prior to conducting any bird hazing operations. These flights will take off and land using the approved helicopter flight path for SEFI and will begin flying high and move slowly in a wide circumferential flight. The presence and distribution of marine mammals will be mapped and their response recorded by a USFWS, IC, or PRBO monitors.

- If the helicopter needs to fly below 100 feet or touch-down in any area for hazing or for transfer of equipment or personnel, the helicopter will avoid if possible flying directly over active haul out areas. If pilots need to fly over such an area, they will adopt a slow graduated descent and approach to avoid any stampeding or injuries, as has been done successfully on many other such projects in the US (Anacapa Rat Eradication Final EIS 2001 and Rat Island Rat Eradication EA 2008). The marine mammal response to the aircraft will be noted, including any habituating reactions.

- A judicious use of bird hazing techniques will be used when gulls and marine mammals are in close proximity, in an effort to use the technique having the greatest probability of dispersing birds while being least disturbing to marine mammals (such as lasers used remotely, and bird distress calls and effigies).

- Use of pyrotechnics and other hazing techniques that might be expected to have greater risk of disturbing marine mammals will be used primarily outside of marine mammals haul outs, and will only be used as a last resort in haul-out areas to haze the most persistent of the roosting gulls on the islands.

- Hazing of gulls using the more impactful visual and auditory techniques will be primarily reserved for areas and times where marine mammals are not present. When hazing is necessary

in haul out areas, researchers will minimize impacts to pinnipeds, and will not fire pyrotechnics toward any marine mammals.

- If dogs are used in the trial, the dog(s) on the island will go through a thorough quarantine, vaccination, and deworming period prior to arrival to avoid any chance of introducing any infectious agent to the island. Since the primary mission of Island Conservation is specifically to avoid any unintentional alien introductions and their possible consequences, we have a very well developed set of biosecurity measures we have used when bringing dogs onto islands for eradication purposes, both in the U.S. (Channel Islands) and internationally.

- Any dogs used for gull hazing will be specially trained for the task, will be under voice control and would not roam freely, and will not be used to intentionally disturb marine mammals. Dogs will be confined when not used for hazing, and their feces will be kept out of intertidal haul out areas. Dogs will go through rigorous training not to respond to marine mammals, and if a dog were to be unresponsive to commands on the island and interact with marine mammals in a negative manner, the dog will not be allowed to continue participating in the trial while unleashed.

(12) MEASURES TO MINIMIZE ADVERSE IMPACTS ON THE AVAILABILITY OF MARINE MAMMALS FOR SUBSITENCE USES

NOT APPLICABLE

(13) SUGGESTED MEANS OF MONITORING AND REPORTING

NMFS approved marine mammal monitors will collect information on the number and species of animals present prior to the initiation of hazing operations. During hazing operations, they will record species and behaviors that occur during hazing activities, the number of individuals flushed, as well as the number of flushing events. In addition, monitors will conduct surveys of pinniped numbers after the completing the hazing trial. All disturbance events will be reported to NMFS within 90 days after the completion of hazing operations. Furthermore, monitors will be in communication with hazing trial implementation staff to relay information on marine mammal responses. If hazing trial activities result in undue or extreme disturbance behavior (such as to pups or stampeding), measures will be taken to halt or alter hazing activities.

(14) SUGGESTED MEANS OF ENCOURAGING RESEARCH

All pinniped monitoring data collected during this gull hazing trial will be recorded and shared with NOAA.

(15) REFERENCES

Ainley, D. and R. Boekelheide. 1990. Seabirds of the Farallon Islands: Ecology, dynamics, and structure of an upwelling-system community. Stanford University Press, Stanford, CA.

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

Aurioles-Gamboa, D., and A. Zavala-Gonzalez. 1994. Ecological factors that determine distribution and abundance of the California sea lion Zalophus californianus in the Gulf of California. Ciencias Marinas 20:535-553.

Barlow, J., P. Boveng, M. S. Lowry, B. S. Stewart, B. J. Le Boeuf, W. J. Sydeman, R. J. Jameson, S. G. Allen, and G.W. Oliver. 1993. Status of the northern elephant seal population along the U.S. west coast in 1992. Admin. Rept. LJ-93-01. Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 32 pp.

Barlow, J., R.L. Brownell, Jr., D.P. DeMaster, K.A. Forney, M.S. Lowry, S. Osmek, T.J. Ragen, R.R, Reeves, R.J. Small. 1995. U.S. Pacific marine mammal stock assessments: 1995. NOAA Tech. Mem. NMFS 219. 162 pp.

Barlow, J., P.S. Hill, K.A. Forney, D.P. DeMaster. 1998. U.S. Pacific marine mammal stock assessments: 1998. NOAA Tech. Mem. NMFS 258. 40 pp.

Boveng, P. 1988. Status of the northern elephant seal population on the U.S. West Coast. Admin. Rep. LJ-88-05 Southwest Fisheries Science Center, National Marine Fisheries Service, P.O. Box 271, La Jolla, CA. 35pp.

Brown, R.F., B.E. Wright, S.D. Riemer. 2005. Trends in abundance and current status of harbor seals, Phoca vitulina, in Oregon 1977-2003. Marine Mammal Science 21:657-670.

Carretta, J. V., J. Barlow, K. A. Forney, M. M. Muto and J. Baker, editors. 2001. U.S. Pacific Marine Mammal Stock Assessments: 2001. NOAA NMFS Dept of Commerce, La Jolla, CA.

