UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

In response refer to:
2012/03967: MLD

October 25, 2012

P. Michael Payne
Chief, Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Room 13705
Silver Spring, MD 20910-3226

Jan Roletto
Research Coordinator
Gulf of the Fallones National Marine Sanctuary
Fort Mason, Building 201
San Francisco, CA 94123

Dear Mr. Payne and Ms. Roletto:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) final biological opinion (Enclosure) based on NMFS' review of the proposed issuance of an Incidental Harassment Authorization to the Gulf of the Farallones National Marine Sanctuary (GFNMS) for the continuation of rocky intertidal surveys for black abalone (*Haliotis cracherodii*) on the South Farallon Islands and its effect on the federally threatened eastern Distinct Population Segment (DPS) of Steller sea lion (*Eumetopias jubatus*) and designated critical habitat, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq). This final biological opinion is based on our review of: (1) the Application for an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act (MMPA) submitted by GFNMS and the effects of the proposed action on Steller sea lions in accordance with section 7 of the ESA; and (2) the draft Environmental Assessment prepared by NMFS' office of Protected Resources and other supporting documentation. A complete administrative record of this consultation is on file at the NMFS Southwest Regional Office.

Based on the best available scientific and commercial information, NMFS' has concluded that the issuance of the IHA permit to the GFNMS to continue rocky intertidal surveys is not likely to jeopardize the continued existence of the federally threatened eastern DPS of Steller sea lion and will not result in the destruction or adverse modification of Steller sea lion critical habitat.

Thank you for consulting with NMFS on the proposed project. If you have any questions regarding this consultation, please contact Monica DeAngelis, of my staff, at (562) 980-3232, or via e-mail at Monica.DeAngelis@noaa.gov.

Sincerely,

for Rodney R. McInnis
Regional Administrator

Enclosure: Biological Opinion

cc: Candace Nachman, NMFS, OPR

National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
Biological Opinion

Action Agency:	Office of Protected Resources, National Marine Fisheries Service and Gulf of the Farallones, National Marine Sanctuary (GFNMS)
Activities Considered:	Issuance of an Incidental Harassment Authorization under Section 101(a)(5)(D) of the Marine Mammal Protection Act to allow the GFNMS to Continue Intertidal Monitoring Work on the South Farallon Islands, California
Consultation Conducted By:	Protected Resources Division, Southwest Regional Office, National Marine Fisheries Service
Tracking Number:	**2012/03967**
Date Issued:	**October 24, 2012**

Section 7(a)(2) of the Endangered Species Act (ESA; 16 U.S.C. § 1531 *et seq.*) requires that each Federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a Federal agency may affect a protected species or critical habitat, that agency is required to consult with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the protected species or critical habitat that may be affected. Federal agencies are exempt from this requirement to consult formally, if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS or the USFWS concur with that conclusion (50 CFR 402.14(b)). For the actions described in this biological opinion, the action agencies are NMFS' Office of Protected Resources (OPR) for issuance of an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act (MMPA) and the Gulf of the Farallones, National Marine Sanctuary (GFNMS) for continuing rocky intertidal monitoring for black abalone (*Haliotis cracherodii*) on the Farallon Islands; and the consulting agency is the NMFS Southwest Region (SWR).

This document represents NMFS' Biological Opinion based on our review of the Application for Level B harassment, Incidental Harassment Authorization under the MMPA submitted by the Gulf of the Farallones National Marine Sanctuary (see the *Background and Consultation History* section for more information on the purpose of this document), and the effects of the proposed action on Steller sea lions in accordance with section 7 of the ESA.

conducting intertidal monitoring work on the Farallon Islands on the threatened eastern DPS Steller sea lion. The IHA, if issued, will be valid for a one year period, and subsequent IHAs would be issued on a yearly basis, once renewal requests are received.

II. Description of the Proposed Action

NMFS proposes to issue an IHA to the GFNMS to harass Steller sea lions, California sea lions, Pacific harbor seals, northern elephant seals and Northern fur seals, incidental to intertidal monitoring work on the Farallon Islands. The IHA, once issued, is valid for one year, but may be renewed. The initial IHA will be valid from November 9, 2012 until November 8, 2013. The applicant expects to re-apply annually. Below is a description of the activities to be covered under the NMFS permit.

Project Location

The Farallon Islands consists of a chain of seven islands located approximate 48 km (30 mi) west of San Francisco, near the edge of the continental shelf and in the geographic center of the GFNMS (Figure 1). The land of the islands above the mean high tide mark is designated as the Farallon National Wildlife Refuge (managed by the USFWS), while the shore and subtidal are in the GFNMS. The nearshore and offshore waters are foraging areas for the five pinniped species listed in the IHA application, one of which is the eastern DPS of Steller sea lions, listed as a threatened species under the ESA.

Figure 1. Farallon Islands offshore of San Francisco and site of the Incidental Harassment Authorization request.

The two largest islands of the seven islands are the Southeast Farallon and Maintop (aka West End) Islands. These and several smaller rocks are collectively referred to as the South Farallon Islands, which are the subject of the IHA application. The two largest islands are separated by only a 9 m (30 ft) wide surge channel. Together, these islands are approximately 49 ha (120 ac) in size with an intertidal perimeter around both islands of 7.7 km (4.8 mi). Middle Farallon Island is located 4 km (2.5 mi) to the northwest, and is an emergent rock outcrop approximately 15 m (49 ft) in diameter. The North Farallon Islands consist of four small islands located further northwest from the South Farallon Islands (11.2 km, 7.0 mi). Only two of the North Farallon Islands are named, North Farallon Island and the Isle of Saint James.

Description of the Proposed Action

Introduction, Purpose and Background

The National Marine Sanctuaries Act (Title 16, Chapter 32, Sections 1431 et seq., as amended) specifies long-term resource management be a fundamental component of sanctuary objectives. In order to fulfill this requirement, the sanctuary includes an assessment of and long-term monitoring of the rocky intertidal areas within the GFNMS, which includes the Farallon Islands.

Ongoing monitoring work began in 1992 and the intertidal monitoring on the islands has become incorporated into a larger and more comprehensive monitoring program of the GFNMS, the Sanctuary Ecosystem Assessment Surveys (SEAS) Program (http://farallones.noaa.gov/science/seas.html). Over 40 visits have been made to the islands since 1993 to complete the intertidal surveys. With time, however, pinnipeds have increased in numbers on the islands, and hauling out more frequently on top of and in the vicinity of the sampling areas.

Rocky intertidal monitoring on the Farallon Islands is now a component of the GFNMS Sanctuary Ecosystem Assessment Surveys (SEAS) long-term monitoring program, and is a necessity to the management and protection of the GFNMS. All GFNMS SEAS monitoring projects are designed to provide documentation on the density and biodiversity of sanctuary natural resources for condition analyses, particularly for a baseline in the event of a major natural or human-induced perturbation. In the last 25 years there have been two large shipping accidents resulting in over 5.6 million liters of oil (1.5 million gallons) spilling into the GFNMS and oiling intertidal areas of the Farallon islands (Carter and Golightly 2003). The Farallon islands are also proximate to three major shipping channels so there is also a constant threat of illegal discharges of bilge waste and ballast water potentially fouling the pristine intertidal zones of the Farallon Islands.

GFNMS biologists have been conducting the intertidal monitoring on the two South Farallon Islands since 1993. This program has and continues to acquire information on seasonal and annual changes of intertidal species abundances in 1-3 visits per year. The monitoring is also important to the overall management of GFNMS resources, as the Farallon Islands represent a unique habitat that is removed from the daily presence of visitors and therefore trampling and extraction by humans. The monitoring data, decades from now, can also be used to assess trends and changes from global climate change and ocean acidification, based on range extensions, changes in biodiversity, and changes in density of calcium carbonate-containing organisms.

Since the federal listing of black abalone as "endangered" under the ESA, GFNMS have been requested by NMFS to explore as much of the shoreline as possible, to document, map the location of quality habitat for black abalone, and the location of known animals. This listing prompted the need to expand the search for black abalone into other areas on the South Farallon Islands to gain a better understanding of the abundance and health of the black abalone population in this remote and isolated location. The monitoring is planned to remain ongoing, and efforts to assess the status and health of the black abalone population on the South Farallon Islands may take several years, and perhaps decades, because black abalone tend to be very cryptic and difficult to find, especially when they are sparse and infrequent in occurrence.

In 2010, GFNMS found a single black abalone on Southeast Farallon Island proximate to one of their quadrat sampling areas. Another black abalone was recently found in 2012. Other black abalone has been found in previous surveys, in the 1990s on Weather Service Peninsula and Maintop (West End) Island in areas now occupied by sea lions. In order that their assessment of black abalone is more comprehensive, the GFNMS needs to expand their shore searches in areas beyond the proximity of our quantitative quadrat sampling areas and also in new areas on Southeast Farallon and Maintop (West End) Islands.

Many of the shorelines where GFNMS conducts their routine intertidal monitoring and where they search for black abalone have become used more heavily by pinnipeds as areas to rest, give birth, and molt. Consequently, it has become more difficult to conduct shore activities in these areas while also completely avoiding disturbance to pinnipeds in certain areas. Consequently, in the future, the GFNMS risks occasionally causing incidental disturbance to pinnipeds in completing their work. The shore areas to be searched are now planned to be expanded to search for black abalone. The GFNMS is therefore requesting an Incidental Harassment Authorization (Level B) for the South Farallon Islands in order to continue their work and expand to unexplored areas of the islands for black abalone census and mapping potential quality habitat.

Description of the Action

Routine shore activity will continue to involve the use of only non-destructive sampling methods to monitor rocky intertidal algal and invertebrate species abundances (Figure 2). At each sampling site there are three to four permanent 30 x 50 cm quadrat sites that occur in the low, middle, and upper elevation tidal zones (marked by white epoxy pads in the quadrat corners). Three to four random quadrats (unmarked) are also sampled at each site each survey, if time permits. Fifty randomly selected points within each permanent and random quadrat are sampled (as described in Foster *et al.* 1991 and Dethier *et al.* 1993). All algal and sessile macroinvertebrate species under each sampling point (loci) are recorded. A photograph is also taken of each labeled quadrat. When completed, a shore walk in the immediate proximity is done by the sampling team to search for select large invertebrates. The length of the shoreline searched in the shore walks is typically about 30 m, but plans are to expand this search effort over larger areas for abalone and in more areas. All procedures are further described in Roletto et al. (1998) and GFNMS (2008).

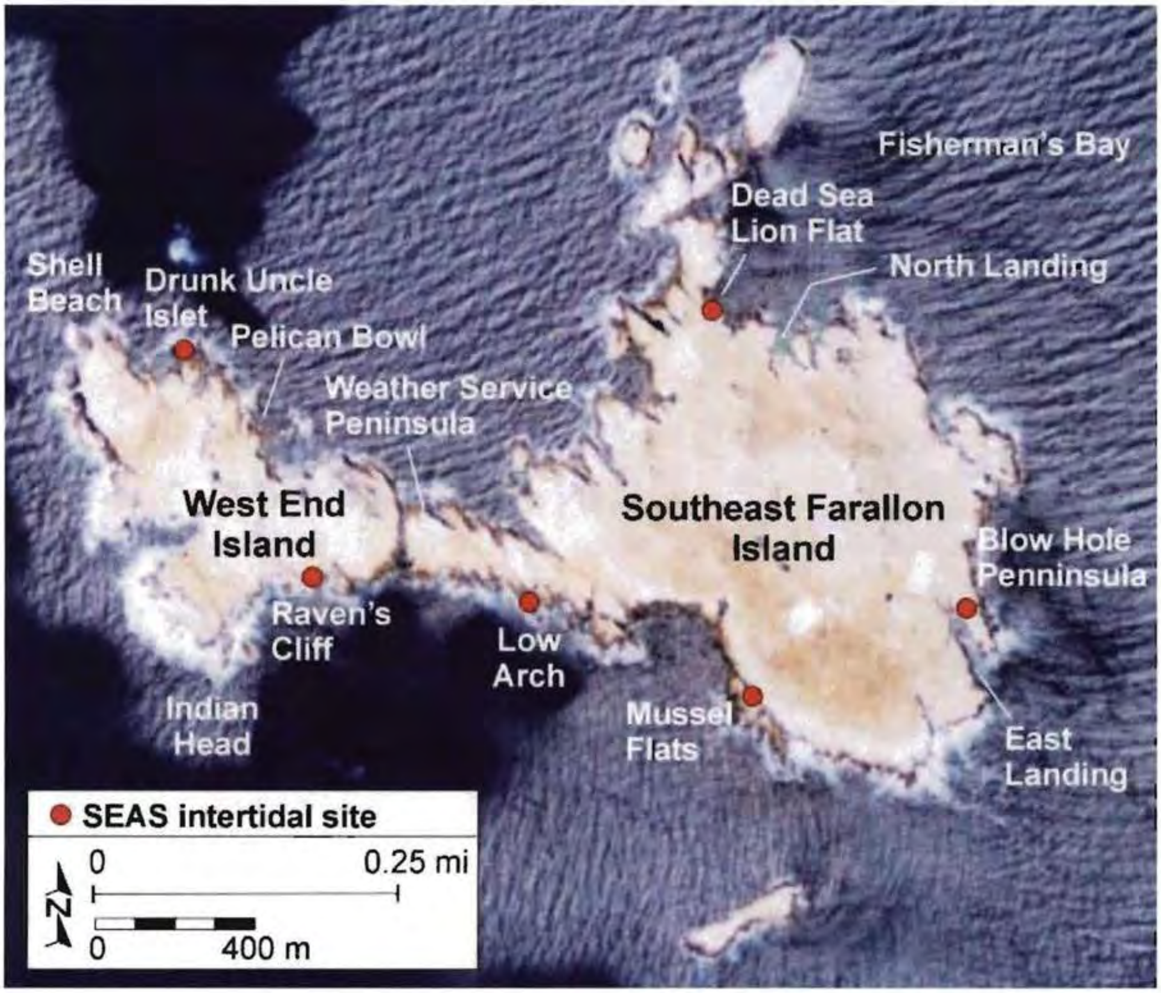

Figure 2. SEAS rocky intertidal sampling locations on Southeast Farallon and West End Islands.

In the past, the sampling, photographic documentation, and shore walks have been scheduled up to three times annually, during February, August, and November. This sampling has recently been reduced in frequency including number of areas that are sampled each survey, due to funding cuts and logistical issues, as well as a way to reduce incidental take of marine mammals by disturbance. Each survey will last for approximately four to eight days. All work will be done only during daylight minus, low tides. Each location (as listed in Tables 1 and 2) will be visited/sampled by three to four biologists, for a duration of three to four hours, one to two times each minus tide cycle, during November and February. For the first year of the IHA, four sites will be sampled during both November and February, with two additional sites to be sampled in February only.

Inaccessible shore areas will be surveyed by boat up to once each year, dependent on boat availability and weather conditions. This effort includes the Middle and North Farallon Islands. In this effort, the boat navigates to within 15-100 m of the shore, and intertidal species that can be seen through binoculars are recorded (presence/absence). PRBO continues its year round pinniped and seabird research and monitoring efforts on the South Farallon Islands, which began in 1968, under MMPA scientific research permits and IHAs. GFNMS biologists will gain access to the sites via boats operated by PRBO, with disturbance and incidental take authorized via IHAs issued to PRBO. For this reason, GFNMS has not requested authorization for take from disturbance by boat, as incidental take from that activity is authorized in a separate IHA.

This is a long-term monitoring project, so the applicant is requesting an IHA November 9, 2012 through November 8, 2013, with the intent to re-apply annually. Current areas that are sampled during August, November, and February are: Blow Hole Peninsula, Mussel Flat, Dead Sea Lion Flat, and Low Arch (Figure 2). Current areas that are sampled only during February are: Raven's Cliff and Drunk Uncle Islet. One of the reasons these areas were selected as part of the long-term monitoring project was because there were little or no pinnipeds hauled out in these areas during minus tides. Due to population growth, pinnipeds are now encroaching in these areas and these animals could be incidentally harassed as a result of GFNMS' activities. An IHA is required to continue monitoring at these historic locations. Areas to be added for intensive black abalone assessment and habitat mapping sampling during November and February include: East Landing, North Landing, Fisherman's Bay, and Weather Service Peninsula on Southeast Farallon Island. Areas to be added for intensive black abalone assessment and habitat mapping during February include: Ravens" Cliff, Indian Head, Shell Beach, and Drunk Uncle Islet (Figure 2). Each sample site will be visited one to two times per minus tide cycle for three to four hours each visit. Table 1 describes the schedule of sampling visits for each location. Due to the timing of the minus tide during August, the applicant does not anticipate sampling during August until 2015, when the minus tide will occur during daylight hours.

Specific dates of sampling in February and November of each year will vary, as in the past, dependent on tide conditions, boat logistics to the island, staff schedules, island housing availability, seabird breeding cycles, and at the discretion of Refuge management. Each visit will last approximately four to eight days.

Table 1. . Estimated number of animals to be disturbed per year per area based on **average** daily counts.*

	East Landing & Blowhole Peninsula	North Landing & Fisherman's Bay	Dead Sea Lion Flat	Mussel Flat	Low Arch	Weather Service Peninsula	Raven's Cliff**	Indian Head**	Shell Beach**	Drunk Uncle Islet & Pelican Bowl**	
CA Sea Lion November	3	152	535	28	269	57	NA	NA	NA	NA	
CA Sea Lion February	12	7	387	38	83	111	163	460	702	226	
Total	15	159	922	66	352	168	163	460	702	226	3233
Harbor Seal November	2	4	2	25	-	1	NA	NA	NA	NA	
Harbor Seal February	2	11	1	28	-	-	-	-	-	-	
Total	4	15	3	53	0	1	0	0	0	0	76
N. Elephant Seal November	-	13	14	31	20	-	NA	NA	NA	NA	
N. Elephant Seal February	-	1	1	2	1	-	-	5	6	-	
Total	0	14	15	33	21	0	0	5	6	0	94
N. Fur Seal November	-	-	-	-	-	-	NA	NA	NA	NA	
N. Fur Seal February	-	-	-	-	-	-	-	6	-	-	
Total	0	0	0	0	0	0	0	6	0	0	6
Steller Sea Lion November	-	-	5	-	-	-	NA	NA	NA	NA	
Steller Sea Lion February	-	-	6	5	1	1	1	8	7	-	
Total	0	0	11	5	1	1	1	8	7	0	34
								AVERAGE TOTAL			3443

* Estimates above are based on the SEAS team sampling each area once in each month indicated.
NA: Not applicable. **These areas on Maintop Island (West End Island) will not be sampled in November to minimize disturbance to seabirds and marine mammals.

Table 2. Estimated number of animals to be disturbed per year per area based on **maximum** daily counts.*

	East Landing & Blowhole Peninsula	North Landing & Fisherman's Bay	Dead Sea Lion Flat	Mussel Flat	Low Arch	Weather Service Peninsula**	Raven's Cliff**	Indian Head**	Shell Beach**	Drunk Uncle Islet & Pelican Bowl**	
CA Sea Lion November	5	520	880	180	575	120	NA	NA	NA	NA	
CA Sea Lion February	50	35	850	110	280	215	260	775	1420	575	
Total	55	555	1730	290	855	335	260	775	1420	575	6850
Harbor Seal November	10	10	5	50	-	5	NA	NA	NA	NA	
Harbor Seal February	10	20	10	55	-	-	-	-	-	-	
	20	30	15	105	0	5	0	0	0	0	175
N. Elephant Seal November	-	40	25	60	45	-	NA	NA	NA	NA	
N. Elephant Seal February	-	5	5	5	5	-	-	25	10	-	
Total	0	45	30	65	50	-	0	25	10	0	225
N. Fur Seal November	-	-	-	-	-	-	NA	NA	NA	NA	
N. Fur Seal February	-	-	-	-	-	-	-	20	-	-	
Total	0	0	0	0	0	0	0	20	0	0	20
Steller Sea Lion November	-	-	10	-	-	-	NA	NA	NA	NA	
Steller Sea Lion February	-	-	15	15	5	5	5	20	20	-	
Total	0	0	25	15	5	5	5	20	20	0	95
									MAXIMUM TOTAL		**7365**

* Estimates above are based on the SEAS team sampling each area once in each month indicated.
NA: Not applicable. **These areas on Maintop Island (West End Island) will not be sampled in November to minimize disturbance to seabirds and marine mammals.

Proposed Mitigation Measures

The mitigation measures presented below were included in the IHA application and the described in the Federal Register for the proposed issuance of an IHA permit (Roletto and Kimura, 2012; 77 FR 50990, August 23, 2012) and corresponding documents. These measures will be included in the IHA permit.

Measures to Minimize Impacts

While the applicant's goal is to continue collecting seasonal data on intertidal species composition, abundance, and diversity on the South Farallon Islands, the GFNMS also recognizes the need to minimize incidental take by disturbance of hauled out pinnipeds when completing their work. Pinniped abundance and distribution have increased since the time the intertidal studies began in 1993. As a result, encounters with hauled out pinnipeds have become more frequent over time.

Based on NMFS OPR's analysis of the proposed action and comments received during the 30-day public comment period on the *Federal Register* notice, the following mitigation and monitoring measures would be in place to reduce the potential for Steller sea lion disturbance: (1) conducting slow movements and staying close to the ground to prevent or minimize stampeding; (2) avoiding loud noises (*i.e.,* using hushed voices); (3) vacating the area as soon as sampling of the site is completed; (4) monitoring the offshore area for predators (such as killer whales and white sharks) and avoid flushing of Steller sea lions when predators are observed in nearshore waters; and (5) using binoculars to detect Steller sea lions before close approach to avoid being seen by animals.

