To:
Chief, Permits Division, F/PR1
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, Maryland 20910

I. Title of the Application

Application for a Permit for Scientific Research under the Marine Mammal Protection Act

II. Date of the Application:

4 December 2006

III. Applicant:

A. Applicant, PI, CI, Personnel Directly Involved in Taking:

PI and primary contact:
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Co-Investigators from the Alaska Sealife Center:
Donald G. Calkins
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Permit Holder:
Alaska SeaLife Center
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The permit holder is an institution. The PI, Dr. Russel D. Andrews is an employee of the Alaska SeaLife Center, and he holds a joint appointment as a Research Assistant Professor in the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks.

B. Qualifications and Experience:

Dr. Russel D. Andrews has a joint appointment as a Research Assistant Professor in the School of Fisheries and Ocean Sciences at the University of Alaska Fairbanks and as a marine mammal scientist for the Alaska SeaLife Center. Dr. Andrews has 16 years of experience in conducting scientific investigations of pinnipeds, cetaceans and seabirds. His research has involved behavioral observations, capture, restraint & immobilization, use of local anesthetics and gas anesthesia, blood & tissue sampling, intramuscular and intravenous injections, arterial catheterization, surgical implantation of biotelemetry devices, and design and use of biotelemetry instruments. He developed stomach temperature telemetry for use in pinnipeds and has worked closely with commercial manufacturers to make the instrumentation that will be used in this study available to the entire research community.

Donald G. Calkins (M.Sc.) is the Steller sea lion and northern fur seal program manager in the Research Department of the Alaska SeaLife Center. He has been studying the biology of Alaskan marine mammals for over 30 years.

Sarah Norberg (M.Sc.) is a Research Associate in the Steller sea lion and northern fur seal research program at the Alaska Sealife Center. She has participated in captive and free-ranging marine mammal research for 4 years. She has been trained in methods for capture, handling, blood and tissue sampling, and instrument attachment of Steller sea lions and northern fur seals. She has two seasons of northern fur seal research experience in the Kuril Islands.

Current CVs are on record at OPR.

IV. Description of the Marine Mammals to be Taken and/or Imported and the Proposed Activity

A. <u>Summary</u>:

The northern fur seal population on the Pribilof Islands is declining for unknown reasons. The estimated population in the North Pacific has decreased over 50% since the 1950's and is currently declining at 6% per year (1998-2004). Given the economic and political impact on commercial fisheries in the North Pacific that resulted from the decline of Steller sea lions, research is urgently needed to understand why northern fur seals are also declining. The objective of this study is to characterize the movements, foraging behavior and habitat-associations of northern fur seal pups during their first winter at sea. To accomplish these objectives, we will monitor their movements, diving behavior and prey ingestion using satellite telemetry. In addition, we will characterize habitat-associations by combining tracking and dive data with bathymetry and satellite remote sensing of hydrographic features. Correlation of environmental features with satellite tracking, diving behavior and foraging success will improve our understanding of fur seal ecology and indicate which hydrographic and physiographic features influence their movements and distribution. By focusing our research on the winter and early spring, we will investigate what is likely to be the most behaviorally and physiologically challenging period for newly weaned fur seals. We propose to capture and instrument up to 50 northern fur seal pups annually on the Pribilof Islands and Bogoslof Island, and up to 200 northern fur seals during pelagic captures in the North Pacific. The project will last up to 5 years.

B. <u>Introduction:</u>

1) **Species Name(s):**
   a) **Target species:** Northern fur seal, *Callorhinus ursinus*. We will be capturing northern fur seals from the Eastern Pacific stock.
   b) **Non-target species:** We do not anticipate that any other species will be incidentally taken. Steller sea lions (*Eumetopias jubatus*), an endangered species, sometimes haul out on beaches used by northern fur seals, but because of the high number of fur seal pups spread out over many rookery areas, it is possible to completely avoid the sea lions while still accomplishing our goals. The Pribilof Islands and Bogoslof Island are home to many seabirds. We will not be working during the breeding season of these birds, and we will not disturb any protected species. During pup capture in October and November, small numbers of the following species may be incidentally disturbed if they happen to be resting on the edge of the fur seal areas: northern fulmar (*Fulmarus glacialis*), red-faced cormorant (*Phalacrocorax urile*), black and red-legged kittiwake (*Rissa tridactyla* and *R. brevirostris*), least and crested auklets (*Aethia pusilla* and *A. cristatella*) and tufted and horned puffins (*Fratercula cirrhata* and *F corniculata*).
   c) **Status of Affected Stock**: Adult male northern fur seals arrive on breeding areas in mid-May. Adult females arrive between mid-June and late July and usually give birth to a single pup within a day or two of arrival. Pups are weaned at approximately 4 months of age, after which they leave the rookery and migrate out of the Bering Sea and into the North Pacific. Detailed information on the natural history of this species can be found in Gentry (1998). The Eastern Pacific stock of northern fur seals is estimated at 888,120 (Angliss and Lodge, 2003; Alaska Marine Mammal Stock Assessment). The estimated population in the North Pacific has decreased over 50% since the 1950's and is currently declining at 6% per year (1998-2004). Northern fur seals have been designated as depleted under the Marine Mammal Protection Act. The population on the Pribilof Islands is declining for unknown reasons. Incidental fisheries catches are considered to be insignificant, and directed take for subsistence purposes is limited to juvenile males and is regulated at a level that is unlikely to affect the population (NMFS 2005). Entanglement in marine debris might be an important factor in the decline (Fowler 1987). Other factors such as environmental change and habitat degradation require more investigation.
2) **Background/Literature Review**

Migratory movements, diving behavior and habitat-associations of northern fur seals:

Little is known about the pelagic life history of northern fur seals during the non-breeding season (November to June). The distribution of fur seals at sea was originally based on sealing records from the end of the 19th century and from animals killed for research in the 20th century. However, the sealing data may be biased to those areas that were most economically viable. Pelagic sealers gave names to the ocean areas (referred to as grounds) where fur seals concentrated in offshore waters along the North American coast from Alaska to California and eastern coast of Asia from Kamchatka to Japan. The migratory pathways and winter distribution of fur seals have also been outlined from extensive pelagic collections along the continental margins of the North Pacific (Lander and Kajimura 1982). However, these collections were limited in geographic and temporal scope and are not considered comprehensive in determining migratory movements. Nevertheless, it is known that female fur seals travel great distances during their winter migration and remain pelagic for approximately eight months (Bigg, 1990). Recent studies by Ream et al. (2005) used satellite telemetry to track the movements of individual females from St. Paul Island during the winter migration. They defined two general winter foraging areas as: coastal areas of the eastern North Pacific, and the subarctic-subtropical transition region of the central North Pacific. Within the coastal region, fur seals were segregated more specifically into foraging areas based on the location of arrival and subsequent movements. Unimak Pass appeared to be the primary migratory corridor from the Bering Sea into the Northern Pacific Ocean.

Less is known about the migratory movements of fur seal pups. Ragen et al. (1995) attached radio transmitters to newly weaned pups and recorded their southward movements using automated stations with radio receivers at six passes in the eastern Aleutian Islands. In addition, they extended their monitoring south of the islands using a fixed-wing aircraft with a radio receiver. Their results showed that the young fur seals departed the Pribilof Islands around the second week of November (peak period of departure) and arrived in the eastern Aleutian Islands in about 10 days, indicating that migration progressed at the rate of 36-40 km day-1. The pups dispersed as they approached the Aleutian Islands and, unlike adult females, did not use Unimak Pass as the primary migratory corridor from the Bering Sea into the Northern Pacific Ocean. However, this study could not detect fur seals moving outside of the monitoring area. Once the pups moved south of the Aleutian Islands, they could not be tracked. In addition, the factors that determined migratory rate and direction could not be determined.