Carretta, J. V., M. M. Muto, J. Barlow, J. Baker, K. A. Forney, and M. Lowry, editors. 2002. U.S. Pacific Marine Mammal Stock Assessments: 2001. NOAA NMFS Dept of Commerce, La Jolla, CA.

Crockford, S. J., S. G. Frederick, and R. J. Wiggen. 2002. The Cape Flattery fur seal: An extinct species of Callorhinus in the eastern Pacific? Canadian Journal of Archaeology 26:152-174.

de Bruyn PJN, Bastos ADS, Eadie C, Tosh CA, Bester MN (2008) Mass Mortality of Adult Male Subantarctic Fur Seals: Are Alien Mice the Culprits? PLoS ONE 3(11): e3757. doi:10.1371/journal.pone.0003757

Hanan, D.A., and M.J. Beeson. 1994. Harbor seal, Phoca vitulina richardsi, census in California, May-June, 1993. Final Rept. to NOAA, NMFS, 501 W. Ocean Blvd., Suite 4200, Long Beach, CA 90802.

Hastings, K.K. and W.J. Sydeman. 2002. Population status, seasonal variation, and long-term population trends of Stellers Sea Lion at the South Farallon Islands, California. Fisheries Bulletin *100:51-62.*

Hildebrandt, W. R. 1984. Archeological presence of the northern fur seal (Callorhinus ursinus) along the coast of Northern California. Murrelet 65:28-29.

Hildebrandt, W. R., and T. L. Jones. 1992. Evolution of marine mammal hunting: A view from the California and Oregon coasts. Journal of Anthropological Archeology 11:360-401.

Hoelzel, A. R. 1999. Impact of population bottlenecks on genetic variation and the importance of Life-history; A case study of the northern elephant seal. Biological Journal of the Linnaean Society 68:23-39.

Hoelzel, A. R., J. Halley, S. J. O'Brien, C. Campagna, T. Arnbom, B. Le Boeuf, K. Ralls, and G.A. Dover. 1993. Elephant seal genetic variation and the use of simulation models to investigate historical population bottlenecks. Journal of Heredity 84:443-449.

Huber, H.R., A.C. Rovetta, L.A. Fry, and S. Johnston. 1991. Age specific natality of northern elephant seals at the South Farallon Islands, California. J. Mammalogy. 72: 525-534.

Jeffries, S.J., R.F. Brown, H.R. Huber, and R.L. DeLong. 1997. Assessment of harbor seals in Washington and Oregon 1996. Annual report to the MMPA Assessment Program, Office of Protected Resources, NMFS, NOAA, 1335 East-West Highway, Silver Spring MD 20910. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

Kajimura, H. 1984. Opportunistic feeding of the northern fur seal, Callorhinus ursinus, in the eastern North Pacific Ocean and eastern Bering Sea. NOAA Technical Report NMFS SSRF-779. 49 pp.

Kenyon, K. W., and F. Wilke. 1953. Migration of the northern fur seal, Callorhinus ursinus. Journal of Mammalogy 34:86–98.

Lamont, M.M., Vida, J.T., Harvey, J.T., Jeffries, S., Brown, R., Huber, H.H., DeLong, R., and W.K. Thomas.1996. Genetic substructure of the Pacific Harbor Seal (Phoca vitulina richardsi) off Washington, Oregon, and California. Marine Mammal Science 12:402-413.

Le Boeuf, B.J., K. Ono, and J. Reiter. 1991. History of the Steller sea lion population at Año Nuevo Island, 1961-1991. Administrative Report LJ-91-45C. National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla. 9 pp. Available from Southwest Fisheries Science Center, P.O. Box 271, La Jolla, Ca 92038.

Loughlin, T.R., A.S. Perlov, and V.A. Vladimirov. 1992. Range-wide survey and estimation of total number of Steller sea lions in 1989. Mar. Mam. Sci. 8:220-239.

Lowry, M.S., J.V. Carretta, and K.A. Forney. 2005. Pacific harbor seal, Phoca vitulina richardsi, census in California during May - July 2004. Administrative Report LJ-05-06, available from Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA 92037. 38 p

Lyman, R. L. 1988. Zoogeography of Oregon coast marine mammals: The last 3,000 years. Marine Mammal Science 4:247-264.

Manna, J., D. Press, D. Roberts and S. Allen. 2006. Harbor Seal Monitoring: Point Reyes National Seashore and Golden Gate National Recreation Area. Annual Report of the National Park Service, San Francisco Bay Area Network. 22pp.

McCann, T.S. 1985. Size, status and demography of southern elephant seals (Mirounga leonina) populations. In J.K. Ling and M.M. Bryden (eds.), Studies of Sea Mammals in South Latitudes. South Australian Museum. 132 pp.

Merrick, R.L., Loughlin, T.R., and D.G. Calkins. 1987. Decline in abundance of the northern sea lion, Eumetopias jubatus , in Alaska, 1956-86. Fishery Bulletin 85: 351-365.

National Marine Mammal Laboratory. 1995. Status review of the United States Steller sea lion (Eumetopias jubatus) population. National Marine Fisheries Service, Seattle, WA. 61 pp. Available at National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle.

Newsome, S. D., M. A. Etnier, D. Gifford-Gonzalez, D. L. Phillips, M. van Tuinen, E. A. Hadly, D. P. Costa, D. J. Kennett, T. P. Guilderson, and P. L. Koch. 2007. The shifting baseline of northern fur seal ecology in the northeast Pacific Ocean. Proceedings of the National Academy of Sciences 104: 9709-9714.