Rookeries and mating areas will be avoided particularly during the Steller sea lion (May through July) and elephant seal (December through January; adults leave by March after weaning) breeding seasons. The presence of pinnipeds with pups will lead to re-scheduling work at that site when possible, unless other means to accomplishing the work will be done without causing disturbance. However, on occasions when sampling occurs during pupping season, intentional flushing of animals will not occur if dependent pups are present. Because several entities conduct activities on the South Farallon Islands (the location of GFNMS' activities), GFNMS personnel will coordinate sampling efforts with other permitted activities (such as those conducted by PRBO Conservation Science and the USFWS).

The methodologies and actions noted here would be utilized and included as mitigation measures in any issued IHA to ensure that impacts to marine mammals are mitigated to the lowest level practicable. The primary method of mitigating the risk of disturbance to pinnipeds, specifically Steller sea lions, which will be in use at all times, is the selection of judicious routes of approach to abalone study sites, avoiding close contact with pinnipeds hauled out on shore, and the use of extreme caution upon approach. In no case will Steller sea lions be deliberately approached by abalone survey personnel, and in all cases every possible measure will be taken to select a pathway of approach to study sites that minimizes the number of animals potentially harassed. In general, researchers will stay inshore of Steller sea lions whenever possible to allow maximum escape to the ocean. Workers will be trained on proper behavior to avoid disturbance. Sea lions (Steller and California), in particular, will always be approached slowly to avoid stampedes. Observers will move briskly and carefully near Steller sea lions to keep as much distance as possible, keep together as a group, keep voices low, and keep a low profile to avoid disturbing animals. In no case will marine mammals be deliberately approached, and in all cases every possible measure will be taken to select a pathway of approach to study sites that minimizes the number of potential marine mammal encounters. Each visit to a given study site will last for a maximum of 4-6 hours, after which the site will be vacated and can then be re-occupied by marine mammals that may have been disturbed by the presence of abalone researchers. By arriving before low tide, worker presence will tend to encourage animals to move to other areas for the day before they haul out and settle onto rocks at low tide. All work will occur during daylight hours.

Incidental marine mammal takes will not result in the physical altering of marine mammal habitat. No survey or sampling equipment will be left in habitat areas, and no toxic chemicals will be present or left in place.

Reporting Requirements for IHA

Researchers would record information about marine mammals present in the vicinity of the rocky intertidal monitoring survey sites. Recorded information would include species and numbers (by age and sex when possible), numbers and types of disturbance reactions noted (if any), and physical and biological conditions at the survey sites. Information about injured or dead marine mammals will be reported to NMFS.

Reporting Prohibited Take

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the IHA (if issued), such as an injury (Level A harassment), serious injury or mortality (e.g., boat-strike), GFNMS shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, at 301-427-8401 and/or by email to Michael.Payne@noaa.gov and the Southwest Regional Stranding Coordinator at 562-980-3230 (Sarah.Wilkin@noaa.gov).

The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Description of the incident;
- Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
- Description of all marine mammal observations in the 24 hours preceding the incident;
- Species identification or description of the animal(s) involved;
- Fate of the animal(s); and
- Photographs or video footage of the animal(s) (if equipment is available).

Activities will not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with L-DEO to determine what is necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. GFNMS may not resume their activities until notified by NMFS via letter, email, or telephone.

Short-Term Monitoring

Currently many aspects of pinniped research are being conducted by PRBO scientists on the Farallon Islands. Observations and reporting from monitoring research will add to the observational database and marine mammal assessments on the Farallon Islands.

The general goal of improving knowledge of pinnipeds on the South Farallon Islands can be accomplished in three specific ways from the surveys:

1) Observations of unusual behaviors, numbers, or distribution of pinnipeds, such that any potential follow-up research can be conducted by the appropriate personnel.
2) Observations of tag-bearing carcasses of pinnipeds, allowing transmittal of the information to appropriate agencies and personnel.
3) Observations of rare or unusual species of marine mammals for agency follow -up.

Long-Term Monitoring

The Steller Sea Lion Recovery Team has recommended that the eastern DPS be considered for de-listing due to the positive status of the population and absence of current threats. As part of this process, the team has recommended the development of a post-delisting monitoring plan that would extend for 10 years. This should bolster existing monitoring programs and help ensure that there are no threats to the population's continued existence. Long-term negative impacts from intertidal monitoring would likely show up in any additional large-scale monitoring plans that include evaluation of the status of Steller sea lion haulouts.

III. APPROACH TO THE ASSESSMENT

NMFS approaches its section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *Action Area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *Exposure Analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response Analyses*).

The final step of our analyses establishes the risks those responses pose to listed resources (these represent our *Risk Analyses*). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or DPSs of species. The continued existence of these "species" depends on the fate of the populations that comprise them.

Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individuals' "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our *Response Analyses*) are likely to have consequences for the individual's fitness.

When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (*see* Stearns, 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a *necessary* condition for reductions in a population's viability, reducing the fitness of individuals in a population is not always *sufficient* to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the population's base condition (established in the *Environmental Baseline* and *Status of the Species* sections) as our point of reference. If we conclude that reductions in the fitness of individuals are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always *sufficient* to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of the Species* section) as our point of reference. Our final jeopardy determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

Biological opinions, then, distinguish among different kinds of "significance" (as that term is commonly used for NEPA analyses). First, we focus on potential physical, chemical, or biotic stressors that are "significant" in the sense of "salient" in the sense of being distinct from ambient or background. We then ask if (a) exposing individuals to those potential stressors is likely to (a) represent a "significant" adverse experience in the life of individuals that have been exposed; (b) exposing individuals to those potential stressors is likely to cause the individuals to experience "significant" physical, chemical, or biotic responses; and (c) any "significant" physical, chemical, or biotic response are likely to have "significant" consequence for the fitness of the individual animal. In the latter two cases, (items (b) and (c)), the term "significant" means "clinically or biotically significant," rather than statistically significant.

For populations (or sub-populations, demes, etc.), we are concerned about whether the number of individuals that experience "significant" reductions in fitness and the nature of any fitness reductions are likely to have a "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the population(s) those individuals represent. Here "significant" also means "clinically or biotically significant" rather than statistically significant.

For "species" (the entity that has been listed as endangered or threatened, not the biological species concept), we are concerned about whether the number of populations that experience "significant" reductions in viability (= increases in their extinction probabilities) and the nature of any reductions in viability are likely to have "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the "species" those population comprise. Here, again, "significant" also means "clinically or biologically significant" rather than statistically significant.

Destruction or adverse modification[1] determinations must be based on an action's effects on the conservation value of habitat that has been designated as critical to threatened or endangered species. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species are likely to respond to that exposure. If primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

If the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena) are reduced, we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent

[1] We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our determinations which focuses on the designated area's ability to contribute to the conservation or the species for which the area was designated.

elements) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment.

To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of monitoring reports submitted by past and present permit holders; reports from NMFS Science Centers; reports prepared by natural resource agencies in States and Tribes; reports from non-governmental organizations involved in marine conservation issues; the information provided by the Permits and Conservation Division when it initiates formal consultation; and the general scientific literature. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring.

During the consultation, we also conducted electronic searches of the general scientific literature using search engines, including *BioOne, Science Direct, Ingenta Connect, JSTOR, Web of Science - Science Citation Index, First Search (Article First, ECO, WorldCat)*, and *Google Scholar*. We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests whales or turtles will exhibit a particular response to a seismic source) as well as data that does not support that conclusion.

From each document, the following was extracted: when the information for the study or report was collected, the study design, which species the study gathered information on, the sample size, acoustic source(s) associated with the study (noting whether it was part of the study design or was correlated with an observation), other stressors associated with the study, study objectives, and study results, by species. The probability of responses from the following information was estimated: the known or putative stimulus; exposure profile (intensity, frequency, and duration of exposure) where information is available, and the entire distribution of responses exhibited by the individuals that have been exposed. Because the response of individual animals to stressors will often vary with time (for example, no responses may be apparent for minutes or hours followed by sudden responses and vice versa) any differences in time to a particular response were noted.

Given the limited information that is available, this assessment involved a large amount of uncertainty. There is limited information on behavioral reactions of marine mammals to human presence; the mechanisms by which human actions affect the behavior and physiology of marine mammals, and the circumstances that are likely to produce outcomes that harm marine mammals (see NRC 2000, for further discussion of these unknowns).

ACTION AREA

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The action area for this proposed action encompasses the West End Island and Southeast Farallon Island, approximately 48 km off the San Francisco, California coast near the continental and in the geographic center of the Gulf of the Farallons National Marine Sanctuary.

IV. STATUS OF THE SPECIES

NMFS has determined that the actions considered in this biological opinion may affect the following species that are provided protection under the ESA and under NMFS' jurisdiction that may occur in the action area (Table 3):

Table 3. Species that are provided protection under the ESA and under NMFS' jurisdiction that may occur in the action area

Marine Mammals		**Status**
Blue whale *(Balaenoptera musculus)*		Endangered
Fin whale *(Balaenoptera physalus)*		Endangered
Humpback whale (*Megaptera novaeangliae*)		Endangered
Sei whale (*Balaenoptera borealis*)		Endangered
Sperm whale (*Physeter macrocephalus*)		Endangered
Killer whale - southern resident DPS (*Orcinus orca*)		Endangered
North Pacific Right Whale (*Eubalaena japonica*)		Endangered
Steller sea lion - eastern distinct population segment (DPS) (*Eumetopias jubatus*)*		Threatened
Guadalupe fur seal (*Arctocephalus townsendi)*		Threatened
Sea turtles		
Leatherback turtle (*Dermochelys coriacea*)**		Endangered
Loggerhead turtle (*Caretta caretta*) – North Pacific DPS		Endangered
Olive ridley (*Lepidochelys olivacea*)***		Endangered/Threatened
Green turtle (*Chelonia mydas*)***		Endangered/Threatened
Marine fish		
Green Sturgeon, southern DPS (*Acipenser medirostris*)***		Threatened
Pacific Eulachon –southern DPS-(*Thaleichthys pacificus*)		Proposed Threatened
Salmonids		
Chinook (*Oncorhynchus tshawytscha*)	Sacramento River winter, evolutionarily significant unit (ESU)	Endangered
	Central Valley Spring ESU	Threatened
	California Coastal ESU	Threatened
Coho (*Oncorhynchus kisutch*)	Central California Coast ESU	Endangered
	S. Oregon/N. California Coast ESU	Threatened
Steelhead (*Oncorhynchus mykiss)*	Southern California DPS	Endangered
	South-Central California DPS	Threatened
	Central California Coast DPS	Threatened
	California Central Valley DPS	Threatened
	Northern California DPS	Threatened
Invertebrates		
Black Abalone *(Haliotis cracherodii)******	Range-wide	Endangered

*Critical habitat for the Steller sea lion has been designated at three rookery sites off the California coast, Año Nuevo Island, Southeast Farallon Island, and Sugarloaf Island and Cape Mendocino. Critical habitat extends 3,000 feet above and 3,000 feet around the base of each of the rookeries. See 50 CFR section 226.202 for more information.

**Critical Habitat for the Leatherback sea turtle has been designated 41,914 square miles of marine habitat in the Pacific Ocean off the coasts of California, Oregon and Washington (77 FR 4170; 01/26/2012)

***Nesting populations of green and olive ridley sea turtles on the Pacific coast of Mexico are listed as endangered. All others are listed as threatened.

****Critical habitat for green sturgeon: NMFS designated critical habitat for southern DPS of green sturgeon and includes marine waters off of California to a depth of 110 meters beginning at Monterey Bay and extending to the California/Oregon border [See 74 Federal Register 52300, published October 9, 2009, effective November 9, 2009].

*****Critical habitat for black abalone: NMFS designated 360 square km of rocky intertidal and subtidal habitat within five segments of the California coast between the Del Mar Landing Ecological Reserve to the Palos Verdes Peninsula, as well as on the Farallon Islands, An˜ o Nuevo Island, San Miguel Island, Santa Rosa Island, Santa Cruz Island, Anacapa Island, Santa Barbara Island, and Santa Catalina Island [76 FR 66806; October 27, 2011].

Listed Species in the Action Area, but Excluded from the Consultation

The following ESA-listed species may be found in the action area, but are excluded from the consultation, as they would not be affected by human presence in the intertidal areas and shoreline on the South Farallon Islands. In addition, animals that do not haul out on land were also excluded since the harassment would be land-based. Any boat-related takes are covered under PRBO's incidental take (NMFS 2008) since they conduct the boat surveys.

Leatherback sea turtles listed as endangered under the ESA may be observed transiting through the action area. Green turtles, loggerhead, and olive ridley sea turtles, all listed as threatened or endangered under the ESA, would be rare in the action area, but records show that all species have stranded in Northern California and the Pacific Northwest area. Leatherbacks are known to migrate to central and northern California from their natal beaches in Indonesia to feed on jellyfish. The upwelling process that is part of the productive Californian coastal ecosystem provides ideal foraging habitat for leatherbacks and other marine life. During aerial surveys conducted since the early 1990s, leatherbacks were most often spotted off Point Reyes, south of Point Arena, in the Gulf of the Farallons, and in Monterey Bay. Leatherback turtles usually appear in Monterey Bay and California coastal waters during August and September and move offshore in October and November. Other observed areas of summer leatherback concentration include northern California and the waters off Washington through northern Oregon, offshore from the Columbia River plume. In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. Although sea turtles may be in the action area, it is unlikely that they would be impacted by the project since their presence is rare and project activities would take place on land and during the winter months, where sea turtles would not be impacted and when sea turtles are less likely to be in the area. Therefore, we have determined that this action may affect, but are not likely to adversely affect sea turtles.

The southern population of green sturgeon was listed as a threatened species on April 7, 2006 (71 FR 17757). Critical habitat for green sturgeon has been designated and includes marine waters off of California to a depth of 110 meters beginning at Monterey Bay and extending to the California/Oregon border (74 Federal Register 52300, published October 9, 2009, effective November 9, 2009). This species consists of coastal and Central Valley populations originating from south of the Eel River, with the only known spawning population in the Sacramento River (NMFS 2006a; NMFS 2006b; NMFS 2007). Based on the physical and chemical characteristics of other bays and estuaries in California, NMFS has confirmed presence of the Southern DPS green sturgeon in: 1) Monterey Bay (Lindley *et al.* 2008), 2) Humboldt Bay (Pinnix 2008), and; 3) coastal waters within the 110 m depth from Monterey Bay, CA to Graves Harbor, AK (including waters off Vancouver Island; Lindley *et al.* 2008). NMFS expects that Southern DPS green sturgeon is also present in California in: 1) the Klamath/Trinity River Estuary, 2) Elkhorn Slough, 3) Tomales Bay 4) Noyo Harbor, 5) Eel River Estuary (S. Lindley 2008, pers. comm.), and 6) coastal marine waters within 100 m depth from the California/Mexico border to Monterey Bay and northwest of Yakutat Bay, AK to the Bering Sea. The presence of green sturgeon has also been confirmed in Oregon in: Coos Bay and in Winchester Bay (NMFS 2006a) and likely present in Alsea River estuary, Siuslaw River estuary, Yaquina Bay, Tillamook Bay (Emmett *et al.* 1991) and the Rogue River estuary (S. Lindley, 2008, pers. comm.); and in Washington in

Willapa Bay, Grays Harbor, Strait of Juan de Fuca (Lindley *et al.* 2008) Puget Sound (Lindley and Moser, unpublished data 2008 *in* 75 FR 59900). Less is known about the green sturgeon's distribution north of its spawning grounds and geographic range. Given the lack of observations or incidences of bycatch in California fisheries, they are likely rare visitors to the action area. Therefore, because their probability of occurring in the action area during the proposed project is sufficiently small to be discountable and because they do not surface to breathe, they would not be affected by airborne noise, and the magnitude of any effect is considered to be discountable and insignificant. We conclude that the proposed GFNMS activities, may affect, but are not likely to adversely affect the southern DPS of green sturgeon. Therefore, the southern population of green sturgeon will not be considered in greater detail in the remainder of this biological opinion. Although, the proposed project area does overlap with critical habitat for green sturgeon, activities will not occur in the water and therefore, no impacts to critical habitat for green sturgeon are expected. Therefore, critical habitat for green sturgeon will not be considered in greater detail in the remainder of this biological opinion.

The Pacific eulachon (commonly called smelt, candlefish, or hooligan) are a small anadromous fish from the eastern Pacific Ocean. The proposed rule to list the southern DPS as threatened under the ESA was published on March 13, 2009 (74 FR 10857). The southern DPS of eulachon consists of populations spawning in rivers south of the Nass River in British Columbia, Canada, to, and including, the Mad River in California. Within the range of the southern DPS, major production areas or "core populations" for this species include the Columbia and Fraser Rivers and may have historically included the Klamath River. Eulachon typically spend 3-5 years in saltwater before returning to fresh water to spawn from late winter through early summer. Spawning grounds are typically the lower reaches of larger rivers fed by snowmelt (Hay and McCarter 2000). Little is known regarding the oceanic distribution of steelhead, coho, and chinook salmon originating from Northern California rivers. Because anadromous fish do not surface to breathe and therefore would not be affected by airborne noise, the magnitude of any effect is considered to be insignificant. We conclude that the proposed GFNMS activities, may affect, but are not likely to adversely affect listed anadromous fish species (*i.e.*, steelhead, coho, chinook salmon, and Pacific eulachon). Therefore, these species will not be considered in greater detail in the remainder of this biological opinion.

The black abalone is a shallow living marine gastropod with a smooth, circular, and black to slate blue colored univalve shell and a muscular foot that allows the animal to clamp tightly to rocky surfaces without being dislodged by wave action. Black abalone historically occurred from Crescent City, California, USA, to southern Baja California, Mexico (Geiger 2004), but today the species' constricted range occurs from Point Arena, California, USA, to Bahia Tortugas, Mexico, and is rare north of San Francisco, California, USA (Morris *et al.* 1980), and south of Punta Eugenia, Mexico (76 FR 66806). Black abalone generally inhabits coastal and offshore island intertidal habitats on exposed rocky shores where bedrock provides deep, protective crevices for shelter (Leighton 2005). Black abalone range vertically from the high intertidal zone to a depth of -6m (as measured from MLLW) and are typically found in middle intertidal zones. Black abalone are expected to be found in the action area; however, impacts to black abalone are covered under the scientific research permit obtained by the GFNMS and will not be addressed further in this biological opinion.

There are several endangered cetaceans that may be transiting through the project area: the blue whale, fin whale, humpback whale, sei whale, sperm whale, and North Pacific right whale; however, these animals are typically found offshore of the action area and do not have the biological requirement, nor are they capable, of coming ashore and hauling out. The eastern North Pacific blue whale stock, California/Oregon/Washington fin whale stock, the California/Oregon/Washington humpback whale stock, eastern North Pacific sei whale stock, California/Oregon/Washington sperm whale stock, North Pacific right whale, and Southern Resident killer whale, are the stocks most likely to be found within the action area. There is no designated critical habitat for blue, fin, humpback, sperm, sei, and North Pacific right whales in waters off California, Oregon and Washington. Critical habitat has been designated for the Southern Resident Killer whale (71FR69054) but it is located in the state of Washington and does not overlap with the action area. Blue whales and Humpback whales are most frequently found near the islands in the summer and fall, when strong upwelling may support a rich pelagic food web. Killer whales are also found around the islands. The islands are in the Gulf of the Farallones National Marine Sanctuary, which protects the feeding grounds of the wildlife of the refuge.

The population of Guadalupe fur seals is considered a single stock because all are recent descendents from one breeding colony at Isla Guadalupe, Mexico. Critical habitat has not been designated for the Guadalupe fur seal in the U.S. While considered rare in the area, Guadalupe fur seals have been observed as far north as Alaska, and several have been rescued by the local stranding networks. The fur seal was extirpated from the Farallon islands, but it is not known whether the Northern fur seal of Guadalupe fur seal were the islands' native fur seal. However, the Northern Fur Seal is the species that began to recolonize the islands in 1996 and Guadalupe fur seals are considered rare.

Consequently, we conclude that the proposed activities may affect, but are not likely to adversely affect blue, fin, humpback, sei, sperm, North Pacific right, and Southern resident killer whales and the Guadalupe fur seal because the probability of those species occurring in the action area during the proposed activities is sufficiently small to be discountable. Therefore, these species will not be considered in greater detail in the remainder of this biological opinion.

Marine Mammals in the Action Area, included in the Consultation

Out of the five marine mammal species observed on the Southern Farallon Islands, only the Steller sea lion is listed as threatened under the ESA and will be included in this consultation.

Steller Sea Lion

In U.S. waters, there are two separate stocks of Steller sea lions: an eastern U.S. stock, which includes animals east of Cape Suckling, Alaska (144°W), and a western U.S. stock, which includes animals at and west of Cape Suckling (Loughlin 1997). Both the eastern and western stocks were listed as federally threatened in 1990 (55 FR 49204); the western stock was subsequently upgraded to endangered status in 1997 (62 FR 24345). Critical habitat for the eastern DPS of Steller sea lions has been designated (50 CFR 226.202(b)), and is not within the action area. Therefore, no effects to critical habitat are expected as a result of the proposed action and effects on critical habitat and will not be considered further in this biological opinion.