Northern fur seals have the distinction of being the first marine mammal species to be studied using modern time-depth recorders (Kooyman et al., 1976, 1983). An overview of fur seal diving behavior and ecology has been described by Gentry and Kooyman (1986) and more recently for northern fur seals only (Gentry 1998). Briefly, dives made by lactating northern fur seals can be categorized into three general patterns: shallow, deep and mixed (Goebel et al., 1991; Goebel, 1998). Shallow dives occur at night, are less than 30 m in deep, and change depth over time in response to vertically migrating prey. Deep dives in excess of 75 m appear to be associated with benthic foraging, occur during the day and night, and do not show depth changes associated with vertically migrating prey. The mixed category is a combination of shallow and deep dives. Dive effort increases during late lactation in response to the increased food requirements of a growing pup. The additional effort results from an increase in the proportion of time spent at sea rather than changes in the characteristics of individual dives, suggesting that the seals dive at an optimal rate near their physiological capabilities at all times during pup-rearing. Females foraging in an area with a broad continental shelf make longer trips to sea, make longer and deeper dives, but may expend less energy (less foraging effort based on the number of dives per hour and proportion of time at sea) than females foraging where the shelf is narrow (Costa and Gentry, 1986; Loughlin et al., 1986; Goebel et al., 1991; Pierson et al., 1998). In an area with a narrow shelf, females make shallow dives at night associated with vertically migrating prey. These results suggest that environmental variables (physiographic and hydrographic) affect diving and foraging strategies. However, these earlier studies had neither the environmental data (sea surface height altimetry, sea surface temperature, ocean color) from satellite remote sensing nor water temperature data from the telemeters attached to the animals that now enable us to identify habitat-associations between marine mammals and dynamic hydrographic features (e.g., anticyclonic meanders) that may influence prey distribution (Davis et al., 1998; Davis et al., 2002). In addition, they could not determine when or where the fur seals were capturing prey. By using satellite-linked stomach temperature measurements, we will be able to determine the time and three-dimensional location of prey capture by fur seal pups. These new sources of environmental and behavioral data, which will be used in this study, will enable us to map the pelagic movements, diving behavior and foraging success of fur seal pups in association with hydrographic features to characterize three-dimensional habitat.

The lack of information on the pelagic habits of young of the year fur seals also applies to older juveniles and adults. Valuable data on the diets and body condition of fur seals were gained from the pelagic harvests during the 1950's through the 1970's, but that source of information no longer exists. Therefore, we propose to also capture and instrument northern fur seals while at sea in the North Pacific.

3) Hypothesis/Objectives and Justification

a) Objectives:

The objective of this study is to characterize the movements, foraging behavior and habitat-associations of northern fur seals while at sea. Correlation of environmental features with satellite tracking, diving behavior and foraging success will improve our understanding of fur seal ecology and indicate which hydrographic and physiographic features influence their distribution.

The specific objectives are:

1. To monitor fur seal pup movements, diving behavior and prey ingestion from their rookery departure in November (post-weaning) to June using satellite telemetry.
2. To characterize fur seal pup habitat-associations by combining tracking and dive data with bathymetry and satellite remote sensing of hydrographic features.
3. To collect data on juvenile and adult northern fur seal diet, body condition, and movements and habitat associations utilizing pelagic captures.

Specific Hypotheses of the Proposed Study

We will test specific hypotheses related to winter movements, diving behavior, foraging location and foraging success of newly weaned fur seals. These movements and behaviors will be correlated with hydrographic and physiographic features to characterize habitat at sea.

a. Winter movements

The following hypotheses derive from the null hypothesis that fur seal pups from the Pribilof Islands migrate to the same areas as adult females.

Ho1: Fur seal pups migrate to coastal areas of the eastern North Pacific and central North Pacific.
Ho2: The pups disperse as they approach the Aleutian Islands and do not use Unimak Pass as the primary migratory corridor from the Bering Sea into the Northern Pacific Ocean.
Rationale: We have little data on the winter movements of newly weaned fur seals once they depart the Pribilof Islands. It is therefore possible that they migrate to the same areas as adults. However, Ragen et al. (1995) showed that pups disperse as they approach the Aleutian Islands and do not use Unimak Pass as the primary migratory corridor. This may indicate that pups do not migrate to the same areas as adults to avoid competition for resources and conserve energy reserves until they begin foraging successfully. We will track the movements of pups from November to June using satellite telemetry. We anticipate at least one high quality location (Argos location class >1) each day, which will enable to characterize their movements with a resolution of ca. 35 km, with further resolution if additional locations are received. Daily locations will be plotted on maps using Geographical Information Software (ArcView).
b. Diving and Foraging Behavior
The following hypotheses derive from the general hypothesis that pups do not have the physiological capabilities to dive as long or as deep as adults, and that they may feed on alternative prey that occur at shallower depths.
Ho1: Foraging dives will be shorter in duration and shallower in depth than dives made be adults.
Ho2: During the fall and spring, foraging dives will occur mostly at night when vertically migrating prey are shallower.
Ho3: During the winter, foraging dives will occur during the daytime and at night.
Rationale: Fur seals consume both fish and squid (Perez and Bigg, 1986; Mori et al., 2001), although dietary composition will vary geographically and temporally. Small schooling fishes (e.g. walleye pollock, Pacific herring, capelin) and neritic squids are the principal forage species over the continental shelf region, and oceanic squids are the important prey species over deepwater areas (Kajimura, 1985). The variety of prey consumed suggests that fur seals are opportunistic in their feeding. Young fur seals have a shorter breath-hold capability compared to adults (Bowen, 1991; Baker and Donohue, 2000), and this limits maximum dive duration and depth. As a result, pups may not feed on the same prey as adults and may concentrate on prey that occur at shallower depths. This may result in a different foraging strategy for young seals, with most dives occurring at night when vertically migrating prey are shallower. During the fall and spring, we hypothesize that most dives will occur at night when vertically migrating prey are closer to the surface. However, foraging dives will occur with greater frequency throughout the day during the winter when light levels are lower. Similar diving behavior has been observed for young Steller sea lions. The satellite telemeters will record the maximum depth, duration and time at depth for each dive during 6-hourly periods corresponding to day, dusk, night and dawn. This will enable us to analyze dive effort on a diel and seasonal basis. In addition, the stomach temperature sensor that communicates with the satellite telemeter will enable us to determine when and where the seals capture prey. This is different from other satellite telemeters where successful feeding dives must be inferred from the depth, duration and frequency of dives.

c. Habitat-associations

The following hypotheses derive from the results of other studies that have demonstrated correlations between the distribution of marine mammals and physiographic and hydrographic features that may concentrate zooplankton and micronekton stocks.

Ho1: In pelagic areas, fur seals will concentrate feeding dives near mesoscale features (e.g., eddies, the confluence of eddies and meanders) with increased nutrient-rich water and primary production in the mixed layer.

Ho2: Within the coastal region, fur seals will concentrate feeding dives near areas of upwelling with increased nutrient-rich water and primary production.