Ono, K.A. 1993. Steller sea lion research at Año Nuevo Island, California, during the 1992 breeding season. Administrative Report LJ-93-21C. National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla. 9 pp. Available from Southwest Fisheries Science Center, P.O. Box 271, La Jolla, Ca 92038.

Pasqual, M.A., M.D. Adkison. 1994. The decline of the Steller sea lion in the northeast pacific: demography, harvest or environment. Ecol. Applications, 4(2) 393-403.

Pyle, P., D. J. Jones, J. Schonewald, R. E. Jones, and J. Roletto. 2001. Historical and recent colonization of the South Farallon Islands, California, by northern fur seals (Callorhinus ursinus). Marine Mammal Science 17:397-402.

Ream, R. R, J. Sterling, and T. R. Loughlin. 2005. Oceanographic features related to northern fur seal migratory movement. Deep-Sea Research II 52:823 843.

Scheffer, V. B., and B. S. Kraus. 1964. Dentition of the northern fur seal. Fishery Bulletin, U.S. 63:293-315.

Springer AM, J.A. Estes, G.B. van Vliet, T.M. Williams, D.F. Doak, E.M. Danner, K.A. Forney, B. Pfister. 2003. Sequential megafaunal collapse in the North Pacific Ocean: An ongoing legacy of industrial whaling? Proceedings of the National Academy of Sciences of the United States of America 100 (21) 12223-12228.

Starks, E. C. 1922. Records of the capture of fur seals on land in California. California Fish and Game 8:155-160.

Stewart, B., B. Le Boeuf, P. Yochem, H. Huber, R. DeLong, R.Jameson, W. Sydeman, and S. Allen. 1994. History and present status of the northern elephant seal population. In: B.J. Le Boeuf and R.M. Laws (eds.) Elephant seals. Univ. Calif. Press, Berkeley. 414 pp.

Sydeman, W., N. Nur, E. McLaren, and G. McChesney. 1998. Status and trends of the ashy-storm petrel on Southeast Farallon Island, California, based upon capture-recapture analysis. Condor **100**:438-447.

Sydeman, W.J., and S.G. Allen. 1999. Pinniped population dynamics in central California: correlations with sea surface temperature and upwelling indices. Marine Mammal Science. 15: 446-461.

Testa, J. W. (editor) 2007. Fur seal investigations 2004-2005. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-174. 76 pp.

Towell, R. G., R. R. Ream, and A. E.York. 2006. Decline in northern fur seal (Callorhinus ursinus) pup production on the Pribilof Islands. Marine Mammal Science 22:486-491.

Townsend, C. H. 1931. The fur seal of the California islands. New York Zoological Society 9:443-457.

York, A. E., R. G.Towell, R. R.Ream, and C. W. Fowler. 2005. Population assessment of northern fur seal on the Pribilof Islands, Alaska, 2002-2003. Pages 8-28 in J. W. Testa, ed. Fur seal investigations, 2002-2003. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-151. 72pp.

Wilson, D. E. and S. Ruff. 1999. The Smithsonian Book of North American Mammals. Smithsonian Institution Press, Washington, D.C.

(16) Additional Tables and Figures

Table 2 (a-d): Summary of monthly pinniped censuses at the South Farallon Islands, 2006-2011 (PRBO Conservation Science, unpubl. data). November counts have been highlighted.

Average numbers with standard deviation

2a) Species by month over the past 5 years.
Average

MONTH	Zalophus	Eumatopias	Phoca	Callorhinus	Mirounga
Jan	3552.1	38.3	52.3	3.6	174.8
Feb	2115.6	38.3	52.1	4.2	172.5
Mar	1028.0	50.9	73.8	2.3	139.4
Apr	1606.4	69.1	59.9	4.2	332.1
May	4590.3	88.9	48.3	5.8	253.5
Jun	3289.1	85.0	66.4	20.0	45.7
Jul	3929.0	69.8	88.0	106.3	20.2
Aug	4292.6	33.1	64.1	108.5	36.4
Sep	2529.7	29.7	30.6	86.2	128.7
Oct	2762.5	51.9	34.4	107.1	217.5
Nov	2533.0	45.7	45.1	69.5	263.9
Dec	3187.1	45.8	48.4	22.0	188.6

2b) StandardDeviation of the Average.

MONTH	Zalophus	Eumatopias	Phoca	Callorhinus	Mirounga
Jan	2164.7	18.0	40.8	6.8	69.1
Feb	1501.0	13.8	38.4	5.3	59.4
Mar	902.5	19.8	31.5	4.5	44.5
Apr	1469.6	32.0	33.8	6.4	71.3
May	2714.4	38.9	31.7	9.8	101.0
Jun	1774.4	30.0	29.8	16.3	23.7
Jul	2094.2	39.0	21.3	64.8	7.9
Aug	1873.8	19.9	39.9	63.2	17.9
Sep	996.3	14.2	29.5	50.4	46.0
Oct	1414.5	32.2	29.1	71.6	107.7
Nov	1169.5	11.3	30.2	55.0	123.0
Dec	1824.1	12.2	23.4	26.8	93.6

Maximum numbers with standard deviation

2c) Species by month over the past 5 years

Ave of Maximum

MONTH	Zalophus	Eumatopias	Phoca	Callorhinus	Mirounga
Jan	5744.4	59.8	96.4	11.2	243.2
Feb	2667.6	52.8	96.2	7.4	239
Mar	1577.6	70.6	105	4.8	196.4
Apr	2768.2	103.8	94	9	405.8
May	7045.4	123.8	75.6	9.6	345.8
Jun	5188.8	110.6	94.6	37	76.6
Jul	5793.4	105	107.8	147.8	29.8
Aug	5182.4	49.4	96.8	151.8	58.2
Sep	3164	41.2	58	140	183.4
Oct	4325.6	77.4	71.8	160.8	301.4
Nov	3537.8	55.8	81.2	109.2	328.4
Dec	4401	56.2	69.6	43.6	264.4