Distribution

Steller sea lions range along the North Pacific Rim from the Channel Islands off Southern California to northern Hokkaido, Japan (Loughlin *et al.* 1984), with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. The eastern DPS of Steller sea lions, currently listed as threatened, has increased in abundance in California coastal waters, and unlike the observed decline in the western DPS of Steller sea lion, there has not been a concomitant decline in the eastern DPS U.S. stock. The project site occurs in the range of the eastern DPS stock, which includes the population along the coast from central California north to Cape Suckling, in southeast Alaska. The species is also listed as "depleted" under the MMPA and is classified as a "strategic" stock. Within their range, land sites used by Steller sea lions are referred to as rookeries or haul out sites. Rookeries are used by adult sea lions for pupping, nursing, and mating during the reproductive season (generally from May to July). Haul out sites are used by all age classes of both genders, but are generally not where Steller sea lions reproduce. The continued use of particular sites may be due to site fidelity, or the tendency for Steller sea lions to return repeatedly to the same site, often the site of their birth. Presumably, haul out sites and rookeries are chosen and continue to be used, because they protect sea lions from predators, offer some measure of protection from severe climate or sea surface conditions, and are in close proximity to prey resources (Ban 2005; Call and Loughlin 2005).

Año Nuevo and the Farallon Islands were the most important Steller sea lion rookeries in California in the 1920s, with 625 and 400 pups counted at each site in 1922 (Bonnot 1929). Counts for the Farallon Island have been low since at least 1974 and has ranged from 2 to 24 pups from 1990 to 2009 (NMML 2012). Figure 3 shows the present haul out sites used by Steller sea lions on the South Farallon Islands.

Figure 3. Location of Steller sea lion haul out sites on the South Farallon Islands. Map courtesy of PRBO Conservation Science, 2012.

The movement patterns of Steller sea lions are not yet well understood, but what is known comes from mark-resight studies of animals branded as pups (Raum-Suryan *et al.* 2002; Scordino 2006; and NMFS 2012) and from animals instrumented with a variety of electronic tags (Merrick and Loughlin 1997; Baba *et al.* 2000; Loughlin *et al.* 2003; Raum-Suryan *et al.* 2004). A northward shift in the overall breeding distribution has occurred, with a contraction of the range in southern California and new rookeries established in southeastern Alaska (Pitcher *et al.* 2007).

Steller sea lions are not known to make regular migrations, but exhibit seasonal movements between rookeries and haul out sites (Sease and York 2003). The best scientific information available indicates that Steller sea lions move on and offshore for feeding excursions. Some individuals are able to move large distances, while others may occupy relatively restriction regions depending on age, sex, and season (Mate 1973; Baba et al. 2000; Raum-Suryan et al. 2002, 2004; Scordino 2006). During the pupping and breeding season, which varies somewhat with latitude, most adult Steller sea lions occupy rookeries typically on islands or offshore reefs. While some juveniles and non-breeding adults occur at or near the rookeries during the breeding season, most are on haulouts or are at sea foraging. After the breeding season, animals may disperse from the rookery at which they breed. Females may move with their pups to other haul out sites (typically from August through October) and males may travel to distant foraging locations (Spaulding 1964; Mate 1973; Porter 1997). For example, adult males have been seen over 1000km from where they held a territory earlier in the same year (also their natal rookery) (Mate 1973; Scordino 2006). In contrast, Raum-Suryan *et al.* (2004) noted that nearshore areas adjacent to haulouts are critical to the developing juvenile as 90% of round trips were $\leq$ 15 km from haul out sites and 84% were <20 hours in length. Thus, these data indicate that potential threats near haulouts are of particular relevance to developing juveniles.

As mentioned previously females with their pups are also known to disperse. In Oregon and northern California, Scordino (2006) reported a marked pattern in seasonal abundance and distribution of females with a decline in the abundance of females and pups in both Oregon and northern California through the fall. Based on resights of pups branded between 2003-2005, Scordino (2006) found that most pips from Northern California and Southern Oregon remained close their natal rookery, but 9-22% dispersed farther than 500 km. Movement across the eastern DPS/western DPS boundary by animals (particularly juveniles) from both populations occurs (Raum-Suryan 2002, 2004; Gelatt *et al.* 2007; Scordino 2006; Pitcher *et al.* 2007). Data imply that eastern DPS males are more likely to be exposed to threats within the breeding range of the western DPS. Thus, it is assumed that only the eastern DPS of Steller sea lions would be impacted by the GFNMS activities on the South Farallon islands.

Population Trend

The best available information indicates that the overall abundance of Steller sea lions in the eastern DPS has increased for a sustained period of at least three decades. Similarly, the best available information indicates that pup production has increased significantly, especially since the mid-1990s. Pitcher *et al.* (2007) estimated that for the 25-year period between 1977 and 2002, overall abundance of the eastern DPS stock of Steller sea lions had increased at an average rate of 3.1% per year.

There are new pup and non-pup count data available since Pitcher *et al.*'s (2007) analyses from most portions of the range. Between 2002 and 2009, NMFS (unpublished) conducted surveys in southeast Alaska, Fisheries and Oceans Canada surveyed British Colombia (Olesiuk 2008), counts of non-pups were made in 2008 by aerial survey in Washington (Jefferies, pers. comm. *in* NMFS 2012), and aerial photographic surveys were flown in Oregon (through 2008), and in California (NMFS unpublished data from 2009 and 2010).

When these new data are added to Pitcher *et al.*'s (2007) time series of surveys, the interval over which we can assess population trend is lengthened, and thus, the confidence that the positive trend is real and sustained is also increased. Based on the new pup count data from southeast Alaska (DeMaster 2009), British Columbia (Olesiuk 2008), Oregon and California (NMFS unpublished data), and multiplying that number (13,889 pups) by either 4.2 or 5.2 (depending on assumptions about the ratios of pups to nonpups in Steller sea lion populations; Trites and Larkin 1996; Pitcher *et al.* 2007), Allen and Angliss (2012) estimated the population abundance of the eastern DPS, using pup multipliers of either 4.2 or 5.2 (Pitcher *et al.* 2007), and the population is estimated to be within the range of 58,334 (13,889 × 4.2) and 72,223 (13,889 × 5.2).

The best available information indicates the eastern DPS has increased from an estimated[2] 18,040 animals in 1979 (90% CI: 14,076-24,761) to an estimated 63,488 animals in 2009 (90% CI: 53,082 - 80,497); thus an estimate of an overall rate of increase for the eastern DPS of 4.3% per year (90% confidence bounds of 1.99% – 7.33%, *in* NMFS 2012-Figure 3.5.6). Moreover, given the observed data, the probability that the overall growth rate was >3.0% was 0.84 (NMML 2012). Most of the overall increase in population abundance was due to increases in the northern portion of the range in southeast Alaska and British Columbia, but the smaller population in the south (Oregon and California) also increased significantly in abundance (e.g., Fritz *et al.* 2008; Olesiuk 2008; DeMaster 2009; NMML 2012).

It is important to note that on a worldwide basis, the eastern DPS has become more important to the long-term viability of the species as a whole as it has recovered, while the western DPS has only recently begun to show limited but significant overall population growth (DeMaster 2011). The rookeries producing the most eastern DPS pups are now in Southeast Alaska and British Columbia. In 2002, approximately 2,500 pups were counted at the Scott Islands rookery in British Columbia (NMFS 2008); a 2010 survey counted 3,936 pups here (P. Olesiuk, pers. comm. to D. Seagars, NMFS Alaska Region, March 6, 2012 *in* NMFS 2012). Based on 2009 data (DeMaster 2009), the Forrester Island complex produced 4,036 pups and Hazy Islands 1,976 pups (both in Southeast Alaska). By contrast, in 2009 the largest rookery for the western DPS was at Ugamak Island complex (with 909 pups) in the eastern Aleutian Islands (DeMaster 2009).

---

[2] Model estimate for 1979 acknowledges that in that particular year only Southeast AK was surveyed

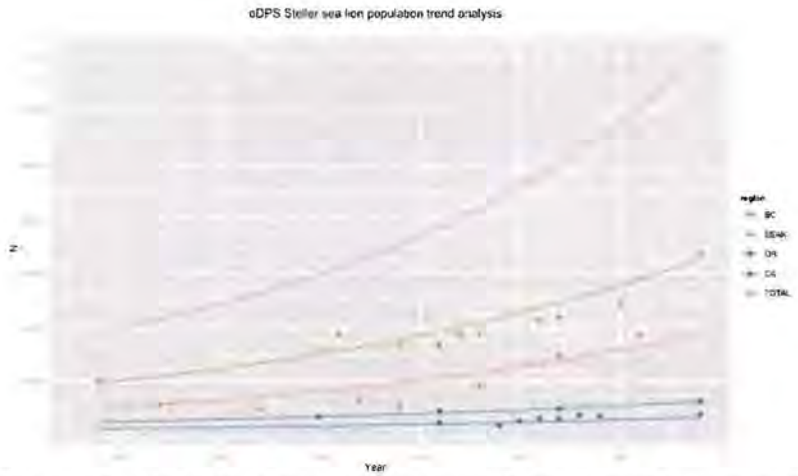

Figure 4. Analysis of population trend for the overall eastern DPS of Steller sea lions, 1979-2009 (NMML 2012).

There is a general consensus that the breeding range of the eastern DPS has shifted north. This shift began at the southern end of the range in the 1930s with the decline of the southern California rookery on San Miguel Island and continued in the 1960s and 1970s when the number of Steller sea lions at central California sites declined (Pitcher *et al.* 2007). Counts in Oregon have shown a gradual increase since 1976, as the adult and juvenile state-wide count for that year was 1,486 compared to 4,169 in 2002 (NMFS 2008). 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 1980-2004. At Año Nuevo Island off central California, 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 (Table 4, Fig. 4; from Allen and Angliss 2012).

Table 4. Counts of adult and juvenile Steller sea lions observed at rookery and haulout trend sites by year and geographical area for the eastern U. S. stock from 1982 through 2009 (NMFS 1995; Strick et al. 1997; Sease et al. 1999; Sease and Loughlin 1999; Sease et al. 2001; Olesiuk 2003; 2008; Brown et al. 2002; NMFS 2008; ODF&W unpubl. data, 7118 NE Vandenberg Ave., Corvallis, OR 97330; Point Reyes Bird Observatory, unpubl. data, 4990 Shoreline Hwy., Stinson Beach, CA 94970; NMFS unpublished data (M. Lowry, SWFSC); DeMaster 2009). Central California data include only Año Nuevo and Farallon Islands. Trend site counts in northern California/Oregon include St. George, Rogue, and Orford Reefs. British Columbia data include counts from all sites. Adapted from Allen and Angliss 2012.

Area	1982	1990	1991	1992	1994	1996	1998	2000	2002	2006	2009
Central CA	511[1]	655	537	276	508	382	564[3]	349	380		308
Northern CA/OR	3,094	3,088	3,180	4,274	3,831	4,192	4,464	3,793	4,885		
British Columbia	4,713	6,109[2]	--	7,376	8,091	--	9,818	--	12,121	15,700	
Southeast Alaska	6,898	7,629	8,621	7,555	9,001	8,231	8,693	9,892	9,951		11,965
Total	15,216	17,481	--	19,48	21,43	--	23,53	--	27,337		

[1] This count includes a 1983 count from Año Nuevo.
[2] This count was conducted in 1987.
[3] This count was conducted in 1999.

In Southeast Alaska, counts of nonpups at trend sites increased by 56% from 1979 to 2002 from 6,376 to 9,951 (Merrick et al. 1992; Sease *et al.* 2001; NMFS 2008). NMFS conducted an aerial survey of Southeast Alaska in early June 2008 and counted only 8,748 non-pups on trend sites (Fritz *et al.* 2008). It is thought that the lower than expected count in Southeast Alaska may have been due to movement of animals early in the survey period (early June to early July) north to the Prince William Sound region (since counts of non-pups there were over 1,300 greater in 2008 than 2007) or south to British Columbia. This hypothesis was supported by counts from a late June 2009 non-pup survey in SE Alaska, in which 11,965 non-pups were observed on trend sites, over 3,200 more than were counted in early June 2008. Between 1979 and 2009, counts of pups on the three largest rookeries in Southeast Alaska (Forrester Island complex, Hazy Island and White Sisters) more than tripled (from 2,219 to 6,859). In British Columbia, counts of non-pups throughout the province increased at a rate of 3.9% annually from 1971 through 2006 (Olesiuk and Trites 2003, Olesiuk 2008). Counts of non-pups at trend sites throughout the range of the eastern Steller sea lion stock are shown in Figure 5 (Allen and Angliss 2012). Between the 1970s and 2002, the average annual population growth rate of eastern Steller sea lions was 3.1% (Pitcher *et al.* 2007).

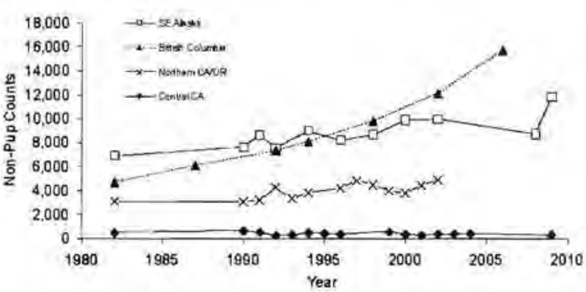

Figure 5. Counts of adult and juvenile Steller sea lions at rookery and haulout trend sites throughout the range of the eastern U.S. stock, 1982- 2009. Data from British Columbia include all sites. Adapted from Allen and Angliss (2012).

Reproduction

Steller sea lions have a polygynous mating strategy, in which a single male may mate with multiple females. As mating occurs on land (or in the surf or intertidal zones), males are able to defend territories and thereby exert at least partial control over access to adult females and mating privileges. The pupping and mating season is relatively short and synchronous, probably due to the strong seasonality in the Steller sea lions' environment and the need to balance aggregation for reproductive purposes with dispersion to exploit distant food resources (Bartholomew 1970).

Male Steller sea lions become sexually mature between three and seven years of age. Males may become territorial at 10 and 11 years of age (Calkins and Pitcher 1982). Breeding males set up territories in May (Pitcher and Calkins 1981) and females, most of whom return to breed at their natal rookery, begin to arrive shortly thereafter (Gentry 1970; Higgins 1984; Merrick 1987). Most males do not defend a territory for more than 3 years, although they may return for up to 7 years (Gisiner 1985). The breeding sex ratio of females to males is often summarized to be about 10-15:1 (Gisiner 1985; Merrick 1987). Female Steller sea lion become sexually mature between three and six years of age; they may still reproduce into their early 20s (Mathisen *et al.* 1962; Pitcher and Calkins 1981). Pitcher and Calkins (1981) concluded that adult females normally ovulate once each year and that most breed annually. However, Steller sea lion females may experience reproductive failures so such breeding may not always result in a surviving pup, especially during periods of nutritional stress (Pitcher 1981).

In May, adult males arrive at the rookeries and compete for territories. In late May, females arrive at the rookeries, where pregnant females give birth to a single pup a few days after arriving on the rookery. About 90% of pups within a given rookery are born within a 25-day period (Pitcher *et al.* 2001). Because pupping is so highly synchronous there are temporal periods of high vulnerability to stressors, such as disturbance or fluctuations in prey availability. Pupping occurs from late May to early July and peaks in June (Pike and Maxwell 1958, Mathisen et al. 1962, Gentry 1970, Pitcher and Calkins 1981, Bigg 1985; Pitcher *et al.* 2001). The mean date of pupping varies throughout the range of the eastern DPS, but not in a linear fashion with latitude. Pitcher *et al.* (2001) reported that the earliest mean pupping date occurred at Forrester Island in southeast Alaska and that the mean date becomes progressively later both south and north of this location, and with the latest mean date at Año Nuevo in California. They hypothesized that female nutritional status likely explains the differences in pupping times at individual rookeries but that the mean timing of births at rookeries was determined by the availability of prey near rookeries and weather conditions favorable for pup survival.

Mating typically occurs about one to two weeks after they pup (Gentry 1970). The gestation period is probably about 50-51 weeks, but implantation of the blastocyst is delayed about 3.5 months after breeding, late September or early October (Pitcher and Calkins 1981). For females with a pup, nursing continues for months to several years (Pitcher and Calkins 1981; Porter 1997; Loughlin 1998; Trites and Porter 2002; Trites *et al.* 2006; summarized in NMFS 2008). The nature and timing of weaning is important because it determines the resources available to the pup during the winter season. The maintenance of the mother-offspring bond may also limit their distribution or the area used for foraging. Trites *et al.* (2006) reported that the proportion of time that Steller sea lion pups nursed declined through the spring to early summer suggesting that sea lion pups began supplementing their milk diet with solid food in the spring. They concluded that weaning appears to typically occur at the start of the breeding season when pups are one or two years old. No sea lions were observed to be weaned during the winter.
Pups first enter the water at about 2–4 weeks of age (Sandegren 1970) and can swim in the open ocean at about 4 weeks of age. Pups begin to disperse (with their mothers) from rookeries to haulouts between 2-3 months of age (Raum-Suryan *et al.* 2002; Scordino 2006).

Pitcher *et al.* (2007) summarized that Steller sea lions historically used six rookeries in California: San Miguel Island, Año Nuevo Island, the Farallon Islands, Seal Rocks off of San Francisco, Sugarloaf Island-Cape Mendocino, and Saint George Reef. Recently, the National Marine Mammal Laboratory (2012) summarized trends for the three rookeries in California where breeding still occurs (Año Nuevo, Sugarloaf-Cape Mendocino, and St. George Reef). Non-pup counts at the three trend sites in California have been stable between 1990-2009, while pup production increased at 5.3% per year between 1996 (N-546) and 2009 (N=893).

Hearing

In-air territorial male Steller sea lion sounds are usually low-frequency roars, while females vocalize less and at a higher frequency (Schusterman *et al.* 1970; Loughlin *et al.* 1987). Campbell *et al.* (2002) determined that females have distinctive acoustic signatures. These calls range in frequency from 30 to 30,000 Hz with peak frequencies from 150 to 1,000 Hz; typical duration is 1,000 to 1,500 milliseconds (Campbell *et al.* 2002). Pups produce bleating sounds. The underwater hearing sensitivity of two Steller sea lions was recently tested; with hearing thresholds of the male significantly higher than those of the female (Kastelein *et al.* 2005). The range of best hearing for the male was from 1 to 16 kHz, with maximum sensitivity (77 dB re 1 μPa-m) at 1 kHz. The range of best hearing for the female was from 16 to above 25 kHz, with maximum sensitivity (73 dB re 1 μPa-m) occurring at 25 kHz. It is not known whether the differences in hearing sensitivities are due to individual differences in sensitivity or due to sexual dimorphism in hearing (Kastelein *et al.* 2005). NMFS currently uses the in-air 90dBA re 20 μPa $_{RMS}$ threshold for injury.

IV. Environmental Baseline

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this biological opinion includes the effects of several activities that affect the survival and recovery of the Steller sea lion in the action area.

A number of human activities have contributed to the current status of the Steller sea lion population in the action area. Some of those activities, most notably commercial sealing, occurred extensively in the past, ended, and no longer appear to affect this Steller sea lion population, although the effects of these reductions likely persist today. Other human activities are ongoing and appear to continue to affect Steller sea lions (See *Status of the Species* Section for specific information).

Of all activities that are normally considered in an environmental baseline, the activities that appear to have the greatest effect on the survival and recovery of the Steller sea lion considered in this biological opinion generally fall into four categories: unnatural changes to vital demographic rates, fisheries, intentional taking (including subsistence hunts), and research activities associated with reducing those impacts. Other activities, like possible pollution and contaminants, entanglement in marine debris, and disruptions (including anthropogenic) of the marine ecosystem, also appear to have effects on the survival and recovery of threatened pinnipeds, but those effects are much more difficult to evaluate. Steller sea lions exhibit natal site fidelity but are also known to travel great distances (*i.e.,* recorded 1500 km), therefore, Steller sea lions born in California, may be subjected to threats throughout their range, which includes Oregon, Washington, and Alaska.

The Eastern DPS of Steller sea lion abundance is well documented in the action area and the following narratives summarise the information that is available. That is followed by a discussion of natural and anthropoggenic phenomena that are known to or are suspected to influence their distribution, abundance, status, and trends in the action area.

Distribution of the Eastern DPS of Steller Sea Lions in the Action Area

The Eastern DPS of Steller Sea lions live year round along the Central California coast. The current population of Steller sea lions in the proposed action area is estimated to number between 50 and 750 animals. Overall, counts of non-pups at trend sites in California and Oregon have been relatively stable or increasing slowly since the 1980s (Allen and Anglis 2012). PRBO estimates that between 50 and 150 Steller sea lions live on the Farallon Islands. On the Southeast Farallon Islands, numbers of Steller sea lions have continued to decline (1974-1996) with a rate of decline of 5.9% per year for adult females; a 4.5% per year decline for immature animals; and a significant decline in maximum number of pups (Hastings and Sydeman 2002). Although the reduced numbers of Steller sea lions on the Farallon Islands has been driven by reduced numbers of adult females during the breeding season, it is unknown whether reduced numbers of adult females and immature animals during this period is due to reduced survival, or changes in geographic distribution (Hastings and Sydeman 2002). Pup counts on the Farallon Islands have generally varied from 5 to 15 (Hastings and Sydeman 2002; PRBO unpublished data).