There are many factors that may influence the winter distribution of fur seals at sea. These factors include physiographic and hydrographic characteristics, prey distribution and predation. Previous studies have demonstrated correlations of marine mammal distribution with physiographic features such as ocean depth and seafloor slope (Evans, 1975; Hui, 1979, 1985; Selzer and Payne, 1988; Sutcliffe and Brodie, 1977; Payne et al., 1986; Whitehead et al., 1992; Jaquet and Whitehead, 1996; Baumgartner, 1997; Davis et al., 1998, 2002). Some studies have also demonstrated correlations between marine mammal distribution and hydrographic characteristics that may secondarily affect prey availability (Reilly, 1990; Reilly and Thayer, 1990; Waring et al., 1993; Reilly and Fielder, 1994; Jaquet et al., 1996; Jaquet and Whitehead, 1996; Croll et al., 1998; Fiedler et al., 1998; Tynan, 1997; Goold, 1998; Griffin, 1999). Cetaceans in the Gulf of Mexico are concentrated near eddies and other mesoscale features with locally concentrated zooplankton and micronekton stocks that appear to develop in response to increased nutrient-rich water and primary production in the mixed layer (Davis et al., 2002). Similar behavior has been observed for a female fur seal in the North Pacific, which swam along the edge of an anticyclonic meander in the Alaska stream. The edges of these meanders are areas of enhanced productivity. We will correlate fur seal movements and diving behavior with hydrographic features determined by coincident sea surface height mesoscale and geostrophic velocity anomaly.

b) Justification, Rationale and Significance

The northern fur seal population on the Pribilof Islands is declining for unknown reasons. The estimated population in the North Pacific has decreased over 50% since the 1950's and is currently declining at 6% per year (1998-2004). As a result, northern fur seals have been designated as depleted under the Marine Mammal Protection Act, and further declines could result in a designation of threatened under the Endangered Species Act. Severe population declines have also occurred in Steller sea lions (*Eumetopias jubatus*), harbor seals (*Phoca vitulina*) and sea otters (*Enhydra lutris*) in the same region. The cause of these dramatic declines remains unknown and controversial, but may include changes in prey availability or quality resulting from natural ecosystem fluctuations and large-scale fishing, especially of walleye pollock. Other possible causes include disease, pollutants and predation by killer whales. Given the economic and political impact on commercial fisheries in the North Pacific that resulted from the decline of Steller sea lions, research is urgently needed to understand why northern fur seals are also declining. Although there are many possible avenues for research, we will focus on the movements, foraging behavior and habitat-associations of pups during their first winter at sea. This is a critical time for young fur seals because growth during the first year is an important factor in determining adult size and survival (Bryden, 1968; Innes et al., 1981; Calambokidis and Gentry, 1985; Albon et al., 1992; Baker and Fowler, 1992; Gaillard et al., 1997; Boltnev et al., 1998; Tveraa et al., 1998; Burns, 1999). By focusing our research on the winter and early spring, we will investigate what is likely to be the most behaviorally and physiologically challenging period for newly weaned fur seals. In fact, it has been suggested that the northern fur seal decline may be related to winter factors in the North Pacific (Trites, 1992). The results from this study will improve our understanding of the pelagic ecology of young fur seals and provide vital information for their management and protection.

Because the objective of this study is to determine how northern fur seals might be affected by changes in the availability or distribution of their prey, we must study live northern fur seals in their natural habitats. We will use computer modeling and laboratory simulation of the response variables whenever possible, but we have already determined through modeling that we do not have enough basic information on many of the parameters that are needed to accurately model the energetics and behavior of fur seals. An alternative species cannot be used because this research is designed to provide information to aid the recovery of this particular species. There are many characteristics of northern fur seals, such as size and behavior, that differ significantly from the values for possible alternative species. There is no other marine mammal with a similar life-history to northern fur seals in the North Pacific. For example, the pups of northern fur seals are the only marine mammal in the North Pacific which are weaned at four months of age and then depart the Bering Sea for a long migration into other parts of the North Pacific for a pelagic existence that may last up to 3 years before returning to land. This research is also designed to specifically address critically important research needs that were highlighted in the recent draft Conservation Plan for northern fur seals (NMFS 2006). This research will contribute to both Objective #2 (Assess and avoid or mitigate adverse effects of human related activities on or near the Pribilof Islands and other habitat essential to the survival and recovery of the Eastern Pacific stock of northern fur seals) and Objective #3 (Continue and, as necessary, expand research or management programs to monitor trends and detect natural or human-related causes of change in the northern fur seal population and habitats essential to its survival and recovery). Our proposed research specifically address these action plans stated in the Conservation Plan: #2.7.1: Study the natural and anthropogenic influences on fur seal feeding ecology; #2.7.2 Evaluate pelagic fur seal sampling; #3.1.3 Estimate pup survival; #3.1.6 Evaluate Behavioral/physiological studies; # 3.3.1 Compile and evaluate available habitat-use data; and # 3.4.5 Quantify environmental effect on behavior and productivity.

C. Methods

1. **Duration of the Project and Locations of Taking:** We are requesting a permit for 5 years. The start date of the research should be September 1, 2007, and the end date should be August 31, 2012. Field seasons for initial captures of pups on the rookery will occur during the months of October and November in each year of the project. If we choose to

capture all 50 fur seal pups on the same rookery, we might visit that area for a maximum of 7 days. If we spread the capture effort out over more than one rookery, the number of days spent at each site would be less than 7 days. The minimum interval between visits to a single area within a season would be 12 hours. If the instrumented fur seals return to the natal islands in subsequent years, we will attempt to capture them for post-monitoring sampling of health and condition. These recaptures would most likely occur between the months of May and November. Research will be conducted on the Pribilof Islands, St. Paul and St. George Islands, and Bogoslof Island, in the Bering Sea. The exact sites of fur seal capture will be determined after coordination with biologists from the National Marine Fisheries Service and any other researchers that might be working at similar sites and times. Choice of sampling sites will depend on factors such as the current year's pup production at that site, results from previous years, presence of Steller sea lions, and activities of other researchers. We may choose to capture all 50 fur seal pups from a single rookery area, or we may spread the effort out over a number of sites on different islands. Pelagic fur seal captures will take place in the North Pacific, primarily in the Gulf of Alaska. Pelagic captures may occur at any time of the year, but are most likely to be attempted between February and May, based on the records from the pelagic harvests.

2. **Types of Activities, Methods, and Numbers of Animals or Specimens to be Taken:** We are proposing to take up to 50 fur seal pups per year by Level A harassment. Seals will be captured by hoop net or noose and physically restrained with sedation if required for: 1) taking of blood samples, 2) measurement of body composition (isotope dilution, bioelectric impedance analysis and ultrasonic imaging of blubber), 3) taking skin, blubber, and muscle biopsies, 4) collecting fecal loops and culture swabs, 5) collecting vibrissae, hair and nails, 6) attachment of flipper tags and marking fur temporarily , and 7) attachment of scientific instruments and placement of stomach temperature transmitter. When the seals return to the natal island in subsequent years, they may be recaptured to remove instruments and to repeat blood collection and measurements of body composition. The young of the year pups will not be recaptured until after they depart the rookery and spend time at sea. If they return the following year before the molt, they may still be carrying their instruments. If they return in their 2nd, 3rd, or 4th year, they may be identified by observers examining flipper tags through binoculars. Most juvenile fur seals do not return to the natal islands until they are 2 or 3 years old. Therefore, the minimum interval between the initial capture event and a subsequent capture would probably be between 7 months and 3 years. Measurements of health status, blood biochemistry and body composition will allow us to examine correlates of foraging success and survival of the instrumented pups. By repeating these measurements when and if the fur seals return to the natal site, we can examine how differences in habitat associations and foraging success relate to growth and overall health and condition.
   Up to 5,000 seals of either sex and any age per year will be taken by Level B activities for approaching the rookery to capture pups, to read flipper tags and to check previously attached equipment for damage. We determined that up to 5000 seals might be

incidentally disturbed during these activities by consulting with researchers from the National Marine Mammal Laboratory that have conducted this type of research on the Pribilof Islands for over 30 years. Because the fur seals will be physically and possibly chemically sedated, there is a risk of accidental death. We request that up to four (4) seals per year can die accidentally during capture, sedation and restraint. We will strive to prevent any accidental mortalities, but with up to 5000 seals being disturbed, the chance of accidental mortalities is small but not zero. Based on our conversations with other northern fur seal researchers, the likelihood of accidental mortality might even be higher than 0.08 percent, but this seems to be a reasonable threshold above which research activities would halt until a review can be conducted.