2d) Standard Deviation of Averaged Maximums

MONTH	Zalophus	Eumatopias	Phoca	Callorhinus	Mirounga
Jan	2657.1	18.1	18.0	12.2	30.8
Feb	1687.8	8.2	33.0	6.2	67.2
Mar	1448.8	17.6	22.8	6.5	38.7
Apr	2647.4	24.6	22.9	8.5	35.5
May	2914.0	47.4	30.5	14.3	98.5
Jun	2093.6	32.1	21.3	7.1	13.1
Jul	2547.2	51.1	21.0	63.5	4.8
Aug	2079.5	23.7	45.2	64.8	17.5
Sep	1146.4	14.4	41.2	40.9	32.3
Oct	1258.0	43.7	20.3	77.8	91.0
Nov	1105.6	13.9	23.4	78.3	118.6
Dec	2348.3	6.9	15.0	41.5	125.6

Figure 1. Monthly average numbers of pinnipeds counted on the South Farallon Islands, 1970-2011. Eum, *Eumatopias jubatus*; Pho, *Phoca vitulina*; Cal, *Callorhinus ursinus*; Mir, *Mirounga angustirostris*; Zal, *Zalophus californianus* (PRBO Conservation Science, unpubl. data).

(from PRBO Census Data)

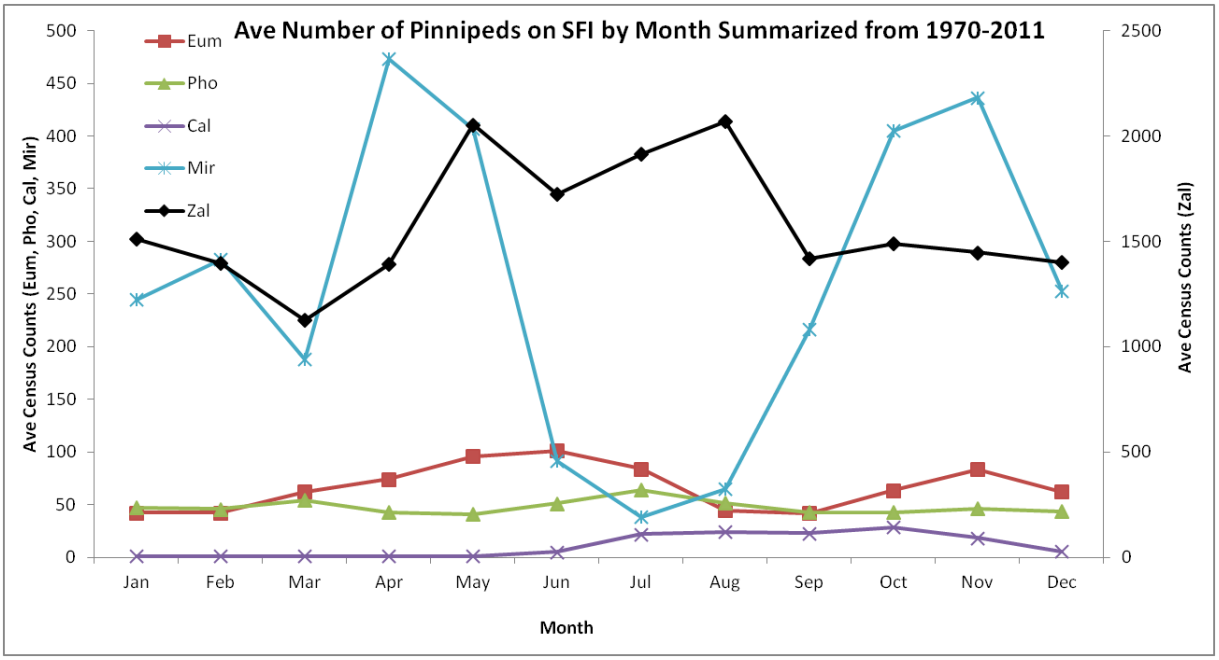


Figure 2: Elephant seal haulout locations on the South Farallon Islands.

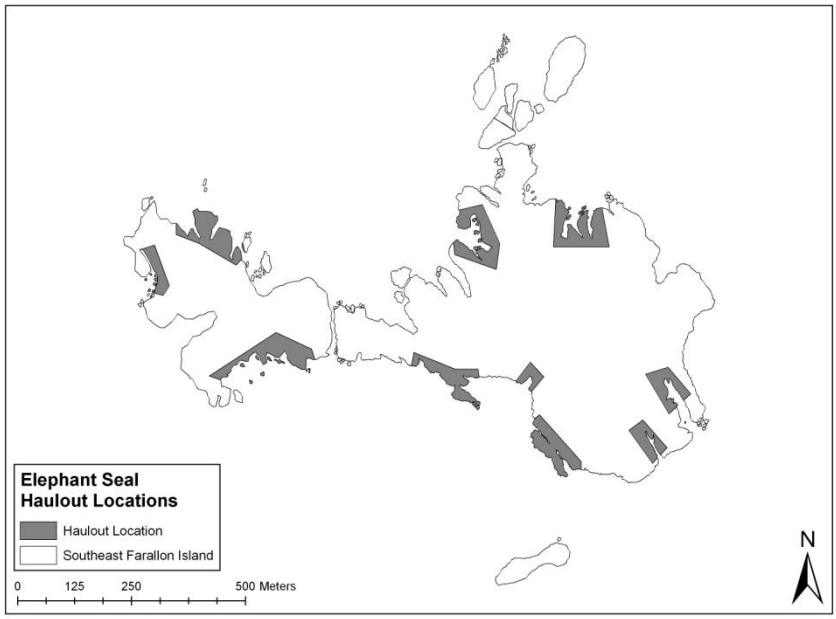


Figure 3: Harbor seal haulout locations on the South Farallon Islands.