Natural and Anthropogenic Stressors in the Action Area

Natural Mortality

Killer whales and sharks prey on Steller sea lions. Based on mortality rates used in Loughlin and York (2000), about 5,500-6,200 sea lions will die each year in a stable or increasing population of approximately 40,000 animals (NMFS 2008). An unknown portion of the mortality will result from predation by transient killer whales residing in the range of the eastern DPS of Steller sea lion. Long *et al.* (1996) reported white shark bites on 548 live and dead pinnipeds in central California, 53 of which were Steller sea lions. For the period from 1970 to 1992 the number of shark-bitten pinnipeds shows an overall increase attributable to increases in both the predators (sharks) and their primary prey (California and Steller sea lions) (NMFS 2008). Long and Hanni (1993) speculated that white shark predation could impede recovery of Steller sea lions in California, if the number of sea lion declines further and the shark population continues to increase.

Parasitism and Disease

During the past three decades, the scientific community and regulatory agencies have become increasingly aware of the long-term impact of environmental stressors on the sustainability of ecosystems. As demonstrated in the case study by Bickham *et al.* (2000) on Steller sea lions, if genetic variability is lost as a result of some historical factor, the likelihood that Steller sea lions would become extinct, if the populations were challenged by some new disease or parasite, is quite high. Disease can increase the mortality and cause reproductive failure through abortions, stillbirths, neonatal mortality, reduced fecundity, and reduced conception rates, all of which can have major impacts on the dynamics of wild populations (Scott 1988; Gulland 1995). Disease and parasitism are common in all pinniped populations and have been responsible for major die-offs worldwide, but such events are usually relatively short-lived. Disease and parasitism are also potential causes for population decline, and evidence is available indicating that animals have been exposed to diseases and that animals also carry parasites.

Conditions may be arising which could enhance Steller sea lion exposure to novel diseases. The marine environment of the eastern North Pacific, the environment in which the Steller sea lion lives, may change in the future due to global warming and related changing ocean conditions. Shifts in the ranges of some species associated pathogens may co-occur or follow such changing environmental conditions over the foreseeable future. Based on the best available information (*e.g.*, Lafferty and Gerber 2002; Goldstein *et al.* 2009), these changes are likely to increase the potential for the introduction of new pathogens. However, none of the evidence available, at this time, provides any indication that disease or parasitism are causing the decline throughout the southern portion of the Steller sea lion's range or are impeding recovery.

Antibodies to *Chlamydophila psittaci*, caliciviruses, herpesviruses, adenoviruses, and *Toxoplasma gondii* were detected at moderate to high frequencies in Steller sea lions in areas of decline and also in areas of the thriving populations (Burek *et al.* 2003). Nutritional stress is widely considered to be the most likely underlying cause of the decline of Steller sea lions in the Gulf of Alaska and Aleutian Islands (Alaska Sea Grant 1993; DeMaster and Atkinson 2002; Trites and Donnelly 2003). Although, the effects of disease and parasitism remain a concern and to date, adequate research has not been conducted to assess the relative nature and magnitude of parasitism in sea lion populations, they do not appear to be significant enough to impede recovery, based on the information currently available.

Parasites that have been reported in Steller sea lions include intestinal cestodes, trematodes, nematodes, acanthocephalans, acarian mites, and anopluran skin louse (Dailey and Brownell 1972; Dailey and Hill 1970). Parasites have been found in Steller sea lions that may cause mortality to malnourished animals. Hookworms are of particular interest because of their ability to cause morbidity and mortality in other pinnipeds. Some research has been conducted on hookworm loads in eastern DPS pups. In pups less than 3 months old examined in 2003 and 2004, total intestinal worm burdens ranged from 18 to 3,477 (Burek *et al.* 2003, 2005). These levels have been shown to cause mortality due to anemia in northern fur seals (Olsen 1958). Preliminary data indicates there are higher stress protein (haptoglobin) levels in eastern DPS animals (than in western DPS animals), where a high prevalence of hookworm parasites has been found, and where animals are crowded. Adequate research has not been conducted to assess the relative magnitude, importance and synergistic effects of parasitism, disease, and crowding in

Steller sea lion populations. The potential for these factors to cause population-level effects as density on rookeries and haulouts increases remains uncertain.

Subsistence/Native Harvest Information

The subsistence harvest of Steller sea lions during 2004-2008 is summarized in Wolfe *et al.* (2009). During each year, data were collected through systematic interviews with hunters and users of marine mammals in approximately 2,100 households in about 60 coastal communities within the geographic range of the Steller sea lion in Alaska. Approximately 16 of the interviewed communities lie within the range of the eastern U.S. stock. The average number of animals harvested and struck but lost is 12 animals/year. An unknown number of Steller sea lions from this stock are harvested by subsistence hunters in Canada. The magnitude of the Canadian subsistence harvest is believed to be small. Alaska Native subsistence hunters have initiated discussions with Canadian hunters to quantify their respective subsistence harvests, and to identify any effect these harvests may have on management of the stock (Allen and Angliss 2012).

Fishery Interactions

Amendments to the MMPA in 1988 and 1994 required observer programs to monitor marine mammal incidental take in some domestic fisheries. Until 2003, there were six different federally regulated commercial fisheries in Alaska that could have interacted with Steller sea lions and were monitored for incidental mortality by fishery observers. As of 2003, changes in fishery definitions in the List of Fisheries have resulted in separating these 6 fisheries into 22 fisheries (69 FR 70094, 2 December 2004). This change does not represent a change in fishing effort, but provides managers with better information on the component of each fishery that is responsible for the incidental serious injury or mortality of marine mammal stocks in Alaska.

Fishery observers monitored four commercial fisheries during the period from 1990 to 2005 in which Steller sea lions from this stock were taken incidentally: the California (CA thresher shark and swordfish drift gillnet, Washington (WA)/Oregon (OR)/CA groundfish trawl, northern WA marine set gillnet, and Gulf of Alaska sablefish longline fisheries. There have been no observed serious injuries or mortalities incidental to the CA thresher shark and swordfish drift gillnet fishery since 1994 (NMFS 2000, Carretta 2002, Carretta and Chivers 2003, Carretta and Chivers 2004). In the WA/OR/CA groundfish trawl (Pacific whiting component only) one Steller sea lion was observed killed in each year in 2001-03; these observed takes in combination with a mortality that occurred in an unmonitored haul resulted in a mean estimated annual mortality level of 0.8. No data are available after 1998 for the northern Washington marine set gillnet fishery. There have been no observer reported mortalities in the Gulf of Alaska sablefish longline since 2000 (Perez unpubl. ms. *in* Allen and Angliss 2012). During the 3-year period from 2007-2009, a total of 20 Steller sea lions mortalities occurred in fisheries operating south of latitude 49 (2007 = 14 mortalities, 2008 = 6 mortalities, 2009 = 0 mortalities), with an average annual take of 6.67 animals. These takes were reported as animals killed by gear; however, they could not be assigned to a particular fishery. These mortalities result in a mean annual mortality rate of 7.47 Steller sea lions. No mortalities were reported by fishery observers monitoring drift gillnet and set gillnet fisheries in Washington and Oregon this decade; though, mortalities have been reported in the past.

Strandings of Steller sea lions provide additional information on fishery-related mortality. Estimates of fishery-related mortality from stranding data are considered minimum estimates because not all entangled animals strand, and not all stranded animals are found or reported. In Alaska, during the 5-year period from 2005-2009, there were eleven serious injuries and mortality of Steller sea lions (6 in 2007, 2 in 2008, and 3 in 2009) due to ingestion of J-hooks attached to a "flasher" (an attractor used in salmon trolling) in which the hook was lodged in the esophagus and penetrating adjacent tissue (NMFS Alaska Region stranding database, unpublished data). A total of 121 observations of Steller sea lions with flashers hanging from their mouth were reported in Southeast Alaska and northern British Columbia between 2003 and 2007 (Raum-Suryan *et al.* 2009; Lauri Jemison pers. comm. *in* Allen and Angliss 2012) indicating an average rate of hook ingestion of 24.2 per year. It is not clear whether entanglements with hooks and flashers involved the recreational or commercial component of the salmon troll fishery. Based on Angliss and DeMaster (1998), it is appropriate to consider these fishery interactions "serious injuries." Mortality records from the Alaska stranding database indicate a rate of incidental mortality of at least 0.6/year from the troll fishery.

Entanglements were also reported in the stranding database, with a total of 9 cases (1 in 2007, 7 in 2008, and 1 in 2009) of serious injury and mortality attributed to entanglement, averaging 1.8 annually between 2005-2009. There were no fishery-related strandings of Steller sea lions in Washington, Oregon, or California between 2005 and 2009. Due to limited observer program coverage, no data exist on the mortality of marine mammals incidental to Canadian commercial fisheries (i.e., those similar to U.S. fisheries known to take Steller sea lions). As a result, the number of Steller sea lions taken in Canadian waters is not known. The minimum estimated mortality rate incidental to commercial and recreational fisheries (both U.S. and Canadian) is 33.5 sea lions per year, based on fisheries observer data (7.47), opportunistic observations (24.2), and stranding data (1.8).

Research-Related Mortality

Marine mammals have been the subject of field studies for decades. The primary objective of many of these studies has generally been monitoring populations to gather data for behavioral and ecological studies. Over time, NMFS has authorized permits for various non-lethal forms of "take" of marine mammals in the proposed action area. Research in the action area has included biopsy sampling, close vessel and aircraft approaches, photo-identification, tagging, and collection of sloughed skin. Intentional lethal sampling of Steller sea lions was a primary means of collecting reproductive, morphometric, dietary, and histological samples for scientific research in the 1960s and 1970s. After the passage of the MMPA, this sampling method was strictly regulated and was discontinued once the species was listed as threatened under the ESA. Research activities under the MMPA and ESA are highly regulated and closely monitored, and may include the incidental taking or harassment of Steller sea lions in the course of research activities. Research activities, including counting, capturing, and handling animals, may result in inadvertent or indirect Steller sea lion mortality. Mortality may occasionally occur incidental to marine mammal research activities authorized under MMPA permits issued to a variety of government, academic, and other research organizations. Between 2003 and 2007, there were a total of 9 incidental mortalities resulting from research on the eastern stock of Steller sea lions, which results in an annual average of 1.8 mortalities per year from this stock (Tammy Adams, pers. comm. *in* Allen and Angliss 2012). Two Steller sea lions died in 2008 in traps at

Bonneville Dam, part of the lethal take program targeting California sea lions, averaging 0.4 deaths per year.

Other Human Activities
Prior to 1972, approximately 45,000 Steller sea lions were intentionally killed in Alaska during state-sanctioned commercial harvest and predator control programs (Merrick *et al.* 1987). These sources of direct intentional killing of Steller sea lions were banned following passage of the MMPA in 1972. A provision under section 118 of the MMPA, however, allowed fishermen to lethally deter Steller sea lions from interfering with commercial fishing operations. A large but unknown number of Steller sea lions are believed to have been shot by fishermen between 1972 and 1990 (Trites and Larkin 1992). Such shooting has been illegal since the species was listed as threatened. (Note: the 1994 amendments to the MMPA made intentional lethal take of any marine mammal illegal except for subsistence hunting by Alaska Natives or where imminently necessary to protect human life). There are no records of illegal shooting of Steller sea lions from the eastern stock listed in the NMFS enforcement records for 1999-2003 (NMFS, unpublished data). Steller sea lions were taken in British Columbia during commercial salmon farming operations. Preliminary figures from the British Columbia Aquaculture Predator Control Program indicated a mean annual mortality of 45.8 Steller sea lions from this stock over the period from 1999 to 2003 (Olesiuk 2004). Starting in 2004, aquaculture facilities were no longer permitted to shoot Steller sea lions (P. Olesiuk, Pacific Biological Station, Canada, pers. comm. *in* Allen and Angliss 2012). Strandings of Steller sea lions with gunshot wounds do occur, along with strandings of animals entangled in material that is not fishery-related. During the period from 2005 to 2009, strandings of animals from this stock with gunshot wounds occurred in Oregon and Washington (three in 2005) resulting in an estimated annual mortality of 0.6 Steller sea lions. This estimate is considered a minimum because not all stranded animals are found, reported, or cause of death determined (via necropsy by trained personnel). Two mortalities from gunshots were reported (1 in 2007 and 1 in 2009); however, Steller sea lions reported in the Alaska stranding database as shot are not included in this estimate, as they may result from animals struck and lost in the Alaska Native subsistence harvest. In addition, human-related stranding data are not available for British Columbia.

Other human related activities may infrequently result in mortality to Steller sea lions. For example, in 2008, two Steller sea lions died when the doors of research traps closed unintentionally at Bonneville Dam (K. Wilkinson, unpublished NMFS NWR Stranding data).

Commercial and Private Marine Mammal Viewing
In addition to vessel operations, private and commercial vessels engaged in marine mammal watching also have the potential to impact Steller sea lions in the proposed action area. NMFS has promulgated regulations at 50 CFR 224.103, which provide specific prohibitions regarding wildlife viewing activities. In addition, NMFS launched an education and outreach campaign to provide commercial operators and the general public with responsible marine mammal viewing guidelines. In January 2002, NMFS also published an official policy on human interactions with wild marine mammals which stated that: "NOAA Fisheries cannot support, condone, approve or authorize activities that involve closely approaching, interacting or attempting to interact with whales, dolphins, porpoises, seals, or sea lions in the wild. This includes attempting to swim, pet, touch, or elicit a reaction from the animals."

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational, and scientific benefits, marine mammal watching is not without potential negative impacts. One concern is that animals become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995). Another concern is that preferred habitats may become abandoned if disturbance levels are too high. There is also direct evidence of pinniped haul out site (Pacific harbor seals) abandonment because of human disturbance at Strawberry Spit in San Francisco Bay (Allen 1991). NMFS has little information on the effects of human disturbance on Steller sea lions in California, particularly during sensitive times of the year when the need to haul out or congregate is greatest (*e.g.*, pupping or breeding seasons), however, close approach by human on foot, aircraft, or in watercraft is likely to disturb Steller sea lions and may disrupt important biological functions. For more information on noise associated with commercial and private marine mammal viewing see *Anthropogenic Noise* Section.

Pollution, Contaminants, and Entanglement in Marine Debris

Chronic exposure to the neurotoxins associated with paralytic shellfish poisoning (PSP) via zooplankton prey has been shown to have detrimental effects on marine mammals. Estimated ingestion rates are sufficiently high to suggest that the PSP toxins are affecting marine mammals, possibly resulting in lower respiratory function, changes in feeding behavior, and a lower reproductive fitness (Durbin *et al.* 2002). The impacts of these activities are difficult to measure. However, some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Contaminants such as organochlorines do not tend to accumulate in significant amounts in invertebrates, but do accumulate in fish and fish-eating animals.

Steller sea lions are exposed to local and system-wide contaminants and pollutants as they traverse the North Pacific basin. Most studies to date on Steller sea lions have involved animals from the western DPS; thus, much remains to be learned about the levels of a suite of contaminants and the physiological mechanisms and reproductive consequences of such substances in the eastern DPS Steller sea lions. Elevated levels of copper, mercury, and selenium were detected in Steller sea lions that foraged along the coast of central California (Reeves *et al.* 2002). Castellini (1999) found that levels of zinc, copper, and metallothionein were comparable between Steller sea lion pups sampled from the eastern and western DPS, and were lower in captive sea lions. The similarity of levels in both DPSs suggests that heavy metal contamination may be having similar effects on both DPSs. Existing studies on Steller sea lions have shown relatively low levels of toxic substances (with few exceptions), as well as heavy metals, and these levels are not believed to have caused high mortality or reproductive failure (Lee *et al.* 1996), and are not considered significant contributors to observed Steller sea lion declines (NMFS 2008).

Steller sea lions become entangled in a variety of debris and been observed with packing bands, discarded fishing gear, rope, and other debris around their necks. Such debris can be lethal, if it is not biodegradable. Entanglements around the neck can be especially deadly if animals are entangled that are still growing (or gaining more massive necks with maturity, as do male sea lions). While noting that entanglement in a variety of debris occurs, including packing bands, loops of line, and fishing gear, and may cause mortality, NMFS (2008) noted that "the extent is unknown and may range from a fraction of a percentage to several percent a year."

Reduction of Prey due to Fisheries
Steller sea lions prey upon some fish species that are also harvested by commercial, subsistence, and recreational fisheries (*e.g.*, Pacific cod, walleye pollock, Pacific hake, salmon, herring, etc.). Fishery removals have the potential to reduce the availability of these species to sea lions at a variety of spatial and temporal scales. Reduced prey availability can represent an acute or chronic threat to sea lion populations. Acute prey shortages may lead to starvation while chronic prey shortages have been shown in other mammals to reduce reproductive fitness, increase offspring mortality, and increase the susceptibility to disease and predation.

Fisheries present within the range of the eastern DPS of Steller sea lion could cause such effects, which include: Acting as a competitor for prey; Causing changes in the local or regional absolute and relative (with respect to other species) abundance of some fish species with the potential for: impacts on ecosystem structure, function, and the resiliency of populations within some, food webs, changes to the age and size structure of fish populations, reductions in Steller sea lion foraging success; Causing changes to fish distributions with resultant effects on Steller sea lion sea foraging efficiency; Causing changes in the average size and age of fish in a population, thereby potentially affecting Steller sea lion foraging efficiency and affecting the dynamics of the fish populations; Causing damage to habitat (e.g., due to bottom trawling) of Steller sea lion prey; and, Disturbance of rookeries or haulouts resulting in abandonment of the site on a short-term and/or long-term basis.

Given the sustained significant increases in non-pup abundance and increases in pup production of Steller sea lions in Southeast Alaska, British Columbia, Oregon, increasing abundance in Washington, current and anticipated continued fisheries management procedures and regulatory mechanisms, there is no indication that fisheries are directly or indirectly competing with eastern DPS Steller sea lions to the point where the level of fisheries related competition constitutes a threat to the survival or recovery of the eastern DPS of Steller sea lions.

Habitat Degradation
Human activities, including discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture and additional impacts from coastal development, are also known to impact marine mammals and their prey in their habitat. In the North Pacific, undersea exploitation and development of mineral deposits, as well as dredging of major shipping channels, pose a continued threat to the coastal habitat for marine mammals. Point-dredged materials and sewage effluent, potential oil spills, as well as substantial commercial vessel traffic, and the impact if trawling and other fishing gear on the ocean floor are continued threats to Steller sea lions in the proposed action area.

In taxa such as pinnipeds, which require specific habitat for breeding on land but are constrained by adaptations for feeding at sea (Stirling 1983), understanding the factors important to selection of breeding habitat is particularly important for assessing the prospect for recovery of small populations. Disturbances of Steller sea lion haulouts and rookeries can potentially cause disruption of reproduction, stampeding, or increased exposure to predation by marine predators.

Critical habitat for Steller sea lion includes an air zone that extends 3,000 feet (0.9 km) above areas historically occupied by sea lions at each major rookery in California and Oregon, measured vertically from sea level. Critical habitat also includes an aquatic zone that extends 3,000 feet (0.9 km) seaward in State and Federally managed waters from the baseline or basepoint of each major rookery in California or Oregon. Critical habitat in California for the Steller sea lion, as designated in 50 CFR Pt. 226.203, Table 1, is at Año Nuevo Island (Figure 5), Southeast Farallon Island (Figure 6), Sugarloaf Island and Cape Mendocino (Figure 7). NMFS comments on actions that may take place in sensitive Steller sea lion critical habitat and regularly reviews and provides recommendations to avoid the most sensitive times and areas in order to minimize the likelihood of having adverse impacts.

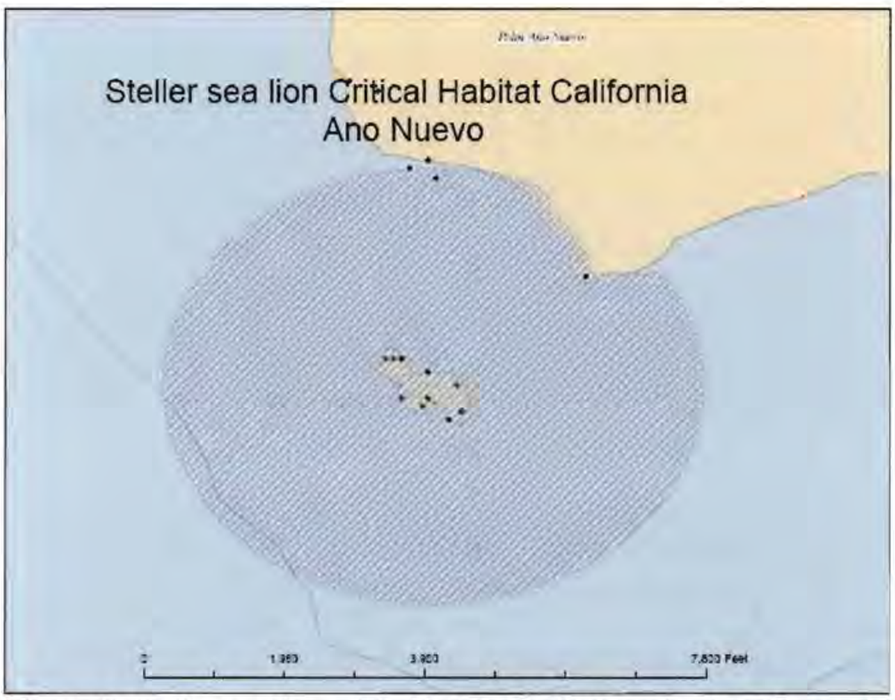

Figure 5. Steller sea lion critical habitat in California, Año Nuevo Island, includes a 3,000 foot buffer (50 CFR 226.03).