In addition to the 50 pups captured from rookeries, we are proposing to capture an additional 200 fur seals using pelagic net capture. Because it is not possible to accurately determine the age and sex of fur seals in the water before enclosing them in the net (with the exception of adult males), we cannot specify exactly how many of each age and sex class will be captured in this manner. The seals will be captured and subject to the same list of research procedures as above, with the addition that adult females will be subject to ultrasonography of the reproductive tract to determine pregnancy.

Our main objective is to provide data on the foraging behavior, habitat associations and survival of northern fur seals. The current pup production on the Pribilof Islands and Bogoslof Island is approximately 180,000 seals. Based on at-sea collections of fur seals, it appears that the young of the year seals spread out over the coastal margins of the north Pacific after their migration out of the Bering Sea. In order to extrapolate our results to such a large cohort that may be utilizing habitats that vary greatly over a wide geographic range, we need as large of a sample size as possible. The sample size of 50 fur seal pups and 200 pelagically captured seals was chosen because it is the largest sample that we can logistically handle at this time, because of man-power and budgetary constraints. Although conclusions based on such a small sample size relative to the cohort population must be made with caution, we anticipate that this sample will provide many insights that will contribute to the conservation of northern fur seals. Hindell et al. (2003) examined the number of tracking records from southern elephant seals that was needed in order to give a useful representation of the spatial distribution of the population from a single island. They found that the relationship between number of seals and spatial area began to reach an asymptote at around 25 – 40 seals. Northern fur seals are thought to migrate over a spatial area similar in size to that of southern elephant seals, so we are confident that our sample size will provide a similarly robust result.

2. Research Techniques:

a): Study Site and Animals

Weaned pups on the rookery: Northern fur seal pups usually depart the rookeries between mid-October and late November. Fifty northern fur seal pups will be captured at several locations on St. Paul Island, St. George Island, and Bogoslof Island using a hoop net or noose prior to their departure from the rookeries. The exact sites of fur seal capture will be determined after coordination with biologists from the National Marine Fisheries Service and any other researchers that might be working at similar sites and times. Animals will be weighed using an electronic scale and measured (i.e., standard length and girth). A satellite telemeter will be glued to the fur on their backs using epoxy, and a stomach temperature transmitter will be inserted into the stomach. Blood samples and other biological samples will be collected for analysis of basic health, nutrition and condition parameters, and body composition will be measured using three different techniques. We will use these three techniques in order to determine whether there is a good correlation between the gold standard of isotope dilution and the two methods that are quicker and easier to perform, bioelectric impedance analysis and ultrasonic imaging of blubber. We will conduct this comparison with the goal of validating an accurate body composition method that takes less time and therefore has a lower impact on the subject than isotope dilution. If in the first year or two of the study we can establish which of the two quicker and easier methods is more suitable for northern fur seals, then in subsequent years we can perform only the better method and not all three methods. For animals that undergo the isotope dilution method, the maximum time of handling will be approximately 2.5 hours. This includes an initial period of approximately 20 minutes for instrument attachment, blood and other tissue sampling, morphometric measurements and marking, followed by release into a corralled area, then subsequent restraint for a final blood sample that would take a maximum of 10 minutes. The animals will be allowed to recover before release back onto the rookery. The criteria that we use to determine “recovery” includes stable and normal heart and respiratory rates, an alert state of consciousness, and normal agility. If after collecting data in the first year we can determine that one of the other methods of body composition measurement is suitable for northern fur seals, then we will use that method for subsequent seals, which would reduce total handling time of the fur seal to approximately 30 minutes.

Pelagic captures: Both fur seals pups and adult females depart the rookeries during November. It would appear that most of them migrate out of the Bering Sea on a course through the central North Pacific, but then migrate closer to shore on their northward journey (Bigg 1990). We propose to use a pelagic net capture method to capture and sample up to 200 northern fur seals per year. The capture locations will be determined by cruising on transect lines or randomly through parts of the Gulf of Alaska and elsewhere in the North Pacific where past pelagic research found concentrations of northern fur seals. Once fur seals are sighted at sea, individuals or small groups (< 20) will be encircled by a modified purse seine or gill net deployed by a seine skiff. The netting will be rugged material with a mesh size small enough to prevent a flipper or head from passing through the mesh. Upon closure of the seine, fur seals will be removed one of two ways. If only a single seal is enclosed in the net, the net will be pursed until the seal is entangled and then the net and seal will be raised out of the water and onto the boat. Northern fur seals (aged 1 to 21 years) have been captured successfully with this method using gill nets off the coast of Japan (Yonezaki et al. 2004). If a group of seals is enclosed, then individuals will be removed from the net by lowering a brailer into the net and “dipping” for a single fur seal. Once caught in the brailer, the brailer will be hoisted and then set down into a capture cage on the deck of the boat. The method of netting and lifting pinnipeds out of the water with a brailer has been used successfully to capture Australian fur seals for research purposes (Dr. Simon Goldsworthy, South Australian Research and Development Institute, personal communication). The in-water net capture method is used routinely to capture other pinnipeds, such as grey seals (Goulet et al. 2001) and harbor seals (Small et al. 2005). Our research group has experience in net captures of harbor seals and we will employ similar techniques to ensure that this is a safe method for fur seals. The circumference of the net will be monitored by crew in small boats. Any fur seals that become entangled but that cannot be brought aboard the boat can be freed by cutting away the net with fisherman’s net knives attached to long poles. At any time free-swimming fur seals can be released from the purse seine by pulling the two ends apart. Once the seals are brought on board the boat, they will be anesthetized and subjected to the same suite of sampling methods as mentioned above for pups, the details of which are described below.

b): Anesthesia and sedation

If necessary to facilitate handling of the fur seals, chemical sedation or gas anesthesia may be used. Valium (diazepam, intramuscular dose of 0.2 mg/kg) may be given to reduce anxiety and resistance to manipulation. Valium would most likely only be used in situations when the fur seal does not relax in between initial handling and subsequent sampling as would be required for the isotope dilution method. Valium may be used before administering gas anesthesia. Isoflurane gas may be administered for induction at 5% in medical oxygen from a properly cleaned and calibrated vaporizer in a closed circuit gas anesthesia machine via a traffic cone mask placed over the snout. Depth of anesthesia will be judged by the anesthetist based on respiratory rate and volume, response to stimuli, palprebral reflex, capillary refill, and jaw and muscle tone, and maintained using 1% to 3% isoflurane in oxygen at an appropriate flow rate as needed. Intubation with an appropriate sized cuffed endotracheal tube should be utilized for continued administration of isoflurane gas and oxygen whenever possible but may be omitted for very short procedures (less than 10 minutes) or when otherwise contraindicated. Respiratory and heart rate, oxygen saturation and deep rectal body temperature will be monitored whenever anesthetic procedures last for more than 10 minutes, and recorded on a written anesthetic record sheet indicating time and duration of anesthesia, rate of isoflurane and oxygen administration, procedures performed, drugs or other products administered, and reactions of the animal from induction through anesthetic recovery. Rectal body temperature will be monitored by a digital thermometer and a flexible rectal probe. The minimum duration of gas anesthesia might only be 5 minutes, and the maximum would probably not exceed 2.5 hours. Based on our experience with isoflurane anesthesia on adult female northern fur seals, seals that do not receive any premedication will recover to normal function within 5 – 15 minutes after cessation of isoflurane administration. The use of sedatives and anesthetics will only be conducted under the supervision of veterinarian or an individual that has received training from a veterinary anesthetist and that has significant experience in anesthetizing fur seals.

Hypothermia (deep rectal temperature < 92 ° F) can be prevented by the application of warm (100-105 °F) water bags to flippers and body, drying of the fur and covering the animal with thermal insulating blankets. Hyperthermia (deep rectal temperature > 106°F) can be controlled by wetting the flippers with cool water, applying ice or cold water packs and use of fans for increased air flow.