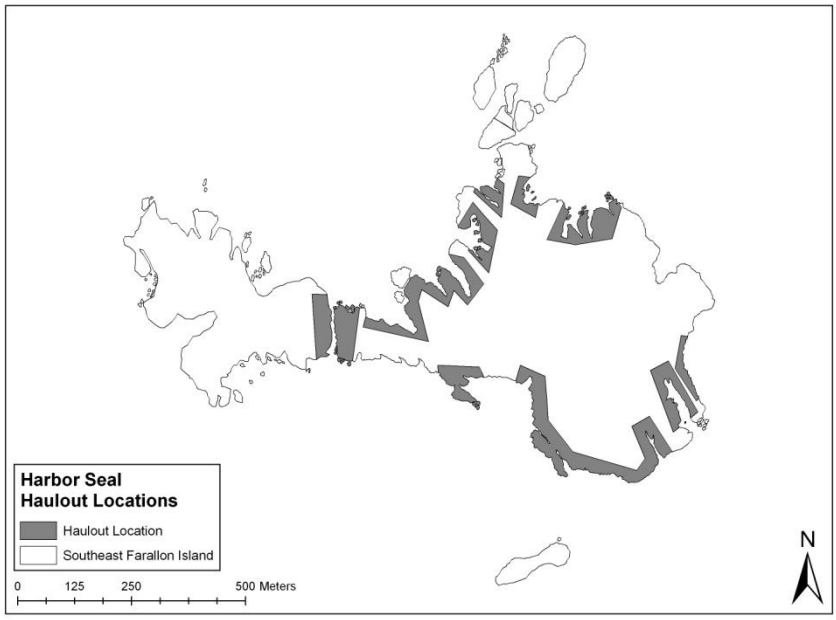


Figure 4: Steller sea lion haulout locations on the South Farallon Islands.

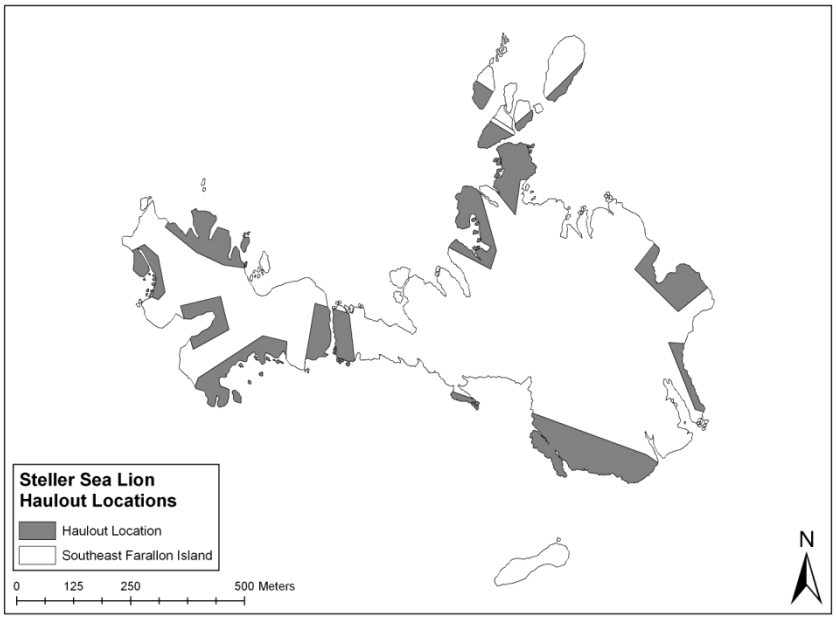


Figure 5: California sea lion haulout locations on the South Farallon Islands.

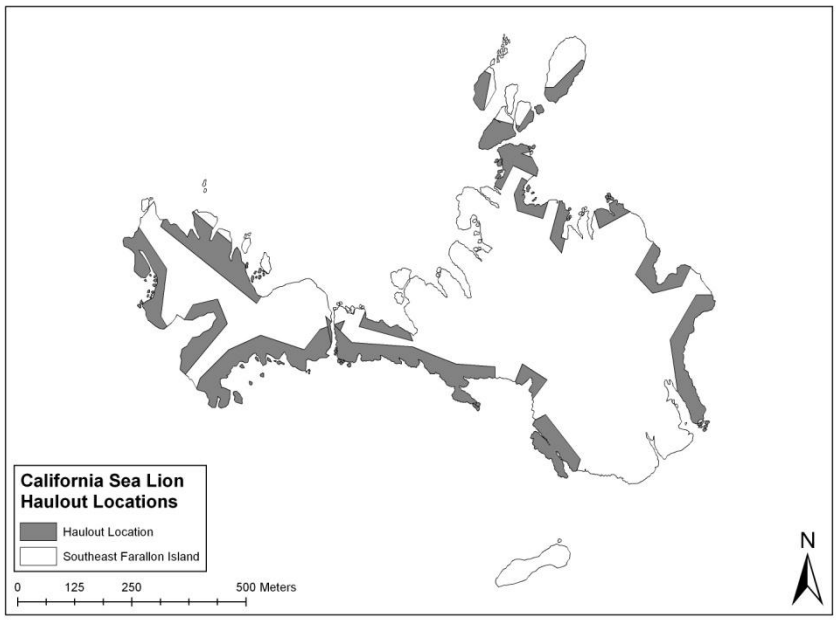


Figure 6: Northern fur seal haulout and breeding area on the South Farallon Islands.