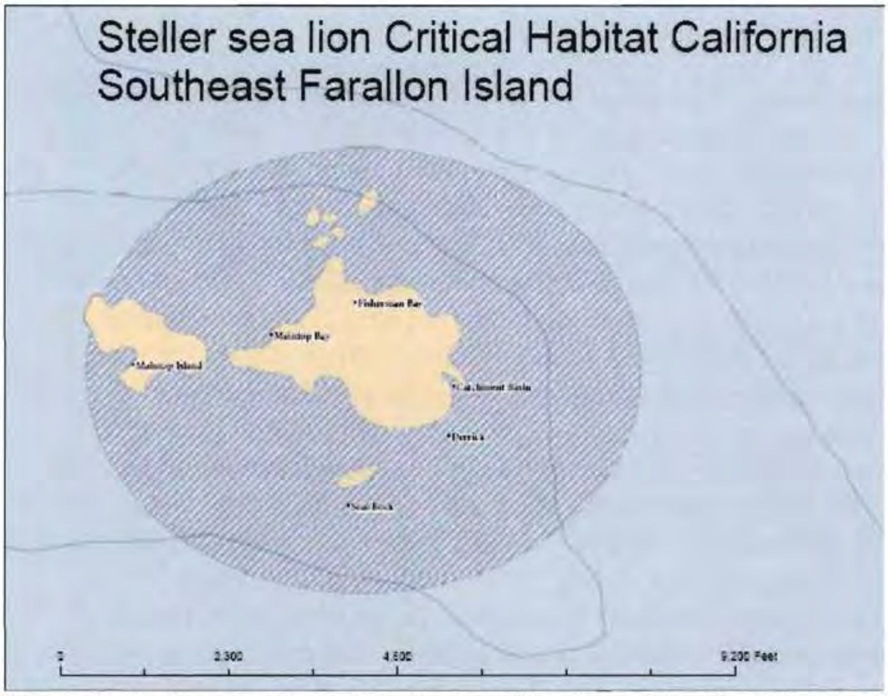

Figure 6. Steller sea lion critical habitat Southeast Farallon Islands, California; includes a 3,000 foot buffer (50 CFR 226.03).

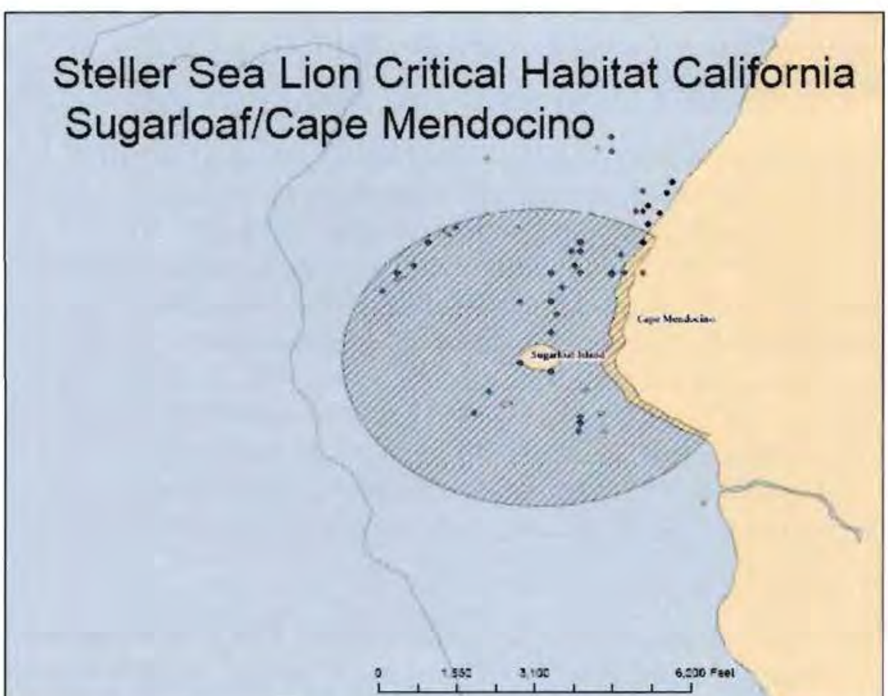

Figure 7. Steller sea lion critical habitat Sugarloaf Island/Cape Mendocino, California; includes a 3,000 foot buffer (50 CFR 226.03).

Anthropogenic Noise

As one of the potential stressors to marine mammal populations, noise and acoustic influences may seriously disrupt marine mammal communication, navigational ability, and social patterns. Many marine mammals use sound to communicate, navigate, locate prey, and sense their environment. Both anthropogenic and natural sounds may cause interference with these functions. Steller sea lions are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noise that could increase ambient noise levels, arise from the following general types of activities in and near the sea, any combination of which, can contribute to the total noise at any one place and time. These noise sources include: transportation; dredging; construction; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; military activities; sonar; explosions; and ocean research activities (Richardson *et al.* 1995). Several researchers have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Jasny *et al.* 2005; National Resource Council 1994, 1996, 2000, 2003, 2005; Richardson *et al.* 1995). Much of this increase is due to increased shipping due to more numerous ships of larger tonnage (National Research Council 2003). Commercial fishing vessels, cruise ships, transport boats, recreational boats, and aircraft, all contribute sound into the ocean (National Research Council 2003). The military uses sound to test the construction of new vessels ("ship shock trials") as well as for naval operations and exercises. Most observations of behavioral responses of marine mammals to the sounds produced have been limited to short-term behavioral responses, which included the cessation of feeding, resting, or social interactions. Acoustic devices have also been used in fisheries nets to prevent marine mammal entanglement (Goodson 1997; NMFS 1997; Marine Mammal Commission 1999) and to deter seals from salmon cages (Johnston and Woodley 1998), but little is known about their effects on non-target species.

Vessel noise, like aircraft noise, is a combination of narrowband "tonal" sounds at specific frequencies and "broadband" sounds with energy spread continuously over a range of frequencies (Richardson *et al.* 1995). Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson 1996). The Navy estimated that the 60,000 vessels of the world's merchant fleet, annually emit low frequency sound into the world's oceans for the equivalent of 21.9 million days, assuming that 80 percent of the merchant ships are at sea at any one time (U.S. Navy 2001). Ross (1976) has estimated that between 1950 and 1975, shipping had caused a rise in ambient noise levels of 10 dB. He predicted that this would increase by another 5 dB by the beginning of the 21st century. The National Resource Council (2003) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade, since the advent of propeller-driven ships.

Calkins and Pitcher (1982) found that disturbance from aircraft and vessel traffic has extremely variable effects on hauled-out sea lions. Michel *et al.* (2001) suggested an association between long-term exposure to low frequency sounds from shipping and an increased incidence of marine mammal mortalities caused by collisions with ships. Pinnipeds, including Steller sea lions, are not as likely to be threatened by vessel noise and ship traffic as cetaceans, since they are smaller and are highly maneuverable in the water. However, sea lion reaction to occasional disturbances ranges from no reaction at all to complete and immediate departure from the haul out area. The type of reaction appears to depend on a variety of factors. When sea lions are frightened off rookeries during the breeding season and pupping season, pups may be trampled or even abandoned. After repeated disturbances, sea lions have temporarily abandoned areas (Thorsteinson and Lensink 1962), but in other situations have continued using areas after repeated and severe harassment. The consequences of such disturbances are difficult to measure. The proximity of their haul out sites to shipping channels and the increase in ship traffic may increase the likelihood of vessel impacts on pinnipeds, but the effects, such as ship strikes or impacts to pinniped communication, are unknown. Stranding data indicates that pinnipeds have been struck by ships and it is likely that the actual number of pinnipeds struck by ships is higher than what is reported in stranding databases, particularly since dead animals are more apt to sink at sea then drift into shore. However, the overall impact of ship strikes to pinnipeds, including Steller sea lions, is unknown. At present, concern about the effects of anthropogenic disturbance focuses on disturbance as an impediment to research on Steller sea lions and whether it might contribute to the decline of the population in the southern portion of their range. Carretta *et al.* (2001) and Jasny *et al.* (2005) identified increasing levels of anthropogenic noise as a habitat concern for whales and other marine mammals because of its potential effect in their ability to communicate.

Oil and Gas Development

Human development activities that result in aquatic habitat destruction from the release of contaminants and pathogens (*e.g.*, during construction/demolition) could directly diminish the health and reproductive success of Steller sea lions or cause them to abandon feeding, breeding, or resting sites. Development and discharge proposals associated with oil and gas development typically undergo an ESA section 7 consultation during the Federal permitting process. At this time, there are no proposed development or discharge proposals within the proposed project area. The types of impacts from geophysical surveys and construction (*i.e.,* introduction of noise into the environment) are covered under *anthropogenic noise*.

Oil spills are expected to adversely affect Steller sea lions if they contact individual animals, haulouts, or rookeries when occupied, or large proportions of major prey populations (Minerals Management Services 1996). Potential effects include: oil exposure, including surface contact and pelage fouling, inhalation of contaminant vapor, or ingestion of oil or oil-contaminated prey. Since the insulation of nonpup sea lions is provided by a thick layer of fat, rather than pelage whose insulative value could be destroyed by fouling, oil contact is not expected to cause death from hypothermia. However, sensitive tissues (*e.g.*, eyes, nasal passages, mouth, or lungs) are likely to be irritated or ulcerated by exposure to oil of hydrocarbon fumes. Steller sea lions were undoubtedly exposed to oil after the Exxon Valdez oil spill in 1989 in Prince William Sound, Alaska, but no significant adverse effects of the oil were confirmed (Calkins *et al.* 1994).

Oil and gas leasing, exploration and development has occurred directly in the historic or current range ofthe eastern DPS in waters off California. New leasing is not currently occurring or planned offshore of California, but there are multiple active leases and platforms on which drilling is occurring and oil is produced in that state. Maps of these leases are available at: http://www.boemre.gov/omm/pacific/lease/lease.htm. They include multiple platforms at the southernmost extent of the range, shoreward of the Channel Islands, off Point Arguello, and off Huntington and Seal Beaches. In July of 2010, BOEMRE Pacific region indicated that there are currently 241,023 acres in active leases and 43 of the 49 active leases are producing in California.

Climate Change and Ocean Acidification

Connecting global warming and ocean acidification to increased levels of carbon dioxide in the atmosphere, recent scientific literature has expressed a growing concern over the potential impacts of these phenomena (McCarty 2001; Fabry et al. 2008; NRC 2010; IPCC 2007; ACIA 2004; NMFS 2010). Findings particularly relevant to Steller sea lions included shifts in the range and abundance of algae, plankton, and fish in high-latitude oceans and changes in the migrations of fish in rivers (IPCC 2007: 8-9).

The general northward shift in distribution within the breeding range and the decline of eastern DPS Steller sea lions in the southernmost part of the range may reflect just such a response to climate change. Changes in the ocean environment, particularly warmer temperatures, may be possible factors that have favored California sea lions over Steller sea lions in the southern portion of the Steller's range (NMFS 2008). The most evident change is that all of the new rookeries in the eastern DPS have been established in Alaska at the northern end of the range, suggesting a population shift north.

In general, Steller sea lions are likely to be less sensitive to this threat than other marine organisms, as they are opportunistic and mobile predators. However, the flexibility of the eastern DPS in responding to climate change is limited by the terrestrial nature of some of their important habitat, such as rookery sites. Historically, rookery sites have been located near areas of high productivity and seasonally available food resources. The foraging efficiency of nursing females may be affected by factors that change the timing, distribution, and abundance of key prey in the proximity of rookeries. While new rookery sites have been established in the northern part of the range of the eastern DPS, the number of sites with suitable characteristics that are also protected from human disturbance may be limited within the range of this DPS. Past patterns of resilience to environmental variability may not, therefore, clearly predict the future ability of the eastern DPS to respond to environmental change.

Global climate warming and ocean acidification pose a threat to the Steller sea lion population from potential food web alteration, direct physiological impacts on prey species, or more generally, to changes in the composition, temporal and spatial distribution and abundance of Steller sea lion prey assemblages. If the underlying food webs are affected by ocean acidification and climate change, this population segment of Steller sea lions would also likely be affected. It has become increasingly clear that global climate warming and related acidification of the oceans poses a serious threat to marine ecosystems in general. However, consideration of this issue is complicated by the rapidly evolving understanding of this complex threat, the uncertainty about how Steller sea lions might respond, and the inability to apply this knowledge under the "foreseeable future" standard to predict a response by the eastern DPS with any reliability.

Clearly, the issue is not specific to Steller sea lions or their habitat. Steller sea lions may be no more sensitive to such modification than many other marine mammal species. Based on the available information, it is likely that global warming and ocean acidification may affect eastern

North Pacific subarctic ecosystems before the end of this century; however the magnitude, timing, and mechanism of the changes, and how they may affect the eastern DPS of Steller sea lion is, at this point, impossible to predict. Given the increasing population trends of the eastern DPS of Steller sea lion, the robust reproduction over a large range, and the relatively large population size, the available information suggests that global warming and ocean acidification are not impeding this population's overall viability and are not likely to cause it to become in danger of extinction within the foreseeable future throughout all or a significant portion of its range (NMFS 2012).

The Impact of the Environmental Baseline on Listed Resources
Although Steller sea lions are exposed to a wide variety of past and present State, Federal or private actions; other human activities that have already occurred or continue to occur in the action area; Federal Actions that have already undergone formal or early section 7 consultation under the ESA; and State or private actions that are contemporaneous with this consultation, the impact of those activities on the status, trend, or the demographic processes of threatened and endangered species remains largely unknown.

The action area for the proposed action encompasses the entire Southeast Farallon and Maintop (West End) Islands and nearshore intertidal waters. We refer the reader to the *Status of the Species* section for general information on the species' biology, ecology, status, and population trends at the species scale. This section identifies many of the major existing stressors that Steller sea lions are exposed to at the same time they will be exposed to the stressors of the proposed operations.

Historically, seal hunts had caused Steller sea lions to decline to the point where they faced risks of extinction. Since the end of commercial hunting, this primary threat to the eastern DPS has been eliminated. However, these species have not yet recovered from those historic declines and scientists cannot determine if those initial declines continue to influence current populations of Steller sea lions. In addition, it is not clear what influence climate change or other factors may have on the current distribution of the eastern DPS of Steller sea lions across their range, particularly with the decrease in their range in California and the establishment of new haul out areas and rookeries in Alaska. The relationships between specific sound sources, or anthropogenic sound in general, and the responses of marine mammals to those sources are still subject to scientific investigation, but no clear patterns have emerged. As a result, the potential consequences of anthropogenic sound on Steller sea lions also remain uncertain. The levels of mortality from research directed activity, entanglement, and "other human related sources" are very small relative to population size and productivity.

The proposed project activities have occurred since 1992. Over 40 visits have been made to the islands since 1993 to complete the intertidal surveys. Therefore, the number and timing of stranding events in California were also examined to detect potential relationships within the conduct of the proposed project activities. Based on the information, we are unable to find a correlation between the stranded animals and the project activities.

V. Effects of the Proposed Action

In this section of the biological opinion, the potential effects of proposed action activities on the eastern DPS of Steller sea lions, is described. As explained in the *Approach to the Assessment* section, we identified several aspects of the proposed project that may affect Steller sea lions. In the following section, we discuss how individual animals may be affected by the proposed action and assess whether any changes in the survival or reproduction of any affected pinniped might be expected. We relate any reductions in fitness to population level consequences and finally the species level.

The ESA does not define harassment nor has NMFS defined this term, pursuant to the ESA, through regulation. However, the MMPA of 1972, as amended, defines harassment as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" [16 U.S.C. 1362 (18)(A)].

For this biological opinion, we define "harass" for ESA purposes, similarly to the MMPA's definition of harassment: an intentional or unintentional human act or omission, that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents. We are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level consequences.

Application of approach to the Assessment

NMFS initially identified one element of the proposed intertidal monitoring activities that may represent a potential hazards to threatened or endangered species or critical habitat that has been designated for them: (1) presence of humans.

Thus, this assessment focuses on the element of human presence. The potential risks associated with and human presence was analyzed by assessing the frequency and the potential for disturbance by human presence. The first step in the analysis evaluates the available evidence to determine the likelihood of listed species or critical habitat being exposed to GFNMS activities. The analysis assumed that GFNMS activities pose no risk to listed species or critical habitat if they are not exposed to the activities (NMFS recognizes that some activities could have indirect, adverse effects on listed species or critical habitat by disrupting marine food chains, a species' predators, or a species' competitors; however, situations where these effects might apply to species under NMFS' jurisdiction were not identified in this case). The analysis also assumed that the potential consequences of exposure to GFNMS activities on individual animals would be a function of the intensity of human presence and the duration, and frequency of the animal's exposure to GFNMS activities. Once we identified that Steller sea lions (eastern DPS) were likely to be exposed disturbance by human presence and the nature of that exposure, we examined the scientific and commercial data available to determine whether and how Steller sea lions are likely to respond given their exposure. The remainder of our analyses proceeded using the approach we described in the previous section. Although the overall trend for the eastern

DPS stock is showing an increase, the stock is declining in the southern portion of its range, which includes California and the action area. Exposure to human presence is likely to disrupt one or more behavioral patterns that are essential to an individual animal's life history or to the animal's contribution to the population. However, these behavioral responses are expected to be temporary and are not likely to hinder the reproductive success or recovery of the Steller sea lion and would also not result in the serious injury or mortality of a single individual. Thus, no impact on the population size of breeding stock of Steller sea lions is expected to occur.

POTENTIAL RESPONSES TO STRESSORS

Based on our review of the available data, the proposed activities are likely to cause one primary stressor: disturbance by human presence. The narratives that follow describe these identified stressor in greater detail, describe the probability of Steller sea lions being exposed to this stressor based on the best scientific and commercial evidence available, then describe the probable responses of this listed species, given probable exposures, based on the evidence available.

Based on our review of the data available, Steller sea lions are likely to be exposed to the four stressors mentioned above. We assume that all five of the pinniped species (Steller sea lions, California sea lions, Pacific harbor seals, Northern elephant seals, and Northern fur seals) could be present during the activities because of limited sighting data or facts about their habitats and presence in similar locations in coastal zones. Any measures to minimize impacts to Steller sea lions would also be beneficial to the other pinniped species known to use the area. NMFS considers an animal to have been harassed if it moved greater than 1 m (3.3 ft) in response to the researcher's presence or if the animal was already moving and changed direction and/or speed, or if the animal flushed into the water. Animals that became alert without such movements were not considered harassed. There is no potential for serious injury or mortality to pinnipeds from any abalone research activities.

Human Presence

Animals respond to disturbance from humans in the same way as they respond to the risk of predation, by avoiding areas of high risk, either completely or by using them for limited periods (Gill *et al.* 1996). There is increasing recognition that the effect of human disturbance on wildlife is highly dependent on the nature of the disturbance (Burger *et al.* 1995; Klein *et al.* 1995; Kucey 2005). Generally, human disturbance to hauled out pinnipeds may be categorized by purpose: scientific investigation, ecotourism, and recreation. Of the three types of human disturbances, ecotourists and recreators are not likely to be aware of the negative impacts that their presence may have on wildlife. Foot traffic at distances of 25-50 m resulted in short-term (several minutes) heart rate increases among Rocky Mountain bighorn sheep in Alberta, Canada (MacArthur *et al.* 1982). Hicks and Elder (1979) studied interactions between humans and California bighorn sheep in the Sierra Nevada Mountains. The authors found that the reactions of sheep to humans were related to distance to humans and to group size and composition. Scientists often need to closely monitor demographic parameters and their work often present the most intense kinds of disturbance: entering rookeries or haulouts and capturing and handling animals. However, most scientists are aware of the potential harmful effects of their work, and any scientific research permit issued takes into account any potential impacts the research could have on individual animals and the population. Disturbance of elephant seal harems caused by visits by researchers resulted in direct but transient changes in some types of behavior; no long-term changes in behavior (period of weeks) was implied from the comparison made between the areas of high and low human presence (Engelhard *et al.* 2002)

Disturbances resulting from human activity and other causes can impact pinniped haul out behavior (Renouf *et al.* 1981; Schneider and Payne 1983; Terhune and Almon 1983; Allen *et al.* 1984; Stewart 1984; Suryan and Harvey 1999; Mortenson *et al.* 2000; Kucey and Trites 2006), both in the short- and long-term. The apparent skittishness of both harbor seals and Steller sea lions raises concerns regarding behavioral and physiological impacts to individuals and populations experiencing high levels of human disturbance. It is well known that human activity can flush harbor seals off haul out sites (Allen *et al.* 1984; Calambokidis *et al.* 1991; Suryan and Harvey 1999; Mortenson *et al.* 2000). Researchers have also observed that human disturbances in the form of boat traffic and people walking on the beach, can flush seals into the water from haul out sites and impact seal haulout numbers (Renouf *et al.* 1981; Schneider and Payne 1983; Terhune and Almon 1983). Lelli and Harris (2001) found that the level of boat traffic (including motor and paddle boats) in Gun Point Cove, Maine, was, by far, the single strongest predictor of harbor seal haulout numbers. Of the 85 incidents in which harbor seals were flushed, 93% were caused by boats.

The Hawaiian monk seal has been shown to avoid beaches that have been disturbed often by man (Kenyon 1972). Stevens and Boness (2003) concluded that after the 1997-98 El Niño when populations of the fur seal, *Arctocephalus australis*, in Peru declined dramatically, seals abandoned some of their former primary breeding sites, but continued to breed at adjacent beaches that were more rugged (*i.e.*, less likely to be used by humans). Abandoned and unused sites were more likely to have human disturbance than currently used sites. Human disturbance appeared to cause Steller sea lions to desert a breeding area at Northeast Point on St. Paul Island, Alaska (Kenyon 1962).