An emergency kit will be present at all times consisting of a respiratory stimulant (doxepram), a cardiac stimulant (epinephrine), a parasympatholytic agent (atropine) and a corticosteroid (dexamethasone). Positive pressure oxygen ventilation utilizing the endotracheal tube and a rebreathing bag or an assisted respiration bellows system on the anesthetic machine will also be available if needed.

Administration of isoflurane gas will be discontinued as soon as possible after the completion of necessary research procedures. Oxygen will be administered for several additional minutes until the endotracheal tube can be removed (as judged by the return of jaw tone and swallowing reflexes).

c): Blood collection

Up to 2.0 ml/kg of blood will be collected to determine the overall health, nutritional status and condition of seals. Blood will be collected and analyzed for hematology and blood chemistry (including glucose, lactate dehydrogenase, creatine phosphokinase, blood urea nitrogen, triglyceride, non-esterified fatty acids, creatinine, sodium, potassium, chloride, calcium, phosphorus, alkaline phosphatase, albumin, gamma-glutamyl transpeptidase, serum glutamate pyruvate transaminase, total protein, cholesterol, globulin, total bilirubin), for serology, bateriology and virology (includes brucella, leptospirosis, seal herpesvirus, toxoplasmosis), endocrinology (including assays of free and bound triiodothyronine and thyroxine, cortisol, corticosterone, testosterone, progesterone, estrogen, leptin and ghrelin). Blood may also be analyzed for contaminants, including organochlorines, PCBs, DDTs, mercury, pesticides.

Blood will be collected from the caudal gluteal vein, jugular vein or flipper vein. The puncture site will be initially cleaned with alcohol and a diluted solution of povidine iodine in saline. Pressure will be applied to the puncture site for 1-2 minutes to reduce bleeding and/or bruising. There is a small risk of infection associated with penetration of the animal's dermis by the needle. Multiple attempts to obtain a blood sample are stressful and may cause some degree of pain, damage to the vein, clotting, bruising and abscess.

Estimated volumes of blood for required analyses:

Blood biochemistry: 5 ml blood

Hematology: 1 ml blood

Serology: 5 ml blood

Endocrinology: 5 ml blood

Immunology: 5 ml blood

Contaminants: 5 ml

Archive: 5 ml

<u>Mitigation</u>: The blood volume of young northern fur seals has not been published, but in other otariid juveniles it varies from approximately 90 to 150 ml per kg^{-1} body mass (Richmond,

2004; Costa et al. 1998)). The acceptable safe veterinary standard for blood withdrawal is 10% of total blood volume (Murray 2000). Therefore, for northern fur seals the acceptable safe limit for blood withdrawal would be at least 9 ml kg^{-1}, but we will be limiting ourselves to only 2 ml kg^{-1} when drawing blood. Therefore, we do not expect any adverse effects from this amount of blood collection. To reduce the risk of infection, only clean, sterile disposable needles will be used to obtain blood samples and a new needle will be used for each blood collection. Needles will not be re-used on individual animals or between animals. The area to be sampled will be thoroughly disinfected with ethyl alcohol or betadine prior to insertion of the needle. Sufficient pressure and/or dry gauze will be applied to the venipuncture site after removal of the needle to minimize the potential for hematoma formation in the surrounding tissues. This procedure will only be performed by/under the direct supervision of qualified and experienced personnel. An emergency kit with equipment and supplies for responding to complications or emergencies will be readily available.

d): Measurement of body composition
An important determinant of post-weaning survival is the energy store of the seal at weaning. The gold standard for determining body composition is isotopic water dilution. Two other methods of body composition analysis are bioelectric impedance analysis and ultrasonic imaging of subcutaneous blubber thickness. Although these latter two methods take less time to perform and may therefore have less impact on seals, they have not been validated in northern fur seals. We know that these methods have not been validated for use on northern fur seals by anyone because we searched the literature and consulted with other pinniped experts. Arnould (1995) has demonstrated the utility of bioelectric impedance analysis on adult female Antarctic fur seals, but there are no studies of its validity when used on young fur seals. Therefore, we will perform all three measurements on the same individuals.
Isotopic water dilution: Deuterated water (0.2 g/kg of 99.9% enriched deuterium oxide) will be administered via one of the following routes: intramuscular, intraperitoneal, or intravenous. Post-injection blood samples (5.0 ml) will be collected at the following times: 1 hours post-injection and 2 hours post-injection. Seals will be released from manual restraint after deuterated water injection and in between blood sampling at 1 hour and 2 hours post-injection.
Bioelectric impedance analysis: Electrodes (sterile needles) for bioelectric impedance analysis (BIA) will be placed subcutaneously and resistance and reactance will be recorded. Four electrodes are used in BIA, 2 will be placed above the skull and 2 near the base of the tail. Electrodes will then be removed and re-inserted up to 5 times to obtain repeat measurements because individual measurements of resistance and reactance can vary significantly and therefore it is necessary to take repeat measurements and then derive a mean value.
Ultrasonic imaging: A portable imaging ultrasound unit will be used to record blubber depth at multiple sites. This procedure involves the application of water or ultrasonic gel to the fur and placement of the ultrasonic transducer against the fur, causing a momentary light pressure on the skin.

e): Skin, blubber and muscle biopsies

We will collect skin, blubber and muscle biopsies from seals for enzyme, fatty acid and contaminant analysis. Enzyme profiles will be examined to determine the aerobic condition of fur seals prior to their commencement of migration. The aerobic condition of fur seal pups may be an important determinant of their diving ability and therefore foraging success and ultimate survival. Fatty acid profiles will provide an indication of the prey of the mother, which may also be an important factor in the condition and survival of the pups. Contaminant loads are another factor that we will examine for correlations with the ability to forage successfully and survive after weaning.

We will take biopsies from the dorsal loin region. A sterile scalpel will be used to make a small incision to collect skin and make an opening for a biopsy punch. The biopsy punch will be used to collect up to 2.0 g of blubber and 0.5 g of muscle. The blubber and muscle will be removed from the same incision site. The maximum depth of biopsy sample will be approximately 1.0 cm below the skin.

Mitigation: Procedures will be conducted with sedation or anesthesia. To reduce the risk of infection, only clean, sterile disposable scalpel blades or biopsy punch tool will be used to obtain biopsy samples and a new scalpel blade or biopsy punch tool will be used for each biopsy. Scalpel blades and biopsy punch tools will not be re-used on individual animals or between animals. The area to be sampled will be thoroughly disinfected with 20% isopropyl alcohol or dilute povidone iodine/ saline solution prior to insertion of the cutting instrument. Only personnel with sufficient experience in the technique will be allowed to perform this procedure. We consider that personnel who have received the appropriate training and have performed the procedure under the supervision of a qualified researcher or veterinarian until the supervisor deems that the person can perform the procedure safely and effectively without supervision to have “sufficient experience”

f): Fecal loops and mucosal/skin swabs

Swabs will be performed to provide material for multiple assays, including epidemiology and endocrine activity. Specific analyses may include examination for bacterial, viral and other pathogens (e.g. mites, fungi, and many viruses) in addition to hormone analyses. Examination of pathogens will be useful when we examine the foraging behavior and ultimate post-weaning survival of northern fur seal pups. Poor foraging success or early mortality may be due to exposure to pathogens that result in eventual disease.

g): Collection of hair, vibrissae and nails:

These parts will be collected for measurement of stable isotope ratios and contaminant loads. Stable isotope ratios upon initial capture as pups will be used to learn about maternal foraging. Examination of stable isotope ratios upon recapture will provide an indication of the trophic level that the fur seal was feeding at between initial and subsequent capture. Contaminant loads may be an important factor in condition and ultimate post-weaning survival. One vibrissa may be pulled. One nail may be clipped. Hair will be collected by clipping a small area (less than 2 cm^2) of fur. There are no published studies on the deposition of isotopes and

contaminants in these different fur seal tissues. Therefore we will compare all 3 tissues to examine differences and make recommendations for future studies.
Mitigation: We do not anticipate any adverse effects of these minor procedures. Whiskers have been pulled from captive Steller sea lions many times and no adverse response was observed (Hirons et al. 2001; personal observation). Pulling, rather than clipping, a vibrissae is preferable because clipping results in an unknown length remaining attached to the sea lion. Stable isotope ratios show regular, oscillating patterns in Steller's sea lion vibrissae of 1-3 cm, and changes in ratios can occur in less than 1 cm (Hirons et al. 2001). Thus, obtaining the root of the vibrissae, representing the most recent growth, for analysis is crucial.

h): Flipper tag and temporarily mark fur

Each seal will be marked with plastic cattle ear tags for future identification. Seals will be marked so that we can remotely monitor the behavior of the fur seal pups after their capture but prior to their departure from the rookeries. The tags will also permit us to identify research seals when they return to the rookery. These tags will be affixed through a foreflipper in loose skin anteriorly, near the area where the flipper meets the body. The hole is made with a punch. Each animal receives two double-sided tags, one per flipper, to minimize the chance of losing the ability to identify the animal should one tag be lost. The flipper tags can sometimes be difficult to spot when the tagged individual is in a large group of pups. Therefore, in order to easily recognize sampled pups, we will also mark pups with a more readily visible from a distance bleach (safe, human hair bleach) mark or by shaving a small spot of fur on the dorsal surface. The bleach mark will last until the seals molt in the following year.
Mitigation: Flipper tags are best considered semi-permanent markers as they can and do pull out because fur seals use their foreflippers in both aquatic and terrestrial locomotion. When the tag is affixed there is the potential for infection at the wound site, particularly because the environment on the rookery is not aseptic and because the activity of the animal may prolong or prevent healing by producing repetitive stress on the wound. There is also the potential for infection when a tag pulls out of the flipper, for whatever reason. In moving about on a rookery or haulout, or swimming, there is the potential for a tag to be torn out of the flipper by abrasion on the substrate or by hydrodynamic pressure. There is no quantitative information on the rate of infection caused by flipper tagging northern fur seals. Care will be taken to avoid placing the tag so low as to have the animal walking on it or so high as to have it irritating the animal's flank area. To reduce the risk of infection, the area will be thoroughly disinfected with ethyl alcohol or betadine prior to applying the tag. In addition, the tags will be thoroughly cleaned and disinfected immediately prior to application. This procedure will only be performed by/under the direct supervision of qualified and experienced personnel. Bleach will be applied to the fur at the beginning of the procedure, when the seal is anesthetized, and it will be rinsed off before the seal is removed from anesthesia. This will prevent any possibility of bleach getting into a seal’s eyes or being ingested.

i): Satellite-linked dive and stomach temperature

We will use the Service Argos satellite system to track the movements of radio-tagged fur seals and receive data on diving behavior. Telemeters transmit ultra-high frequency (UHF) radio signals to Argos receivers on five National Oceanic and Atmospheric Administration (NOAA) TIROS-N weather satellites. The satellites are in sun-synchronous polar orbits. To conserve power, we will limit transmissions to times when the fur seals are at the surface. Locations will be determined by Service Argos from Doppler shift of tag transmissions created by the speed of the satellite passing overhead.

The satellite telemeter will record and transmit data on dive behavior. The satellite transmitter is approximately 7.8 cm long by 5.0 cm wide by 2.5 cm high and it weighs approximately 105 grams. The tags will be shaped with a trailing taper so as to minimize the hydrodynamic drag. The depth range for the satellite telemeter will be 1-500 m, with a resolution of 1 m. Data on maximum dive depths, dive durations, and the amount of time that the animal spends at certain depths will be collected and encoded into histograms with programmable ranges of depth and time. The transmit buffer stores 24 hours of data in 6-h histogram periods that correspond to night (2100-0259), dawn (0300-0859), day (0900-1459) and dusk (1500-2059). Dive data will be analyzed with the SATPAK software from Wildlife Computers. Data will be tested for normality using a Kolmogorov-Smirnov test (significance considered at $P = 0.05$) available with STATISTICATM software. The number of dives per day and percentage of dives by duration and depth categories will be determined. In addition, we will determine the percentage time spent at each depth category. These data will enable us to assess preferred foraging depths as a function of time of day, ocean depth and proximity to hydrographic features.

In addition to dive behavior, the satellite telemeter will record and transmit data on stomach temperature, which provides information on the timing and quantity of prey ingestion. This method relies on the decrease in stomach temperature that occurs when a relatively warm animal ingests much cooler prey. The stomach temperature transmitter sends a 5 kHz pulse at a rate that is dependent upon temperature (~ once per 2 sec at 37 deg C), and the pulses are received by circuitry in the satellite transmitter. The stomach temperature transmitter is housed in biocompatible epoxy and titanium, and the size and shape are designed to promote retention in the stomach for up to one year. The transmitter is cylindrical and is approximately 2.2 cm in diameter and 6 cm in length. The transmitter will be placed into the stomach by pushing it down the esophagus with a stomach tube (Andrews, 1998). Upon ingestion of cold fish, stomach temperature drops quickly, and the amplitude of the drop and time course of rewarming depends upon the size of the meal and the temperature of the fish (equal to seawater temperature measured by the satellite transmitter). The satellite transmitter compresses the stomach temperature data and transmits it in Argos messages. This additional information on prey ingestion allows a direct measurement of foraging success and the determination of habitats that are most productive for fur seals.

Mitigation: External tags will be hydrodynamically shaped with a trailing taper as suggested by Bannasch et al. (1994). A similar sized device on a small gentoo penguin model increased drag by only 15 – 25 % (Bannasch et al. 1994). Penguins are much more streamlined than fur seals, so we expect that the added drag and therefore the impact on the seal will be much less than this. Stomach temperature transmitters have been used with captive Steller sea lions and have been retained in the stomach for up to 2 years with no ill effect digestion or any aspect of health (Andrews 1998).

j): Reproductive tract ultrasonography

We will use ultrasonography to image the reproductive tracts of female non-pups captured at sea. Ultrasound exams of this type are a common tool used on captive cetaceans and pinnipeds with little or no risk to the animal (Brook et al. 2001). In cases where detailed ovarian fine structure on non-pups is not possible by external examination, transrectal and transvaginal ultrasonography will be used.

Mitigation: Internal ultrasonography is a safe, effective method used in both humans and wildlife (Adams et al. 1991, Adams 1999, McCorkell et al. 2006). Transrectal or transvaginal ultrasonography on female northern fur seals will be performed by a qualified veterinary ultrasonographer/theriogenologist, or technical staff specifically trained in this procedure by a qualified veterinary ultrasonographer/theriogenologist.

k): Stomach lavage

In order to determine the diet of fur seals captured at sea or when they return to the rookery, seals will receive stomach lavage and fecal enema. The proper stomach lavage procedure is to first estimate the length of the stomach tube necessary by measuring the distance to the stomach along the outside of the animal's body. The tube should be smoothly inserted into the mouth, down the left side of the animal's throat, into the stomach. To further verify that the tube is in the stomach, a small amount of air should be blown down the tube while listening for gurgling either through the tube or via a stethoscope placed on the left abdominal wall. The stomach tube will be inserted into the stomach of anesthetized animals and then gentle suction will aspirate stomach fluids up the tube, which is then pinched, extracted, and the stomach contents drained into sample containers. When little or no fluid is aspirated, 1 liter of warm water can be inserted into the stomach via the tube, and then this fluid and solid stomach contents can be aspirated.