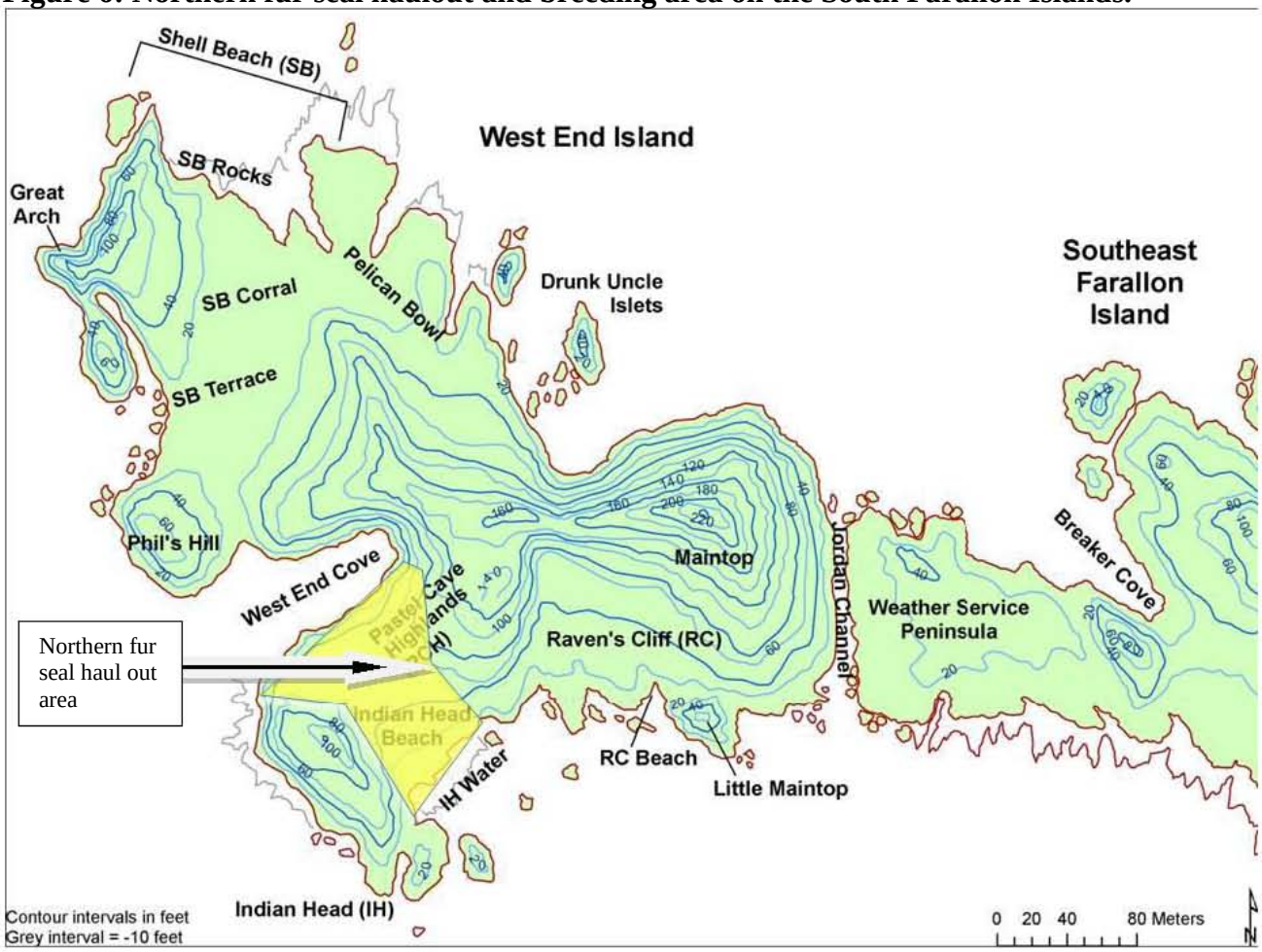


Figure 7: Primary late fall gull roosting areas on the South Farallon Islands.