EXPOSURE ANALYSIS

Exposure analyses are designed to identify the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence. In this step of our analysis, we try to identify the number, age (or life stage), and gender of individuals that are likely to be exposed to an Action's effects and the populations or subpopulations those individuals represent.

Human Presence

Steller sea lions are regularly observed hauled out at Southeast Farallon and Maintop (West End) islands. These animals could be present during the proposed project. The probability of their presence in the area of the proposed project is likely to depend on the season, including variable oceanographic conditions, wave height, and availability of prey. Steller sea lions use the island as a haul out site year-round; however, the number of animals varies at each of the haul out locations depending on season. Animals may be disturbed or temporarily displaced from the area. Any behavioral disruptions resulting from the presence of researchers are expected to be temporary (*e.g.*, animals are expected to return to use the haul out by the end the day). The intertidal zones where GFNMS conducts intertidal monitoring area also areas where pinnipeds can be found hauled out on the shore. Accessing portions of the intertidal habitat may cause incidental Level B (behavioral) harassment of pinnipeds through some unavoidable approaches if pinnipeds are hauled out directly in the study plots or while biologists walk from one location to another. No motorized equipment is involved in conducting these surveys.

Current areas that are sampled during November and February are: Blow Hole Peninsula; Mussel Flat; Dead Sea Lion Flat; and Low Arch (see Figure 2). Current areas that are sampled only during February are: Raven's Cliff and Drunk Uncle Islet. Areas to be added for intensive black abalone assessment and habitat mapping sampling during November and February include: East Landing; North Landing; Fisherman's Bay; and Weather Service Peninsula on Southeast Farallon Island. Areas to be added for intensive black abalone assessment and habitat mapping during February only include: Ravens' Cliff; Indian Head; Shell Beach; and Drunk Uncle Islet (see Figure 2). Each sample site will be visited one to two times annually per minus tide cycle for 3-4 hours each visit and only during daylight hours. Tables 1 and 2 outline the schedule of sampling visits for each location.

Specific dates of sampling in February and November of each year will vary, as in the past, dependent on tide conditions, boat logistics to the island, staff schedules, island housing availability, seabird breeding cycles, and at the discretion of Refuge management. Each visit will last approximately 4-8 days.

Estimated Exposure

If we assume that 100% of the animals hauled out each of the survey locations for that day might be exposed to survey activities (*i.e.*, human presence), then this estimate represents the number of times a sea lion might be "taken" in the form of harassment. We do not anticipate any of these sea lions to die or exhibit responses that might constitute harm or injury.

Figure 3 depicts the overlap between Steller sea lion haul out sites and abalone sampling sites. The current population of eastern Steller sea lions in the proposed research area is estimated to number between 50 and 750 animals. PRBO estimates that between 50 and 150 Steller sea lions live on the Farallon Islands. On Southeast Farallon Island, the abundance of females declined an average of 3.6 percent per year from 1974 to 1997 (Sydeman and Allen, 1999). Pup counts on the Farallon Islands have generally varied from five to 15 (Hastings and Sydeman, 2002; PRBO unpub. data). However, the proposed site visits in November and February fall outside of the pupping and breeding seasons for Steller sea lions.

It is likely that a maximum of 95 Steller sea lions will be taken by harassment caused by the proposed research activities which represents approximately 0.18% of eastern DPS Steller sea lions (conservatively using the N_{MIN}). P roposed mitigation measures and minimizing the number of disturbances necessary to successfully complete the abalone research would greatly reduce the potential harassment caused by the proposed research activities

Response Analysis

Potential Responses to Human Presence

Potential impacts on sea lions from human disturbance could range from a physiological stress response, to sea lions leaving the haulout either temporarily or permanently (Orsini 2004). Short-term effects of human presence include disruptions of sea lion daily activities and potential redistribution of animals within and among sites. However, the effects of repeated short-term disturbance at the population level are unknown, particularly in research-related disturbances (NMFS 2002). Displacements may increase population numbers and density at alternate sites or force individuals to inhabit sub-optimal habitat (Creel *et al.* 2002).

Long-term effects of human disturbance that significantly reduces the time that sea lions haul out, or substantially interferes with the activity pattern of hauled out sea lions, could potentially have consequences on life cycles and activities (Orsini 2004). Steller sea lion research in Alaska and British Columbia has focused on both the western DPS (declining) and eastern DPS (increasing) populations. Comparable research on both these populations has not revealed any discernable negative effects on either population. Constantine *et al.* (2004) argued that the long-term effects of reduced resting behavior on long-lived species, such as sea lions, might affect their fitness, individual reproductive success and population size; however, the lack of any obvious long-term effect and the apparent resilience of sea lions to human encroachment and hunting pressures, argues in favor of the resiliency of sea lions to intermittent disturbances (Kucey 2005). Sea lions at certain haul out sites may become habituated to repeated disturbance stimuli, or conversely, may exhibit increased levels of response (Frid and Dill 2002). However, sea lions can still experience continued physiological stress with frequent human approach despite an apparent habituated response to high levels of intrusion (Fowler 1999). Regardless of the level of habituation, Kucey (2005) determined that it was clear that Steller sea lions demonstrate a flight response to sudden movements, noises, smells, and approaches (in particular with aircraft and vessels).

Stress Responses

Acute responses to sounds may be difficult to quantify, but they are much more tractable to investigation than are responses to repeated or chronic sounds. Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg 2000; Sapolsky 2005; Seyle 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune response.

Although stress-induced pathologies have been hard to identify in free-ranging marine mammals, based on work with terrestrial mammals, it is likely that marine mammals would experience similar responses. The stress caused by pursuit and capture activates similar physiological responses in terrestrial mammals (Harlow *et al.* 1992) and cetaceans (St. Aubin and Geraci

1992). In the case of many stressors, the first and most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the autonomic nervous system and the classical "fight or flight" response, which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with stress. These responses have a relatively short duration and may or may not have significant long-term effect on an animal's welfare.

An animal's third line of defense to a stressor involves its neuroendocrine systems, usually hormones associated with the hypothalmus-pituitary-adrenal system (most commonly known as the HPA axis in mammals or the hypothalamus-pituitary-interrenal axis in fish and some reptiles). Unlike stress responses associated with the autonomic nervous system, virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. In the majority of stress studies, the HPA axis has been the primary neuroendocrine axis monitored. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987; Rivier 1995) and altered metabolism (Elasser *et al.* 2000), immune competence (Blecha 2000) and behavior. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress, is the biotic cost of the response. When stressed, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response does not pose a risk to the animal's welfare.

However, when an animal has insufficient biotic reserves to satisfy the biotic cost of a stress response, then resources must be shifted away from other biotic functions. When sufficient reserves are diverted from these functions, the functions are impaired. For example, when stress shifts metabolism away from growth, young animals no longer thrive, and growth is stunted. When energy is shifted from supporting reproduction, reproductive success is diminished. In these cases, animals have entered a pre-pathological state (pathological state and are experiencing "distress;" *sensu* Seyle 1950) or "allostatic loading" (*sensu* McEwen and Wingfield 2003). This period of distress will last until the animal replenishes its biotic reserves sufficient to restore normal function.
Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (Holberton *et al.* 1996; Hood *et al.* 1998; Jessop *et al.* 2003; Krausman *et al.* 2004; Lankford *et al.* 2005; Reneerkens *et al.* 2002; Thompson and Hamer 2000). Although no information has been collected on the physiological responses of marine mammals upon exposure to anthropogenic sounds, studies of other marine animals and terrestrial animals would lead us to expect some marine mammals to experience physiological stress responses and, perhaps,

physiological responses that would be classified as "distress" upon exposure to certain frequency sounds.

Behavioral/Disturbance Responses

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill *et al.* 2000; Gill *et al.* 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). Based on the evidence available, marine mammals are likely to exhibit several behavioral responses upon being exposed to loud sound transmissions. They will: try to avoid exposure, respond to the exposure as they would respond to other human activities (behavioral disturbance), experience social disruptions, exhibit behaviors associated with distress (see the Stress Response Section), habituate to the stressors, or they will not respond. These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response or more serious physiological changes with chronic exposure to stressors), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky *et al.* 2000; Walker *et al.* 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner *et al.* 2004), and the death of individual animals (Daan *et al.* 1996; Feare 1976). The narratives that follow summarize the information available on these behavioral responses and since there isn't a wealth of information on a marine mammal's response to human disturbance, we assume that marine animals would likely follow similar responses to other wild animals, even though the studies presented were not all conducted on marine mammals.

When encountering disturbance stimuli, ranging from the low-flying helicopter to the wildlife photographer, an animal's response appears to follow the same economic principles used by prey when they encounter predators (Berger *et al.* 1983; Madsen 1994; Gill *et al.* 1996, 2001; Gill and Sutherland 2000). This verbal model is called the risk-disturbance hypothesis. It predicts that responses by disturbed animals track short-term changes in factors characterizing disturbance stimuli, with responses being stronger when perceived risk is greater. The level of perceived risk may result from a combination of factors that characterize disturbance stimuli, along with factors related to natural predation risk (Frid 2001; Papouchis *et al.* 2001).

Existing studies of behavioral effects of man-made sounds in marine environments remain inconclusive, partly because of their limited ability to detect behavioral changes that are significant to the biology of the individual animals being observed. These studies are further complicated by the variety of responses that can occur within a single species of marine mammals, which can exhibit a wide range of responses to man-made noise that can vary by individuals and their circumstances. Under certain circumstances, some individuals will continue the normal activities in the presence of high levels of man-made noise; in other circumstances, the same individual or other individuals may avoid an acoustic source at much lower received levels (Richardson *et al.* 1995).

Determining the significance of noise disturbance to marine mammals remains a challenge for scientists. A workshop held by the National Research Council in 2004, examined the threshold for "biologically significant" effects of noise on marine mammals; that is, noise from an action that affects the ability of an animal to grow, survive, and reproduce. These can also have population-level consequences and affect the viability of the species. The National Research Council recommended that a predictive model be developed to determine the biological significance of behavioral change in response to noise. The consensus of participants in the workshop was that at least a decade would be required to have the data and understanding to turn such a conceptual model into a functional tool (National Research Council NRC 2005).

Probable Responses of Steller sea lions to the proposed action

Since Steller sea lions are skittish by nature, it is likely that loud, frequent, unfamiliar noises are likely to disrupt resting sea lions or those foraging in the water near the sound source. Steller sea lions would likely abandon haulouts, or dive if foraging in the water, if disturbed by project activities. Generally, animals return to their previous behavior within an hour (Porter 1997) or a few days (Kucey 2005), depending on the level and length of disturbance.

Human Presence

Determining the effects of human disturbance on individual Steller sea lion behavior depends on what is considered normal or baseline behavior. Kucey (2005) determined that significant seasonal differences in the behaviors between Steller sea lions that remained on land and those that returned to the water did exist. Animals that returned to the water showed a decrease in rates of total numbers of behaviors and interactions in the winter/spring, when compared to summer, and an increase following a research disturbance. Seasonal considerations that may have affected haulout behavior may include: reproductive status, prey availability correspondence to foraging efforts, distances traveled between haul out sites and rookeries, and possible climate conditions on the haulout or in the water. Individual sea lions took longer to "settle down" in winter/spring than in summer. This may be related to the fact that sea lions typically spend longer at sea during winter/spring months (Merrick and Loughlin 1997; Sease and York 2003), and may behave differently onshore after their winter trips. Kucey (2005) who observed that it took sea lions longer to "settle down" in winter/spring than in summer, determined that this may be explained by weather conditions or fatigue due to greater physical exertion during the trips (*i.e.*, sea lions may need more rest after winter trips and are less likely to flush completely, but may shift around the haul out site or show signs of "agitation" before resting).

In addition, Kucey (2005) observed similar rates of behavior for animals remaining on land, but substantially different rates among age and sex classes for animals that returned to the water. Such age and sex class behavioral differences may be related to the social, physical, or reproductive status of individual animals and their varying energetic expenditures (Harkonen *et al.* 1999). From spring to summer breeding seasons, sea lions distribute themselves within and among sites according to their reproductive status. Disturbance that displaces adult male sea lions from their territories, for example, especially during the breeding season, increases the likelihood of aggressive interactions occurring among males (NMFS 2002). In contrast, adult males may also provide a stabilizing influence in the summer months that shortens the time it takes the other sea lions to "settle down" after hauling out. Lewis (1987; *in* Richardson *et al.*

1995) reported 22 out of 23 stampedes of Steller sea lions were caused by human disturbance during censuses. Although a few pups were killed, there were changes in some animals' behavior, which included reduced mother-pup contact.

Overall, Steller sea lions showed a short-term effect of disturbance at a local population level, whereby mean numbers of sea lions using haul out sites dropped following a major disturbance, and according to Kucey (2005), did not recover for 2-4 days.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, NMFS searched for information on future Federal, State, tribal, local, or private actions that were reasonably certain to occur in the action area. The action area is part of the National Marine Sanctuaries; thus, any future projects would likely need a federal permit from NOAA and the USFWS.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

NMFS' Office of Protected Resources Permits and Conservation Division proposes to issue an IHA for incidental takes that would occur during the surveys, pursuant to MMPA section 101(a)(5)(D).

In this assessment, we measure risks to listed individuals using changes in the individual's "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect listed plants or animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (Anderson 2000; Mills and Beatty 1979; Brandon 1978; Stearns 1977, 1992). As a result, if we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

The following narratives summarize the probable risks the proposed project, particularly human presence, pose to Steller sea lions, over a one year period (the expected length of time of the current IHA. These summaries integrate the results of the *Exposure* and *Response* analyses presented in previous sections of this biological opinion. It is reasonable to assume that the proposed project will create sounds within the Steller sea lion's hearing range (*e.g.*, human voices). However, as mentioned previously in the *Effects* section, we do expect the project to result in the incidental harassment of animals, but no pinnipeds, including Steller sea lions, will be exposed to loud enough sounds to impact their hearing.

Steller sea lions likely to be exposed to the proposed project include those animals from the eastern DPS. The minimum size of the population can be estimated as the actual count of hauled out sea lions of 52,847 (as corrected); this does not account for animals at sea (Angliss and Allen *et al.* 2012). We assume any age or gender may be exposed, however since the work window is outside of the pupping season, few, we do not expect any exposure to newborn pups. In addition, although the overall trend for the eastern DPS stock of Steller sea lions is showing an increase, the stock is declining in the southern portion of its range, which includes California and the action area.

For the purposes of this biological opinion, if Steller sea lions are present, we assumed that 100% of the animals hauled out might be exposed to abalone research (including human presence), and this represents the number of individuals that might be "taken" in the form of harassment. If on land, the animals will likely depart from the haulout into the water, swim with their head above water, vocalize, or dive. If the disturbance persists, animals may vacate and depart from the area near the source of disturbance. A maximum of about 95 animals are expected to be taken by harassment as a result of proposed abalone research activities. As mentioned previously, the minimum population estimate for the eastern DPS of Steller sea lions is 52,847; therefore, this project may incidentally harass 0.18% of the total population annually.

The only type of harassment expected is displacement. We expect no mortality or injury to Steller sea lions, in particular to younger animals, since the research activities will be conducted outside of the pupping season and the risk of stampedes is reduced by the proposed approach measures to each abalone survey site.

The disturbance responses associated with direct effects of project activities (*i.e.*, human presence) are expected to have short duration; they are likely to result in acute stress responses (*e.g.*, physiological and hormonal changes in animals that are normally associated with "fight or flight" responses), but not likely to impair the overall health of sea lions by depleting their energy reserves since the response intensity and duration is not likely to exceed the received threshold above 90dBA re 20 μPa_{RMS} ,where we would expect permanent impacts.

It is not expected that this project will impact the prey base; therefore depletion of energy reserves via a lack of a food source, is also not expected. Some of the same Steller sea lions may be exposed multiple times over the course of the project, but these actions are not likely to impair the overall health of those sea lions by depleting their energy reserves since the response intensity and duration is not likely to exceed the threshold where we would expect permanent impacts (above the received level of 90dBA re 20 μPa_{RMS}). Although we acknowledge that some individuals may suffer reduced fitness (from stress caused by the harassment) due to effects of the proposed action, we do not expect that a large proportion of Steller sea lions using the project site would suffer reduced fitness (that is, their response to the proposed action is not expected to reduce a sea lion's probability of surviving to age "x" and its probability of reproducing at age "x"), and therefore, we do not expect a subpopulation effect. In addition, any effects of the action on individual fitness would likely not exceed the natural variability in the subpopulation. Because we do not expect the action to have adverse consequences on the viability of the subpopulations that sea lions in the action area represent, we would not expect the eastern DPS population of Steller sea lions to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild. Given this and the likely response by Steller sea lions to the proposed project (*i.e.*, harassment as defined in this document), individual Steller sea lions are likely to be adversely affected by human presence during proposed project activities, but as mentioned previously, the proposed project is not expected to appreciably reduce the eastern DPS of Steller sea lion's likelihood of surviving or recovering in the wild.

Although the biological significance of the animal's behavioral responses to abalone research activities remains unknown, exposure to human presence are likely to disrupt one or more behavioral patterns that are essential to an individual animal's life history or to the animal's contribution to a population. For the proposed action, behavioral responses that result from human presence and any associated disruptions, are expected to be temporary and are not likely to affect the reproduction, survival, or recovery of the Steller sea lion.

As mentioned previously, no impact on the population size or breeding stock of Steller sea lions is expected to occur. The movement to the water is expected to be gradual, as opposed to a stampede, due to the disturbance minimization approach technique (see *Terms and Condition 1*). During bouts of research activities some animals may be temporarily displaced and either raft in the water or relocate to other haul out sites. Most animals are expected to return soon after research activities cease for that day. The long term effect on the island as a rookery and haulout is expected to be negligible. In summary, the proposed project consists of the following activities that may contribute to take:

> 1) In any given abalone research study season (*i.e.,* November and February), the researchers will visit the islands for a total of 4-8 days each of the two months, and each site is not visited during both months. Visits to each site are thus separated by several months. Each site visit typically lasts 3-4 hours.

We do expect that the action will result in the incidental harassment of Steller sea lions, as defined in the MMPA, even though mitigation measures will be in place. These measures will reduce the severity of the harassment, but will not resolve the likelihood of incidental harassment.

VII. Conclusion

After reviewing the best available scientific information and commercial information on the current status of the threatened Steller sea lion, the environmental baseline for the action area, the effects of the action proposed for November and February, and the cumulative effects, it is NMFS' biological opinion that the Gulf of the Farallones National Marine Sanctuary's abalone research activities on Southeast Farallon and Maintop (West End) islands may adversely affect, but are not likely to jeopardize, the continued existence of Steller sea lions under NMFS' jurisdiction.

VIII. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibits the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be implemented by the Gulf of the Farallones National Marine Sanctuary and NMFS-OPR in order for the exemption in section 7(o)(2) to apply. If either of these entities fails to implement and adhere to the terms and conditions of this Incidental Take Statement, the protective coverage of section 7(o)(2) may lapse.

A marine mammal species or population stock which is listed as threatened or endangered under the ESA is, by definition, also considered depleted under the MMPA. The ESA allows takings of threatened and endangered marine mammals only if authorized by section 101(a)(5) of the MMPA. Until the proposed action receives authorization for the incidental taking of marine mammals under section 101(a)(5)(D) of the MMPA, the incidental takes of marine mammals described below are not exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA. The Gulf of the Farallones National Marine Sanctuary submitted an application for an Incidental Harassment Authorization on April 25, 2012 (revised application deemed complete on August 25, 2012). Issuance of an Incidental Harassment Authorization is anticipated by November 2012.

Amount or Extent of the Take Anticipated

The effects analyses contained in this biological opinion concluded that individual Steller sea lions may be exposed to and are likely to respond to human presence associated with the proposed intertidal monitoring activities.

This biological opinion concluded that Steller sea lions are likely to be exposed to and likely to respond to human presence in ways that constitute "harassment" for the purposes of the ESA. The closer these seals are to the activities and the greater the number of times they are exposed to these activities, the greater their likelihood of being exposed to and responding to, that exposure. Based on our analysis, NMFS does not expect any Steller sea lions to be injured or killed as a result of exposure to the proposed action (refer to the *Effects of the Action* section of this biological opinion for further discussion).

For the purposes of this biological opinion and Incidental Take Statement, we assumed that 100% of the animals hauled out at South Farallone and Maintop (West End) islands might be exposed to abalone research activities (human presence), and this represents the number of times a sea lion might be "taken" in the form of harassment.

The estimated 95 individual animals expected to be taken by harassment does not take into account that multiple individuals may be exposed more than once during each day and it is expected that some of the same individuals will be impacted throughout the day's abalone research activity. The minimum population estimate for the eastern DPS of Steller sea lions is 52,847, therefore this project may incidentally harass 0.18% of the total minimum population, annually.

It is estimated that approximately 95 individual Steller sea lions could be potentially affected by Level B behavioral harassment over the course of the proposed IHA. Estimates of the numbers of marine mammals that might be affected are based on consideration of the number of marine mammals that could be disturbed appreciably by approximately four to eight day surveys, lasting three to four hours each, one to two times each during November and February during the course of the proposed activity. All of the potential takes are expected to be Level B behavioral harassment only. Because of the mitigation measures that will be required and the likelihood that some pinnipeds will avoid the area during restoration and maintenance activities, no injury or mortality to pinnipeds is expected or requested.

Effect of Take

In the accompanying Biological Opinion, NMFS has determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate for NMFS-OPR to minimize the impacts of incidental take on threatened and endangered species:

1. In order to minimize take of eastern Steller sea lions, all activities must comply with the IHA issued under section 101(a)(5)(D) and 50 CFR 216.107.