Mitigation: There is the risk of introduction of liquid into the trachea, initiating aspiration pneumonia or death. There is also a risk of cross-contamination if equipment is not properly disinfected between animals. Only experienced, qualified personnel (veterinarians, biologists) who know how to properly pass a stomach tube to avoid introduction of liquid into the trachea will attempt this procedure. Tubes will be properly washed, disinfected, rinsed, and shaken or spun dry between animals.

l): Fecal collection by enema

The purpose of using enemas is to collect the contents of the digestive tract for analyses of an animal's diet. A clean, lubricated enema tube is inserted into the rectum and 1-2 liters of warm water are gently applied to flush feces from the lower digestive tract. Animals will be anesthetized with isoflurane gas during the procedure, as it would be conducted in conjunction with capture, restraint, and instrument attachment or other procedures.

We are proposing to do both fecal enemas and gastric lavages on all captured fur seal > 4 months of age. They are not interchangeable techniques, nor do they provide duplicative data. Gastric lavage can be used to identify recent feeding, but if foraging occurred more than three hours before the sampling, then the stomach is likely to be empty but the enema will very likely show evidence of hard part remains. The hard part remains found in the lower bowel are not completely representative of all prey parts, because many parts are retained within the stomach and often are eventually regurgitated. Therefore, whenever they are possible to collect, stomach contents are very valuable.
Mitigation: Any time a foreign object is inserted into the rectum there is the possibility of perforation, which can lead to peritonitis that may result in death. When performed by a qualified, experienced person using a blunt ended tube and commonly accepted standards of good practice, these risks are negligible. As animals will be immobilized for this procedure, the risks will be very minimal. Yonezaki et al. (2004) has demonstrated that enemas are a safe and effective technique to examine diet in northern fur seals.

m): Tooth extraction for aging
We will pull one pre-molar tooth on all captured fur seals > 4 mo. old that are not tagged and therefore are of unknown age. Teeth will not be extracted from the 50 fur seal pups captured on the rookery. Age is a critical component to all physiological interpretations, foraging patterns, as well as population structure and distribution. Pulling a tooth allows examination of tooth characteristics including size, root closure, incremental cementum growth layers, dentine thickness and crown appearance, which when combined with eruption patterns, mass and body length permits very accurate age estimation. A dental elevator is used to loosen the tooth attachments and extract the tooth. Fur seals would be anesthetized and the area around the tooth cleaned before extraction. The dental elevator will be sterilized before using on each fur seal. If necessary, after extraction, pressure will be applied to the cavity until bleeding has stopped. Only one premolar tooth will be removed for analysis.
Mitigation: Only personnel with sufficient experience in the technique will be allowed to perform this procedure. The animal will be anesthetized and respiration will be closely monitored. Goebel et al. (2005) examined the long and short-term effects of non-lethal tooth extraction on Antarctic fur seals, and the only short-term effect was a minor effect on maternal attendance (on-shore visit duration was slightly longer after tooth extraction). Tooth extraction had no effect on over winter survival, fecundity, mass gain or diving behavior (Goebel et al. 2005).

3. Additional Information for Removing Animals from the Wild into Captivity and Research or Enhancement on Captive or Rehabilitating Animals
We will not be removing any seals from the wild so this section is not applicable.

4. Lethal Take: We do not request any intentional lethal takes. Because the fur seals will be physically restrained and possibly chemically sedated, there is a risk of accidental death. There is also the remote risk that an incidentally disturbed fur seal could accidentally die during the capture process, e.g. if it was trampled by an adult male that was incidentally disturbed. We request that up to four (4) seals per year can die accidentally during capture, sedation and restraint.

5. Exports of Marine Mammals from the U.S.
Not applicable

D. Research Effects and Mitigation Measures

1) **Effects**
   a) **Effects on Individual Animals:** All of the techniques that will be used are standard methods used to study the behavior and physiology of mammals. All procedures except for stomach temperature telemetry have been used on northern fur seals or closely related otariids and have been shown to be safe and effective (c.f.; Arnould, 1995; Ragen et al., 1995; Gentry, 1998; Ream et al. 2005) Stomach temperature telemetry has been used on Steller sea lions without any ill effects (Andrews, 1998). Minor and temporary tissue trauma and pain from biopsies and blood collection will occur. There is a chance of accidental mortality resulting from capture and restraint, but this is very unlikely. Therefore, the effects of this project on individual animals should be no more than a very minor, short term stress from handling.
   b) **Effects of Incidental Harassment**: During the capture process, many non-targeted fur seals will be disturbed by the presence and movements of researchers. The fur seal rookeries on the Pribilof Islands have been subject to this kind of disturbance for over 100 years. It appears that when researchers move cautiously and restrict movements to the periphery of pup groups, the overall disturbance is minor (based on personal communications with researchers who have worked on fur seal rookeries for decades). We will carefully observe the reactions of non-targeted seals to our activities, and will cease operations if seals appear unduly stressed or are in danger of hyperthermia or trauma from falling, overcrowding, or other potential hazards. Indicators of "undue stress" include the following: abnormal respiratory rates, incessant alarm vocalizations and abnormally aggressive behavior towards conspecifics.
   c) **Effects on Stocks:** This project is not likely to have any measurable effect on the north pacific stock of northern fur seals. The potential biological removal for this stock is 16,162 seals (Angliss and Lodge, 2003), so even in the outrageously unlikely event that we reached our maximum limit of 4 accidental mortalities, we could not exert a measurable effect on this population.
2) **Measures to minimize effects:** We will strive to minimize any stress, pain and suffering. All procedures that may cause anything more than very minor discomfort, such as muscle biopsies, will be done with the use of local or gas anesthesia to prevent pain and suffering. Post-operative discomfort at the biopsy and blood collection sites is possible as well as at site of flipper tags. Mitigation measures have been described for the individual methods in section 2. All procedures will be conducted according to ASLC protocols that have been developed in consultation with veterinarians and marine mammal experts. The ASLC protocols have been repeatedly used on ASLC captive pinnipeds and shown to be safe and effective. All procedures will reviewed by

our institutional animal care and use committee (IACUC) before commencing research. Fur seals on the rookeries where seal captures take place will be disturbed by the presence and movements of researchers. Scientific research of this type has been conducted at the Pribilof Islands for many decades, and protocols for observing disturbance and determining what is safe have been developed by NMFS researchers (c.f. NMFS's annual fur seal investigations reports, such as Robson, 2002; Gentry, 1998). During the breeding season a box that acts as a blind can be used to move through the rookery. Outside of the breeding season it is possible to capture pups without the box. It appears that when researchers move cautiously and restrict movements to the periphery of pup groups, the overall disturbance is minor. We will carefully observe the reactions of non-targeted seals to our activities, and will cease operations if seals appear unduly stressed or are in danger of hyperthermia or trauma from falling, overcrowding, or other potential hazards. We have already met the other researchers that are likely to take this species in the same location, and we will continue to coordinate with them as well as all appropriate NMFS personnel and tribal government representatives to ensure that our takes will not be unnecessarily duplicative.

3) **Monitoring effects of activities:** All fur seals will be monitored post-procedure until they have completely recovered from the anesthesia or handling procedure. They will be maintained in a safe area until complete recovery from anesthesia prior to release. The seals will be monitored with satellite telemetry and flipper tags to facilitate long-term monitoring.
4) **Alternatives:** Because the objective of this study is to determine how northern fur seals might be affected by changes in the availability or distribution of their prey, we must study live northern fur seals in their natural habitats. We will use computer modeling and laboratory simulation of the response variables whenever possible, but we have already determined through modeling that we do not have enough basic information on many of the parameters that are needed to accurately model the energetics and behavior of northern fur seals. All procedures included will only be performed under valid ASLC IACUC approvals. Copies of these approvals will be provided prior to any sampling event.