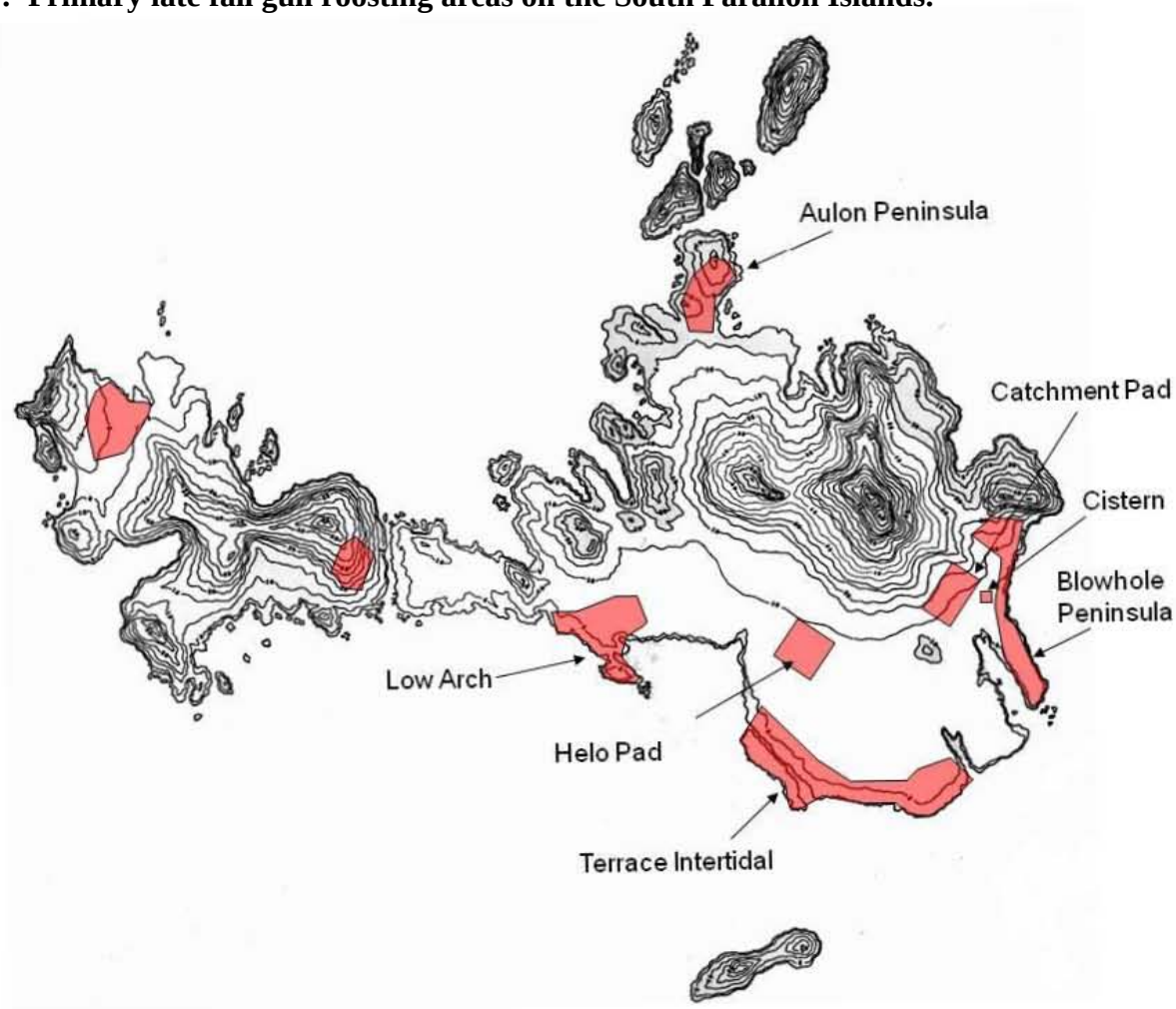
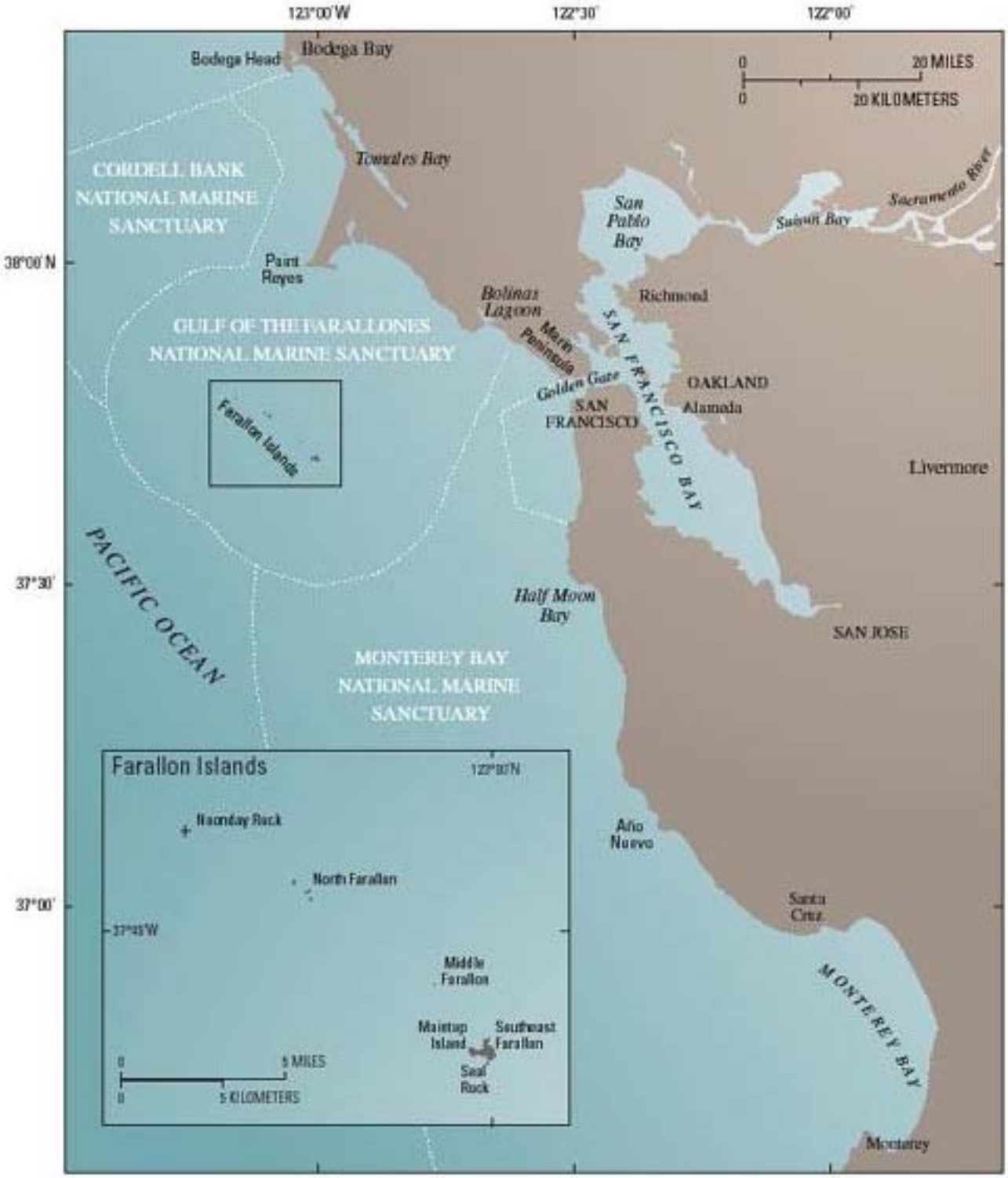