2. In order to minimize take of eastern Steller sea lions, researchers must not approach beaches if predators are visible in the area.

3. Require that the Gulf of the Farallones National Marine Sanctuary shall immediately cease abalone research activities should an injured or dead Steller sea lion be found on Southeast Farallon and Maintop (West End) islands; and that injury or death is attributed, by NMFS, to abalone research activities.

4. Require that the Gulf of the Farallones National Marine Sanctuary shall monitor and report the implementation of measures described in the terms and conditions and evaluate mitigation measures and results of the monitoring program.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Endangered Species Act of 1973, as amended, the agencies must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements, as required by the section 7 regulations (50 CFR 402.14(i)).

In addition to implementing the proposed mitigation measures NMFS-OPR as detailed in the Description of the Action section of this Biological Opinion, include the following Terms and Conditions to implement the Reasonable and Prudent Measures:

1. A copy of the Incidental Take Statement and IHA must be in the possession of each researcher operating under the authority of the IHA.

2. GFNMS shall implement measures to reduce the risk of disturbance by selecting judicious routes of approach to abalone study sites, avoiding close contact with Steller sea lions hauled out on shore, and the use of extreme caution upon approach. In no case will marine mammals be deliberately approached by abalone survey personnel, and in all cases every possible measure will be taken to select a pathway of approach to study sites that minimizes the number of Steller sea lions potentially harassed. In general, researchers will stay inshore of Steller sea lions whenever possible to allow maximum escape to the ocean.

3. Provide instructions to abalone research personnel on appropriate conduct when in the vicinity of hauled out marine mammals. Abalone research personnel should attempt to avoid unnecessary noise while on Southeast Farallon and Maintop (West End) islands. Each visit to a given study site will last for approximately 4 hours, after which the site is vacated and can be re-occupied by any marine mammals that may have been disturbed by the presence of abalone researchers. By arriving before low tide, worker presence will tend to encourage pinnipeds to move to other areas for the day before they haul out and settle onto rocks at low tide.

4. Abalone research personnel must monitor for predators and not approach hauled out areas if killer whales or white sharks are seen. Steller sea lions must not be disturbed until the area is free of predators. To minimize human presence on the islands, at least one of the abalone researchers should be designated as the biological monitor during abalone research activities. The biologist and monitoring protocols are subject to approval by NMFS.

5. Interim monitoring reports shall be submitted to NMFS-SWR on a monthly basis during the research work window. In addition, a comprehensive Draft Interim Monitoring Report shall be submitted to NMFS-SWR at the conclusion of and within 90 days of, the work window for that year. A Final Interim Monitoring Report must be submitted to the SWR Regional Administrator within 30 days after receiving comments from the SWR Regional Administrator on the Draft Interim Report. Once comments are received, a Final Interim Report must be submitted to the Regional Administrator. If no comments are received from NMFS, the Draft Interim Monitoring Report will be considered to be the final report. Information to be included in the reports is detailed in the Incidental Harassment Authorization Permit requirement for this action.

6. If an animal has died or become injured in the vicinity of the Northwest Seal Rock all operations must cease and officials must immediately notify the SWR Stranding

Coordinator at 562-980-3230 and the Marine Mammal Center at 707-465-6265. Officials must also contact the SWR Protected Resources Division at 562-980-3232 before resuming operations to determine if the death was attributed to project activities.

7. A draft Final Monitoring Report shall be submitted to NMFS no later than 90 days after the project is completed in 2012. A Final Monitoring Report must be submitted to the SWR Regional Administrator within 30 days after receiving comments from the SWR Regional Administrator on the Draft Monitoring Report. Once comments are received, a Final Monitoring Report must be submitted to the SWR Regional Administrator. If no comments are received from NMFS, the Draft Monitoring Report will be considered to be the final report. Information to be included in the reports is detailed in the Incidental Harassment Authorization Permit requirement for this action.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act (Act) directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has identified no conservation recommendations at this time.

REINITIATION NOTICE

This concludes formal consultation on the NMFS' proposal to permit the Gulf of the Farallones National Marine Sanctuary to conduct abalone research activities during November and February. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, NMFS must immediately request reinitiation of section 7 consultation.

LITERATURE CITED

ACIA (Arctic Climate Impact Assessment). 2004. Impacts of a warming arctic. Cambridge University Press, New York, NY.

Alaska Sea Grant. 1993. Is it food? Addressing marine mammal and sea bird declines. University of Alaska Sea Grant, 93-01.

Allen, S. G. 1991. Harbor seal habitat restoration at Strawberry Spit, S. F. Bay. Point Reyes Bird Observatory Report PB91-212332/GAR. 47 pp.

Allen, S.G., D.G. Ainley, G.W. Page, and C.A. Ribic. 1984. The effect of disturbance on harbor seal haul out patterns at Bolinas Lagoon, California. Fishery Bulletin 82(3):493-500.

Anderson, J. J. 2000. A vitality-based model relating stressors and environmental properties to organism survival. Ecological Monographs 70:445-470.

Angliss, R.P. and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-13, 48 pp.

Allen, B.M. and R.P. Angliss. 2012. Alaska Marine Mammal Stock Assessments, 2011. U.S. Dept. of Comm., NOAA Tech Memo, NMFS-AFSC-234, May 2012.

Baba, N. H. Nitto, and A. Nitta. 2000. Satellite tracking of a young Steller sea lion off the coast of northern Hokkaido. Fisheries Science 66:180-181.

Ban, S. 2005. Modeling and characterization of Steller sea lion haulouts and rookeries using oceanographic and shoreline type data. University of British Columbia. M.Sc. Thesis. 94 pp.

Bartholomew, G. 1970. A Model for the Evolution of Pinniped Polygny. Evolution 24:3, 546-549.

Beale, C. M., and P. Monaghan. 2004. Human disturbance: people as predation-free predators? Journal of Applied Ecology 41:335-343.

Berger, J., D. Daneke, J. Johnson, and S.H. Berwick. 1983. Pronghorn foraging economy and predator avoidance in a desert ecosystem: implications for the conservation of large mammalian herbivores. Biological Conservation 25:193-208.

Bickham, J.W., S. Sandhu, P.D.N. Hebert, L. Chikhi, R. Athwal. 2000. Effects of chemical contaminants on genetic diversity in natural populations: implications for biomonitoring and ecotoxicology. Mutation Research 463: 33-51.

Bigg, M.A. 1985. Status of Steller sea lion (*Eumetopias jubatus*) and California sea lion (*Zalophus californiaus*) in British Columbia. Canadian Spec. Publ. Fish. Aquati. Sci., 77:1-20.

Blecha, F. 2000. Immune system response to stress. Pages 111-121 *In:* G. P. Moberg and J. A. Mench (eds.). The biology of animal stress. CAB International, Wallingford, Oxon, UK.

Bonnot, P. 1929. Report on the seals and sea lions of California, 1928. California Department of Fish and Game Fish Bulletin 14.

Brandon, R. 1978. Adaptation and evolutionary theory. Studies in the History and Philosophy of Science 9:181 - 206.

Brown, R.F., S.D. Riemer, and B.E. Wright. 2002. Population status and food habits of Steller sea lions in Oregon. Rep. from Oregon Dept. of Fish and Wildlife to Oregon State Univ. Contract F0225A-01. 17pp.

Burek, K.A., F.M.D Gulland, G. Sheffield, E. Keyes, T.R. Spraker, A.W. Smith, D.E. Skilling, J. Evermann, J.K. Stott, and A.W. Trites. 2003. Disease Agents in Steller sea lions in Alaska: A Review and Analysis of Serology Data From 1975-2000. Fisheries Centre Research Reports ISSN 1198-6727. 11(4). 27 pp.

Burek, K.A., F.M.D. Gulland, G. Sheffield, K.B. Beckmen, E. Keyes, T.R. Spraker, A.W. Smith, D.E. Skilling, J.F. Evermann, J.L. Scott, J.T. Saliki, and A.W. Trites. 2005. Infectious disease and the decline of Steller sea lions (*Eumetopias jubatus*) in Alaska, USA: Insights from serologic data. Journal of Wildlife Diseases. 41:512-524.

Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: contrasting responses of birds, tourists, and managers. Environmental Conservation. 22:56-65.

Calambokidis, J. G.H. Steiger, J.R. Evenson, S.J. Jeffries. 1991. Censuses and disturbance of harbor seals at Woodard Bay and recommendations for protection. Final report to the Washington Department of Natural Resources, Olympia. 44 pp.

Call, K.A., and T.R. Loughlin. 2005. An ecological classification of Alaskan Steller sea lion (*Eumetopias jubatus*) rookeries: a tool for conservation/management. Fisheries Oceanography. 14(Suppl. 1)212-222.

Calkins, D.G., E. Becker, T.R. Spraker, and T.R. Loughlin. 1994. Impacts on Steller sea lions. pp. 119-1390 *In* T.R. Loughlin (ed.), Marine Mammals and the Exxon Valdez. Academix Press, N.Y.

Calkins, D.G., and K.W. Pitcher. 1982. Population assessment, ecology, and trophic relationships of Steller sea lions in the Gulf of Alaska. pp. 447-546 *In* Environmental assessment of the Alaskan continental shelf. U.S. Dept. Comm.. and U.S. Dept. of Int., Final Rep. Principal Investigators, 19:1-565.

Campbell, G.S., R.C. Gisiner, D.A. Helweg, and L.L. Milette. 2002. Acoustic identification of female Steller sea lions (*Eumetopias jubatus*). Journal of the Acoustical Society of America. 111:2920-2928.

Carretta, J.V. 2002. Preliminary estimates of cetacean mortality in California gillnet fisheries for 2001. Unpubl. doc. submitted to Int. Whal. Comm. (SC/54/SM12). 22 pp.

Carretta, J.V., and S. Chivers. 2003. Preliminary estimates for marine mammal mortality and biological sampling of cetaceans in California gillnet fisheries for 2002. Unpubl. doc. submitted to Int. Whal. Comm. (SC/54/SM12). 22 pp.

Carretta, J.V. and S.J. Chivers. 2004. Preliminary estimates for marine mammal mortality and biological sampling of cetaceans in California gillnet fisheries for 2003. Unpubl. doc. submitted to Int. Whal. Comm. (SC/56/SM1). 21 pp.

Carter, H.R. and R.T. Golightly (eds.) 2003. Seabird injuries from the 1997-1998 Point Reyes tarball incidents. Unpublished report, Humboldt State University, Department of Wildlife, Arcata, California, 215pp.

Castellini. M.A. 1999. Assessing heavy metals in populations of marine mammals. EPA Symposium on Western Ecological Systems. San Francisco, April, 1999.

Constantine, R. D.H. Brunton, and T. Dennis. 2004. Dolphin-watching tour boats change bottlenose dolphin (*Tursiops truncatus*) behavior. Biological Conservation. 117: 299-307.

Creel, S., J.E. Fox, A. Hardy, J. Sands, B. Garrott and R.O. Peterson. 2002. Snowmobile activity and glucocorticoid stress responses in wolves and elks. Conservation Biology. 16: 809-814.

Daan, S., C. Deerenberg, and C. Dijkstra. 1996. Increased daily work precipitates natural death in the kestrel. Journal of Animal Ecology 65: 539-544.

Dailey, M.D., and R.L. Brownell, Jr. 1972. A checklist of marine mammal parasites. Pp. 528-589 *In* S.H. Ridgeway (ed.), Mammals of the sea, biology, and medicine. Charles C Thomas Publ., Springfield, IL. 812 pp.

Dailey, M.D. and B.L. Hill. 1970. A survey of metazoan parasites infesting the California (*Zalophus californianus*) and Steller (*Eumetopias jubatus*) sea lion. Bull. S. Calif. Acad. Sci. 69:126-132.

DeMaster, D. 2009. Aerial survey of Steller sea lions in Alaska, June-July 2009 and update on the status of the western stock in Alaska. December 2, 2009 Memorandum to D. Mecum, K. Brix and L. Rotterman, NMFS Alaska Regional Office, Juneau AK. NMFS Alaska Fiseries Science Center, 7600 Sand Point Way NE., Seattle WA 98115

DeMaster, D. 2011. Memorandum from D. DeMaster to James W. Basiger regarding the AFSC evaluation of eastern distinct population segment of Steller sea lions. 6 May 2011.

DeMaster, D. and S. Atkinson, eds. 2002. Steller sea lion decline: is it food II? University of Alaska Sea Grant, AK-SG-02-02.

Dethier, M. N., Graham, E. S., Cohen, S., and Tear, L. 1993. Visual versus random-point percent cover estimations: 'objective", is not always better. Marine Ecology Progress Series 96:93-100.

Durbin, E., G. Teegarden, R. Campbell, A. Cembella, M. F. Baumgartner, and B. R. Mate. 2002. North Atlantic right whales, *Eubalaena glacialis,* exposed to paralytic shellfish poisoning (PSP) toxins via a zooplankton vector, *Calanus finmarchicus.* Harmful Algae 1(3): 243-251.

Elasser, T. H., K. C. Klasing, N. Flipov, and F. Thompson. 2000. The metabolic consequences of stress: targets for stress and priorities of nutrient use. Pages 77-110 *In:* G. P. Moberg and J. A. Mench (eds.). The biology of animal stress. CAB International, Wallingford.

Emmett, R. L., S. A. Hinton, S. L. Stone, and M. E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in West Coast estuaries, Volume II: Species life history summaries. ELMR Report No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 329 pp

Engelhard, G.H., A.N.J. Baarspul, M. Broekman, J.C.S. Creuwels, and P.J.H. Reijnders. 2002. Human disturbance, nursing behaviour, and lactational pup growth in a declining southern elephant seal (*Mirounga leonina*) population. Canadian Journal of Zoology. 80(11): 1876-1886.

Fabry, V.J., B.A. Seibel, R.A. Feely, and J.C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. ICES Journal of Marine Science, 65: 414-432.

Feare, C. J. 1976. The breeding of the Sooty Tern *Sterna fuscata* in the Seychelles and the effects of experimental removal of its eggs. Journal Zoology (London) 179: 317-360.

Foster, M. S., C. Harrold, and D. D. Hardin. 1991. Point vs. photo quadrat estimates of the cover of sessile marine organisms. Journal of experimental marine biology and ecology 146:193-203.

Fowler, G.S. 1999. Behavioral and hormonal responses of Magellan penguins (Spheniscus magellanicus) to tourism and nest site visitation. *Biological Conservation.* 90:143-149.

Frid, A. 2001. Fleeing decisions by Dall's sheep exposed to helicopter overflights. Biennial Symposium of the Northern Wild Sheep and Goat Council 112:153-169.

Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation 110:387-399.

Frid, A. and L.M Dill. 2002. Human-caused disturbance stimuli as a form of predation. Conservation Biology. 6: 11-30.

Fritz, L., M. Lynn, E. Kunisch, and K. Sweeney. 2008. Aerial, ship, and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 2005-2007. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-AFSC-183.

Geiger, D. L. 2004. AbMap: The abalone mapping project. http:// www.vetigastropoda.com/ABMAP/text/index.htm.

Gelatt, T.S., A.W. Trites, K. Hastings, L. Jemison, K., Pitcher, and G. O'Corry-Crow. 2007. Population trends, diet, genetics and observations of Steller sea lions in Glacier Bay National Park, *in* Piatt, J.F., and Gende, S.M., eds., Proceedings of the Fourth Glacier Bay Science Symposium, October 26-28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5045, p. 145-149.

Gentry, R.L. 1970. Social behavior of the Steller sea lion. University of California, Santa Cruz Ph.D. Thesis.

Gill, J. A., W. J. Sutherland, and A. R. Watkinson. 1996. A method to quantify the effects of human disturbance on animal populations. The Journal of Applied Ecology 33:7.

Gill J. A. and W. J. Sutherland. 2000. Predicting the consequences of human disturbance from behavioural decisions. Pages 51-64 *In:* L. M. Gosling and W. Sutherland (eds.). Behaviour and conservation. Cambridge University Press, Cambridge (UK).

Gill, J. A., K. Norris, and W. J. Sutherland. 2001. Why behavioral responses may not predict the population consequences of human disturbance. Biological Conservation 97: 265-268

Gisiner, R.C. 1985. Male territorial and reproductive behavior in the Steller sea lion (*Eumetopias jubatus*). Ph.D., University of California, Santa Cruz.

Goldstein, T., T. S. Zabka, R. L. DeLong, E. A. Wheeler, G. Ylitalo, Sibel Bargu, Mary Silver, Tod Leighfield, Frances Van Dolah, Gregg Langlois, Inga Sidor, J. Lawrence Dunn, and Frances M. D. Gulland. 2009 a. The role of domoic acid in abortion and premature parturition of California sea lions (*Zalophus californianus*) on San Miguel Island, California. Journal of Wildlife Diseases 45: 91-108.

Goodson, A. D. 1997. Developing deterrent devices designed to reduce the mortality of small cetaceans in commercial fishing nets. Marine and Freshwater Behaviour and Physiology 29: 211-236.

Gulland, F.M.D. 1995. Impact of infectious diseases on wild animal populations—A review. *In* Ecology of infectious diseases in natural populations, B.T. Grenfall and A.P. Dobson (eds.). Cambridge University Press, Cambridge, United Kingdom, pp. 20-51.

Harkonen, T., K. Harding, and S. Lunneryd. 1999. Age- and sex-specific behaviour in harbour seals Phoca vitulina leads to biased estimates of vital population parameters. Journal of Applied Ecology. 36: 825-841.

Harlow, H.J., F.G. Linzey, W.D. Van Sickle, and W.A. Gern. 1992. Stress response of cougars to nonlethal pursuit by hunters. Canadian Journal of Zoology. 70:136-139.

Harrington, F. H. and A. M. Veitch. 1992. Calving success of woodland caribou exposed to low-level jet fighter overflights. Arctic 45: 213-218.

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.

Hay, D. E. and McCarter, P. B. 2000. Status of the eulachon *Thaleichthys pacificus* in Canada. Department of Fisheries and Oceans Canada, Canadian Stock Assessment Secretariat, Research Document 2000-145. Ottawa. 92 p.

Hicks, L.L. and J.M. Elder. 1979. Human disturbance of Sierra Nevada bighorn sheep. Journal of Wildlife Management. 43:909-915.

Higgins, L.V. 1984. Maternal behavior and attendance patterns of the Steller sea lion in California. M.S. thesis, University of California, Santa Cruz.

Holberton, R. L., B. Helmuth, and J. C. Wingfield. 1996. The corticosterone stress response in gentoo and king penguins during the non-fasting period. The Condor 98:4.

Hood, L. C., P. D. Boersma, and J. C. Wingfield. 1998. The adrenocortical response to stress in incubating magellanic penguins (Spheniscus magellanicus). The Auk 115:9.

IPCC. 2007. Climate Change 2007: Synthesis report; summary for policymakers. Accessed 24 March 2008. Available: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

Jasny, M., J. Reynolds, C. Horowitz, and A. Wetzler. 2005. Sounding the depths II: The rising toll of sonar, shipping, and industrial ocean noise on marine life. Natural Resources Defense Council. 84 pp.

Jessop, T. S., A. D. Tucker, C. J. Limpus, and J. M. Whittier. 2003. Interactions between ecology, demography, capture stress, and profiles of corticosterone and glucose in a free-living population of Australian freshwater crocodiles. General and Comparative Endocrinology 132:10.

Johnston, D. W. T. H. Woodley 1998. A survey of acoustic harassment device (AHD) use in the Bay of Fundy, Canada. *Aquatic Mammals* **24**:51–61.

Kastelein, R.A., R. van Schie, W.C. Verboom, and D. de Haan. 2005. Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*). Journal of the Acoustical Society of America 118, Part 1:1820-1829.

Kenyon, K.W. 1972. Man versus the Monk Seal. J. Mamm., 53: 687-696.

Klein, M.L, S.R. Humphrey, and H.F. Percival. 1995. Effects of ecotourism and distribution of waterbirds in a wildlife refuge. Conservation Biology. 16:227-232.

Krausman, P. R., L. K. Harris, C. L. Blasch, K. K. G. Koenen, and J. Francine. 2004. Effects of military operations on behavior and hearing of endangered Sonoran pronghorn. Wildlife Monographs:1-41.

Kucey, L. 2005. Human Disturbance and the Hauling Out Behavior of Steller Sea Lions (*Eumetopias jubatus*). University of British Columbia. M.Sc. Thesis. 67 p.

Kucey, L. and A. W. Trites. 2006. A Review of the Potential Effects of Disturbances on Sea Lions: Assessing Response and Recovery *In* Sea Lions of the World (eds. A.W. Trites, S.K. Atkinson, D.P. DeMaster, L.W. Fritz, T.S. Gelatt, L.D. Rea, and K.M. Wynne). Proceedings of the symposium Sea Lions of the World: Conservation and Research in the 21st Century, September 30-October 3, 2004, Anchorage, AK. Alaska Sea Grant College Program, AK-SK-06-01, 581-590.

Lafferty, K. and L.R. Gerber. 2002. Good medicine for conservation biology: The intersection of epidemiology and conservation theory. Conservation Biology 16(3):1-12.

Lankford, S. E., T. E. Adams, R. A. Miller, and J. J. Cech Jr. 2005. The cost of chronic stress: impacts of a nonhabituating stress response on metabolic variables and swimming performance in sturgeon. Physio. & Biochem. Zoo. 78: 599-609.