E. Resources Needed to Accomplish Objectives

The research included in this application is funded via various sources including Federal Appropriations to the ASLC and a grant from the North Pacific Research Board.

F. Publication of Results

Our results will be published in the appropriate scientific journals and will be presented at society meetings as well as at the ASLC annual research colloquium. In addition, information on this project will be distributed to the public through ASLC outreach and education programs.

V. National Environmental Policy Act (NEPA) Considerations

1. Will your research or enhancement activity involve equipment or techniques that are new, or may be considered innovative or experimental?

No. All of the procedures that we will use have been used safely and effectively on either northern fur seals or other otariids (c.f. NMFS's annual fur seal investigation reports, such as Robson, 2002;

Gentry, 1998; Andrews, 1998).

2. Does your activity involve the collection, handling, or transport of potentially infectious agents or pathogens, and/or does your activity involve the use or transport of hazardous substances?
Yes. The collection and transport of biological samples will only occur with proper sample identification and personal protective equipment (e.g., latex gloves, close-toed shoes).

3. If any of your activities occur in or near unique geographic areas, would any aspect of your activities impact the physical environment?
The Pribilof Islands are a unique geographic area, but our research will not have any impact on the physical environment. Similar research has been conducted there for over 30 years and we are unaware of any reports of impact on the physical environment.

4. Do you know if your work could affect entities listed in or eligible for listing in the National Register of Historic Places, or cause loss or destruction of scientific, cultural or historic resources?
The proposed activities will not cause loss or destruction of any resources. Fur seals are harvested by Pribilof Islanders, but our take is too small to possibly affect this resource, even if we reached our limit of 4 mortalities (NMFS 2006).

5. Would your proposed activities include actions that might involve the transport of any material, biological or otherwise, from one area to another?
No, all transport of animals would occur within the indigenous area.

VI. Previous and Other Permits

A. Previous permits:

ASLC holds the following permits: National Marine Fisheries Service, Office of Protected Resources (#881-1443, 881-1668, 881-1724)

B. Other permits:

US Department of Agriculture, Animal and Plant Health Inspection Service (#96-R-0005)

US Department of the Interior, Fish and Wildlife Service (#01-015)

US Department of the Interior, Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge (Special Use Permit No. 74500 – 03-045)

US Department of Homeland Security, US Coast Guard (DTCG-Z71117-02-RP-025L)

US Department of Defense, Army Corps of Engineers Nationwide Permit No. 5

State of Alaska, Department of Natural Resources, Division of Mining, Land and Water (Land Use Permit No. LAS 25187)

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VIII. Certification and Signature

"I hereby certify that the foregoing information is complete, true, and correct to the best of my knowledge and belief. I understand that this information is submitted for the purpose of obtaining a permit under one or more of the following statutes and regulations promulgated thereunder, as indicated in the Section I of this application:

The Endangered Species Act of 1973 (16 U.S.C. 1531-1543) and regulations (50 CFR 222.23(b)); and/or

The Marine Mammals Protection Act of 1972 (16 U.S.C. 1361-1407) and regulations (50 CFR Part 216); and/or

The Fur Seal Act of 1966 (16 U.S.C. 1151-1175).

I also understand that any false statement may subject me to criminal penalties of 18 U.S.C. 1001, or to penalties provided under the Endangered Species Act of 1973, the Marine Mammal Protection Act of 1972, or the Fur Seal Act of 1966, whichever are applicable."

Signature of applicant ______________________________________

Date ______4 December 2006_________________________________

Typed or Printed Name of Applicant_Russel D. Andrews, Ph.D_____

Title of Applicant_Marine Mammal Scientist, Alaska Sealife Center__

Table 1:Takes of northern fur seals (*Callorhinus ursinus*); all actions apply only to northern fur seals; no seals will be transported away from the region of capture.

Species	Life Stage	Sex	Number of animals expected to be taken per year	Number of takes per animal	Take Action	Location	Dates/Time Period
Northern fur seals	all	m/f	5000	Maximum of 50, but more likely 1 – 2.	Incidental disturbance	St. Paul Island, St. George Island, Bogoslof Island, AK	Year round
	all[1]	m/f	4	1	Incidental mortality	St. Paul Island, St. George Island, Bogoslof Island, AK	Year round
	>1 mo. to 4 years[2]	m/f	50	2	Capture (by hand, hoop net, noose), physically restrain, chemically immobilize (isoflurane, valium), take morphometric measurements (length, girth, mass)	St. Paul Island, St. George Island, Bogoslof Island, AK	Initial capture: October – November each year of permit; recaptures can occur anytime the seals return to the islands or are caught at sea

	> 4 mo. through adult	m/f	200	3[3]	Capture (by pelagic net capture), physically restrain, chemically immobilize (isoflurane, valium), take morphometric measurements (length, girth, mass)	Gulf of Alaska, Aleutian Islands	Year-round
The following takes are a subset of those northern fur seals that will be captured on fur seal rookeries. They are additional procedures per animal, not additional animals.							
Northern fur seals	>1 mo. to 4 years	m/f	50	2	Blood collection	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	2	Inject isotopes (D_2O) and collect serial blood samples	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	2	Bioelectric impedance analysis	St. Paul Island, St. George Island, Bogoslof Island, AK	

	>1 mo. to 4 years	m/f	50	2	Ultrasonic imaging	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	2	Muscle, blubber and skin biopsies	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	2	Fecal loops and culture swabs	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	2	Collect vibrissae, hair, and nails	St. Paul Island, St. George Island, Bogoslof Island, AK	

	>1 mo. to 4 years	m/f	50	2	Flipper tag and mark temporarily (clip fur, hair bleach)	St. Paul Island, St. George Island, Bogoslof Island, AK	
	>1 mo. to 4 years	m/f	50	1	Attachment of scientific instruments (SLTDR, stomach temperature transmitter)	St. Paul Island, St. George Island, Bogoslof Island, AK	
The following takes are a subset of those northern fur seals that will be captured at sea. They are additional procedures per animal, not additional animals.							
Northern fur seals	> 4 mo. through adult	m/f	200	3	Blood collection	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Inject isotopes (D_2O) and collect serial blood samples	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Bioelectric impedance analysis	Gulf of Alaska, Aleutian Islands	

	> 4 mo. through adult	m/f	200	3	Ultrasonic imaging	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Muscle, blubber and skin biopsies	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Fecal loops and culture swabs	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Collect vibrissae, hair, and nails	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Flipper tag and mark temporarily (clip fur, hair bleach)	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	1	Attachment of scientific instruments (SLTDR, stomach temperature transmitter)	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	3	Stomach lavage	Gulf of Alaska, Aleutian Islands	

	> 4 mo. through adult	m/f	200	3	Fecal enema	Gulf of Alaska, Aleutian Islands	
	> 4 mo. through adult	m/f	200	1	Tooth extraction	Gulf of Alaska, Aleutian Islands	
	adult	f	200	3	Transrectal and vaginal ultransonography	Gulf of Alaska, Aleutian Islands	

1: We are requesting authorization for accidental mortality for all age classes because it is possible, although highly unlikely, that a fur seal of any age or sex could die during the disturbance caused during capture.
2: Fur seals will be initially captured at approximately 4 months of age, but if they return to the natal islands in subsequent years, we will attempt to re-capture them at that time, and that is why we have included seals up to 4 years of age in the age class category.
3: We request authorization to recapture an individual up to 3 times within one year, but we cannot determine if a seal has been previously captured until it is in our hands and the flipper tag can be read. It is impossible to read the flipper tags while the seal is in the water, so seals may actually be captured more than 3 times in a season, but once they have been captured 3 times previously in a year, on the 4th or greater recapture it will be released immediately after its flipper tag is read. With a population of > 800,000 fur seals, it is highly unlikely that we would ever recapture the same seal more than once within a single year.