Figure 8: Map of the Farallon Islands and the central California coast.



17) Appendices

Appendix A. Gull Hazing Trial Study : Farallon National Wildlife Refuge

SUMMARY OF THE JANUARY 2011 PILOT STUDY

Introduction

A gull hazing trial was conducted on Southeast Farallon Island (SEFI) from January 21-26, 2011 in order to assist in the development of a gull hazing protocol to accompany a proposed eradication of invasive House mice (*Mus musculus*) from the Farallon National Wildlife Refuge, which is being considered by the U.S. Fish and Wildlife Service.

One of the eradication alternatives being considered involves using cereal-based pellets that Western gulls (*Larus occidentalis*) and other gull species are known to be able to consume. While most gulls and other breeding seabirds are not present on the island at this time, nor do they feed on the island during the proposed time for mouse removal, some western gulls could still be present and roosting. Hazing of the gulls will be necessary to ensure the delivered pellets are available to all mice on the islands, as well as to reduce the number of gulls that might come into contact with and consume the pellets.

Goal and Objectives

The goal of the brief trial was to determine which gull hazing techniques might be most effective in minimizing the number of gulls and other potential non-target birds from roosting on the islands during a proposed mouse eradication operation.

- Establish which hazing techniques are most effective for hazing gulls
- Estimate the personnel, equipment, and materials needed to effectively haze gulls
- Determine the effective distances for the various techniques and tools
- Observe gulls and ascertain where they retreat to when hazed off the island

Methods

The field trial team consisted of Maddie Pott of Island Conservation and two hazing experts: Winston Vickers of the Office of Spill Prevention and Response (California Department of Fish and Game) and Derek Milsaps of APHIS USDA Wildlife Services.

Hazing was generally restricted to Southeast Farallon Island, but attempts were also made to haze gulls on West End Island and offshore islets from Southeast Farallon. Hazing techniques tested during the trial were conducted in limited study areas on the islands, and were implemented so as to avoid disturbances to marine mammals in the area at the time.

Diurnal hazing techniques tested included Mylar tape, effigies, *Airsoft* guns, and the broadcasting of predator calls. Dawn and dusk hazing methods included spotlights, lasers, and pyrotechnics. Nocturnal hazing consisted of lasers and predator calls. Attempts were made to assess the numbers of gulls present in treated areas before and after the initiation of hazing efforts and to determine how long the effects of hazing lasted.

Results

Results indicated that intensive use of pyrotechnics at dawn and dusk proved to be highly effective at moving gulls from the island and discouraging them from alighting on the island. Lasers used in the hours before dawn were also very effective at discouraging gulls from landing on the island. The daytime use of effigies, especially in conjunction with predator calls was effective at dissuading gulls from roosting on the island throughout the course of the day. Observations of gulls indicated that the majority of gulls retreated to West End (Maintop and Shell Beach) and Saddle Rock when hazed off of Southeast Farallon Island.

It was concluded that Southeast Farallon could be effectively hazed with as few as five personnel at dawn and dusk, but that one person permanently patrolling the island during the day and night for gulls would be useful in further limiting the number of gulls attempting to reestablish and land on the island. Additional personnel would be needed to haze gulls off of West End and surrounding islets. The gulls appeared to move from one island to another, but did not leave the island group entirely, as the hazing was only done in limited areas. It is unknown how long the hazing techniques would be effective, as habituation could set in over time. Recommendations included that a full scale island-wide hazing study be conducted to test the efficacy of the hazing techniques over a wider area, over a longer period of time, using a wider array of techniques. This trial should also assess the potential for disturbances to marine mammals present as a result of the gull hazing methods, and identifying ways to avoid and minimize these impacts, if possible.

APPENDIX B

List of environmental compliance permits needed to conduct the Farallon Islands gull hazing trial.

1. ESA Sec. 7 consultation, NOAA-NMFS (Steller sea lions)
2. Incidental Harassment Authorization for marine mammals, NOAA-NMFS
3. Wilderness Act Minimum Requirements Analysis
4. Overflight permit, Gulf of the Farallones National Marine Sanctuary
5. Authorization to enter State Special Closure, California Department of Fish and Game