Le Boeuf, B.J., K. Ono, and J. Reiter. 1991. History of Steller sea lion population at Año Nuevo Island, 1961-1991. Southwest Fisheries Science Center Admin. Rep. LJ-91-45C, 9 p.

Lee, J.S., S. Tanabe, H. Umino, R. Tatsukawa, T.R. Loughlin, D.G. Calkins. 1996. Persistent organochlorines in Steller sea lion (*Eumetopias jubatus*) from the Gulf of Alaska and the Bering Sea, 1976-1981. Mar. Pollut. Bull. 32:535-544.

Leighton, D.L. 2005. Status review for the black abalone, *Haliotis cracherodii* Leach 1814. Unpublished document produced for the Black Abalone Status Review Team, Office of Protected Resources, Southwest Region, National Marine Fisheries Service, Long Beach, CA, USA. 32 pp.

Lelli, B. and D.E. Harris. 2001. Human Disturbances Affect Habor Seal Haul-out Behavior: Can the Law Protect These Seals From Boaters. Macalester Environmental Review. Macalaster College, posted October 23, 2001. 22 pp.

Lewis, J.P. 1987. An evaluation of a census-related disturbance of Steller sea lions. MSc. Thesis, University of Alaska, Fairbanks.

Lima, S. L. 1998. Stress and decision making under the risk of predation: recent developments from behavioral, reproductive, and ecological perspectives. Advances in the Study of Behavior 27:215-290

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E.L. Rechisky, J.T. Kelly, J. Heublein, and P. Klimley. 2008. Marine Migration of North American Green Sturgeon, Transactions of the American Fisheries Society 137: 182-194.

Long, D.J., and K.D. Hanni. 1993. Dynamics of white shark *(Charcharadon carcarias)* predation on Steller sea lions *(Eumetopias jubatus)* in California.*In* Abstracts of Tenth Biennial Conference on the Biology of Marine Mammals, November 11-November 15, 1993, Galveston, TX.

Loughlin, T.R. 1997. Using the phylogeographic method to identify Steller sea lion stocks *In* Molecular Genetics of Marine Mammals (eds. A.E. Dizon, S.J. Chivers, and W.F. Perrin). Society for Marine Mammalogy Spec. Publ. 3.

Loughlin, T.R. 1998. The Steller sea lion: a declining species. Biosphere Conservation 1(2):91-98.

Loughlin, T.R., and A.E. York. 2000. An accounting of the sources of Steller sea lion, *Eumetopias jubatus*, mortality. Mar. Fish. Rev. 62(4):40-45.

Loughlin, T.R., D.J. Rugh, and C.H. Fiscus. 1984. Northern sea lion distribution and abundance: 1956-80. Journal of Wildlife Management. 48: 729-740.

Loughlin, T.R., J.T. Sterling, R.L. Merrick, J.L. Sease, and A.E. York. 2003. Diving behavior of immature Steller sea lions (*Eumetopias jubatus*). Fish B-NOAA 101: 566-582.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and behavioral responses of mountain sheep. J Wildlife Management. 62:1246-1254.

Madsen, J. 1994. Impacts of disturbance on migratory waterfowl. Ibis 137: 567-574.

Marine Mammal Commission. 1999. Annual report to Congress 1998. 4340 East-West Hwy., Rm. 905, Bethesda, MD, pp. 1-236.

Mate, B.R. 1973. Population kinetics and related ecology of northern sea lion, *Eumetopias jubatus,* and the California sea lion, *Zalophus californianus*, along the Oregon coast. University of Oregon, Ph.D. dissertation. 94 pp.

Mathison, O.A., R.T. Baade, and R.J. Lopp. 1962. Breeding habits, growth and stomach contents of the Steller sea lion in Alaska. Journal of Mammalogy, 43:469-477.

McCarty, J.P. 2001. Ecological consequences of recent climate change. Conservation Biology 15:320-331.

McEwen, B. S., and J. C. Wingfield. 2003. The concept of allostasis in biology and biomedicine. Hormones and Behavior 43:2 - 15.

Merrick, R.L., M.K. Chumbley, and G.V. Byrd. 1987. Diet diversity of Steller sea lions (*Eumetopias jubatus*) and their population decline in Alaska; a potential relationship. Ca. J. Fish. and Aquatic Sci 54:1342-1348.

Merrick, R.L., D.G. Calkins, and D.C. McAllister. 1992. Aerial and ship-based surveys of Steller sea lions *(Eumetopias jubatus)* in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1991. NOAA Tech. Memo. NMFS-AFSC-1. 41 pp.

Merrick, R.L., and T.R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions in Alaskan waters. Can J. Zool. 75:776-786.

Michel, J., R. Nairn, J.A. Johnson, and D. Hardin. 2001. Development and design of biological are physical monitoring protocols to evaluate the long-term impacts of offshore dredging operations on the marine environment: Final Report to the U.S. Department of Interior, Minerals Management Service, International Activities and Marine Minerals Division (INTERMAR), Herndon, VA. Contract No. 14-35-0001-31051. 116p.

Mills, S. K. and J. H. Beatty. 1979. The propensity interpretation of fitness. Philosophy of Science 46:263-286.

Minerals Management Service. 1996. Final Environmental Impact Statement, Outer Continental Shelf oil & Gas Leasing Program: 17997-2002. U.S. Department of the Interior, Minerals Management Service, Herndon, VA.

Moberg, G. P. 1987. A model for assessing the impact of behavioral stress on domestic animals. Journal of Animal Science 65:1228.

Mob erg, G. P. 2000. Biological response to stress: implications for animal welfare. Pages 1 - 21 *In:* G. P. Moberg, and J. A. Mench, editors. The biology of animal stress. Basic principles and implications for animal welfare. Oxford University Press, Oxford, United Kingdom.

Morris, R. H., D. L. Abbott, and E. C. Haderlie. 1980. Intertidal invertebrates of California. Stanford University Press, Palo Alto, CA.

Mortenson, J., M. Brown, J. Roletto, L. Grella, L. Culp, and J. Kinman. SEALS Annual Report: 1999. 2000. Unpublished Report, National Oceanic and Atmospheric Administration, Gulf of the Farallones National Marine Sanctuary, San Francisco, CA.

Müllner, A., K. E. Linsenmair, and M. Wikelski. 2004. Exposure to ecotourism reduces survival and affects stress response in Hoatzin chicks (*Opisthocomus hoazin*). Biological Conservation 118:549-558.

National Marine Fisheries Service. 1995. Status review of the United States Steller sea lion (*Eumetopias jubatus*) population. Prepared by the National Marine Mammal Laboratory, AFSC, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115. 61 pp.

National Marine Fisheries Service. 1997. Investigation of scientific information on the impacts of California sea lions and Pacific harbor seals on salmonids and on the coastal ecosystems of Washington, Oregon, and California. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-28. 172 pp.

National Marine Fisheries Service. 2000. Section 7 Consultation on Authorization to take Listed Marine Mammals Incidental to Commercial Fishing Operations under Section 101(a)(5)(E) of the Marine Mammal Protection Act for the California/Oregon Drift Gillnet Fishery.

National Marine Fisheries Service (NMFS). 2002. Environmental Assessment on the effects of NMFS permitted scientific research activities on threatened and endangered Steller sea lions. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Silver Spring, MD. 140 p.

National Marine Fisheries Service (NMFS). 2006a. Fishery take of Southern DPS green sturgeon in northern waters. Memorandum to the Record from Churchill Grimes (NMFS), November 27, 2006. 5 pages.

National Marine Fisheries Service (NMFS). 2006b. The likely distribution of the Southern Distinct Population Segment of North American green sturgeon in SWR waters. Memorandum for the Southern Distinct Populations Segment of North American green sturgeon consultation guidance (151422SWR2005SA00226) from Jeffrey McLain (Fishery biologist, NMFS), December 18, 2006. 7 pages.

National Marine Fisheries Service (NMFS). 2007a. Endangered Species Act section 7(a)(2) consultation guidance for the Southern Distinct Population Segment of North American green sturgeon. Memorandum for Protected Resources Division Area Office Supervisors from Russ Strach (Assistant Regional Administrator, Protected Resources, NMFS), February 1, 2007. 2 pages.

National Marine Fisheries Service (NMFS). 2008. Recovery Plan for the Steller sea lion (*Eumetopias jubatus*). Revision. United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, MD. 325 pp.

National Marine Fisheries Service (2010) Final biological opinion on the authorization of groundfish fisheries under the Fishery Management Plans for groundfish of the Bering Sea and Aleutian Islands Management Area and of the Gulf of Alaska, and the State of Alaska parallel groundfish fisheries.
(http://fakr.noaa.gov/protectedresources/stellers/esa/biop/final/1210.htm)

NMML. 2012. Memorandum from Douglas DeMaster, NMFS, AFSC, NMML to Jim Balsiger, NMFS/AKR. 10 April 2012: Regional and overall trend analyses for the eastern DPS Steller sea lion, 1970s-2010; 16p.

National Marine Fisheries Service. 2012. (Draft) Status Review of the Eastern Distinct Population Segment of Steller Sea Lion (*Eumetopias jubatus*). 106 pp. + Appendices. Protected Resources Division, Alaska Region, National Marine Fisheries Service, 709 West 9th St., Juneau, Alaska 99802.

National Park Service. 1994. Report to Congress. Report on the Effects of Overflights on the National Park System. National Park Service. September 12, 1994.

National Research Council. 1994. Low-frequency sound and marine mammals: current knowledge and research needs. Committee on Low-Frequency Sound and Marine Mammals, National Research Council, Washington, D.C.

National Resource Council (NRC). 1996. The Bering Sea Ecosystem. National Academy Press, Washington, D.C. 307 pp.

National Research Council. 2000. Marine mammals and low-frequency sound: Progress since 1994. Ocean Studies Board. National Academy Press, Washington, D.C.

National Resource Council (NRC). 2003. Decline of the Steller sea lion in Alaskan waters; untangling food webs and fishing nets. National Academy press, Washington, D.C. 184 pp.

National Research Council. 2005. Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects. National Academies Press, Washington, D.C. 142 pages.

Olesiuk, P. F. 2003. Recent trends in the abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia. NMMRC Working Paper No. 2003-11.

Olesiuk.P.F. 2004. Status of sea lions (*Eumetopias jubatus* and *Zalophus californianus*) wintering off southern Vancouver Island. NMMRC Working Paper No. 2004-03 (DRAFT).

Olesiuk, P.F. 2008. Abundance of Steller sea lions (*Eumetopias jubatus*) in British Columbia. Canadian Science Advisory Secretariat Research Document. 2007/063.

Olsen. O.W. 1958. Hookworms, *Uncinara lucasi* Stiles, 1901, in fur seals, Callorhinus ursinus (Linn.), on the Pribilof Islands. Trans. 23rd. North American Wildlife Conference. P. 152-175.

Orsini, J.P. 2004. Human impacts on Australian sea lions (*Neophoca cinerea*) halued out on Carnac Island (Perth, Western Australia), implications for wildlife and tourism management Western Australia. Murdoch University, Ph.D. Thesis. 134 p.
Palcios 1999.

Papouchis, C., F. J. Singer, and W. B. Sloan. 2001. Responses of desert bighorn sheep to increased human recreation. Journal of Wildlife Management 65:573-582.

Pike, G.C. and B.E. Maxwell. 1958. The abundance and distribution of the northern sea lion (*Eumetopias jubatus*) on the Coast of British Columbia. Journal of the Fisheries Research Board of Canada. 15:5-17.

Pinnix, W. 2008. Letter to J. Weeder (NMFS) with subject "Green sturgeon acoustic telemetry detections in Humboldt Bay, California." Dated February 20, 2008. 2 pages.

Pitcher, K.W. 1981. Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska. Fishery Bulletin 79:467-472

Pitcher, K.W., and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. J. Mamm. 62:599-605.

Pitcher, K.W., V.N. Burkanov, D.G. Calkins, B. J. Le Boeuf, E.G. Mamaev, R. L. Merrick, and G.W. Pendleton. 2001. Spatial and Temporal Variation in the Timing of Births of Steller Sea Lions. Journal of Mammalogy, 82: 1047-1053.

Pitcher, K.W., P.F. Olesiuk, R.F. Brown, M.S. Lowry, .S.J. Jeffries, J.L. Sease, W.L. Perryman, C.E. Stinchcomb, and L.F. Lowry. 2007. Status and trends in abundance and distribution of the eastern Steller sea lion (*Eumetopias jubatus*) population. Fish. Bull. 107(1): 102-115.

Porter, B. 1997. Winter ecology of Steller sea lions (Eumetopias jubatus) in Alaska, M.Sc. thesis, University of British Columbia, Vancouver, British Columbia, Canada. 84 pp.

Raum-Suryan, K.L., K.W. Pitcher, D.G. Calkins, J.L. Sease, and T.R. Loughlin. 2002. Dispersal, rookery fidelity, and metapopulation structure of Steller sea lions (*Eumetopias jubatus*) in an increasing and a decreasing population in Alaska. Mar. Mamm. Sci. 18(3):746-764.

Raum-Suryan, K.L., M.J. Rehberg, G.W. Pendleton, K.W. Pitcher, and T.S. Gelatt. 2004. Development of dispersal, movement patterns, and haul-out use by pup and juvenile Steller sea lions (*Eumetopias jubatus*) in Alaska. Canadian Journal of Zoology. 86(539-553).

Raum-Suryan, K.L, L. Jemison, and K.W. Pitcher. 2009. Entanglement of Steller sea lions (*Eumetopias jubatus*) in marine debris: Identifying causes and finding solutions. Marine Pollution Bulletin 58: 1487-1495.

Reeves, R. R., B. S. Stewart, P. J. Clapham, J. A. Powell, and P. Folkens (illustrator). 2002. National Audubon Society Guide to Marine Mammals of the World. Alfred A. Knopf, New York, NY.

Reneerkens, J., R. I. Guy Morrison, M. Ramenofsky, T. Piersma, and J. C. Wingfield. 2002. Baseline and stress-induced levels of corticosterone during different life cycle substages in a shorebird on the high Arctic breeding grounds. Physio. & Biochem. Zoo. 75:200-208.

Renouf, D., L. Gaborki, G. Galway, and R. Finlayson. 1981. The effect of disturbance on the daily movements of harbour seals and grey seals between the sea and their hauling grounds at Miquelon. Applied Animal Ethology 7:373-379.

Richardson, W. J., C. R. Greene Jr., C. I. Malme, and D. H. Thomson. 1995. Marine mammals and noise. Academic Press, San Diego, CA. 576 pp.

Rivier, C. 1995. Luteinizing-hormone-releasing hormone, gonadotropins, and gonadal steroids in stress. Annals of the New York Academy of Sciences 771(1):187-191.

Roletto, J. and S. Kimuro. 2012. Sanctuary Ecosystem Assessment Surveys Rocky Intertidal Monitoring on the South Farallon Islands. Incidental Harassment Authorization Application, Revised August 20, 2012.

Romero, L. M. 2004. Physiological stress in ecology: lessons from biomedical research. Trends in Ecology & Evolution 19:249–255.

Ross, D. 1976. Mechanics of underwater noise. Pergamon, New York. 375 pp.

Sandegren, F.E.. 1970. Breeding and maternal behavior of the Steller sea lion (*Eumetopias jubata*) in Alaska. M.S.Thesis, Univ. Alaska, Fairbanks.

Sapolsky, R. M. 2005. The influence of social hierarchy on primate health. Science 308: 648-652.

Sapolsky, R. M., L. M. Romero, and A. U. Munck. 2000. How do glucocorticoids influence stress-responses? Integrating permissive, suppressive, stimulatory, and adaptive actions. Endocrine Reviews 21:55-89.

Sapolsky, R. M. 2005. The influence of social hierarchy on primate health. Science 308: 648-652.

Schneider, D.C. and P.M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. Journal of Mammalogy 64(3): 518-520.

Scordino, J. 2006. Steller sea lions (*Eumetopias jubatus*) of Oregon and northern California: seasonal haulout abundance patterns, movements of marked juveniles, and effects of hot branding on apparent survival of pups at Rogue Reef. M.Sc. Thesis, University of Oregon, Corvallis, OR. 93p.

Scott, M.E. 1988. The impact of infection and disease on animal populations: Implications for conservation biology. Conservation Biology 2:40-56.

Sease, J. L., and T. R. Loughlin. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1997 and 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-100, 61 pp.

Sease, J. L., J. M. Strick, R. L. Merrick, and J. P. Lewis. 1999. Aerial and land-based surveys of Steller sea lions (*Eumetopias jubatus*) in Alaska, June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFSAFSC-99, 43 pp.

Sease, J.L., and A.E. York. 2003. Seasonal distribution of Steller's sea lions at rookeries and haul-out sites in Alaska. Mar. Mamm. Sci. 19(4):745-763.

Seyle, H. 1950. Stress and the general adaptation syndrome. British Medical Journal:1383-1392.

Simmonds, M.P. and Hutchinson, J.D. (1996) *The Conservation of Whales and Dolphins*. John Wiley & Sons.

Spaulding, D.J. 1964. Comparative feeding habits of the fur seal, sea lion and harbour seal on the British Columbia coast. Bull. Fish. Res. Board Canada 146:1-52.

St. Aubin, D.J. and J.R. Geraci. 1992. Thyroid hormone balance in beluga whales, *Delphinapterus leucas*: Dynamics after capture and influence of thyrotopin. Can. J. Vet. Res. 56:1-5

Stearns, S. C. 1977. The evolution of life history traits: A critique of the theory and a review of the data. Annual Review of Ecology and Systematics 8:145-171.

Stearns, S. C. 1992. The evolution of life histories. Oxford University Press, Oxford.

Stevens, M.A. and D.J. Boness. 2003. Influences of habitat features and human disturbance on use of breeding sites by a declining population of southern fur seals (*Arctocephalus australis*). J. Zool. Lond. 260: 145-152.

Stewart, B.S. 1984. Diurnal hauling patterns of harbour seals at San Miguel Island, California. Journal of Wildlife Management. 48: 1459-1461.

Stirling, I. 1983. The evolution of mating systems in pinnipeds. *In* Recent advances in the study of mammalian behavior: 489-527. Special Publication, American Society of mammalogy No. 7. Eisenburg, J.F. and Kleiman, D.G. (Eds.). Lawrence, KS: American Society of Mammologists.

Strick, J. M., L. W. Fritz, and J. P. Lewis. 1997. Aerial and ship-based surveys of Steller sea lions (*Eumetopias jubatus*) in Southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1994. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-71, 55 pp.

Suryan, R.M. and J.T. Harvey. 1999. Variability in reactions of Pacific harbor seals, *Phoca vitulina richardsi*, to disturbance. Fishery Bulletin 97: 332-339.

Sutherland, W. J. and N. J. Crockford. 1993. Factors affecting the feeding distribution of Red-breasted Geese *Branta ruficollis* wintering in Romania. Biological Conservation 63: 61-65.

Swingle, W. M, S. G. Barco, T. D. Pitchford, W. A. McLellan, and D. A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Marine Mammal Science 9(3): 309-315.

Sydeman, W.J. and S. Allen. 1999. Pinniped population dynamics in central California: correlations with sea surface temperature and upwelling indices. Mar. Mamm. Sci. 15:446-461.

Terhune, J.M. and M. Almon. 1983. Variability of harbour seal numbers on haul-out sites. Aquatic Mammals 10(3): 71-78.

Thompson, D.R. and K. C. Hamer. 2000. Stress in seabirds: causes, consequences and diagnostic value. Journal of Aquatic Ecosystem Stress and Recovery 7: 91-110.

Thorsteinson, F.V., and C.J. Lensink. 1962. Biological observations of Steller sea lions taken during an experimental harvest. J. Wildl. Mgmt. 26:353-359.

Trites, A.W., and P.A. Larkin. 1992. The status of Steller sea lion populations and the development of fisheries in the Gulf of Alaska and Aleutian Islands. A report of the Pacific States Marine Fisheries Commission pursuant to NOAA award no. NA17FD0177. 134 p.

Trites, A.W. and P.A. Larkin. 1996. Changes in the abundance of Steller sea lions (*Eumetopias jubatus*) in Alaska from 1956 to 1992: How many were there? Aquatic Mammals 22:153-166.

Trites, A.W. and B.T. Porter. 2002. Attendance patterns of Steller sea lions (*Eumetopias jubatus*) and their young during winter. J. Zool. 256:547-556.

Trites, A.W., B.P. Porter, V.B. Deecke, A.P. Coombs, M.L. Marcotte, and D.A.S. Rosen. 2006. Insights into the timing of weaning and the attendance patterns of lactating Steller sea lions (*Eumetopias jubatus*) in Alaska during Winter, Spring and Summer. Aquatic Mammals. 32(1):85-97.

Trites, A.W. and C.P. Donnelly. 2003. The decline of Steller sea lions in Alaska: a review of the nutritional stress hypothesis. Mammal Review 33:3-28.

U.S. Department of the Navy. 2001. Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Volume I.

Walker, B. G., P. D. Boersma, and J. C. Wingfield. 2005. Field endocrinology and conservation biology. Integrative and Comparative Biology 45(1):12-18.

Wiley, D. N., R. A. Asmutis, T. D. Pitchford, and D. P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae,* in the mid-Atlantic and southeast United States, 1985-1992. Fishery Bulletin 93(1): 196-205.

Wolfe, R.J., J.A. Fall, and M. Riedel. 2009. The subsistence harvest of harbor seals and sea lions by Alaska Natives in 2008. Alaska Dept. of Fish and Game, Juneau, AK, Subsistence Division Technical Paper No. 347. Juneau, AK.