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**Project No:** ____
**Date Received:** ____

# GEM PROPOSAL SUMMARY PAGE

**(To be filled in by proposer)**

| | |
|---|---|
| Project Title: | Harbor seal monitoring in southern Kenai Peninsula fjords |
| Project Period: | FY 05-FY07 |
| Proposer(s): | Anne Hoover-Miller and Shannon Atkinson<br>**Alaska SeaLife Center**<br>**P.O. Box 1329**<br>**Seward, Alaska 99664-1329**<br>Email: anne_hoovermiller@alaskasealife.org<br>Email: shannon_atkinson@alaskasealife.org |
| Study Location: | Kenai Peninsula |

Abstract: This proposal supports an existing remote video monitoring system in Aialik Bay, a tidewater glacial fjord. This system is used to observe harbor seals in glacial ice habitats and the impacts of vessels on seals. Haulout activity, numbers of seals, vessel impacts on seals, ambient behaviors of undisturbed seals, glacial activity, ice conditions, weather, and other events affecting seals are recorded daily. Seed funding is requested to test prototype digital still cameras at land-based haulouts in Day harbor for documenting seals in a fjord lacking tidewater glaciers. Integrations of the remote monitoring into GEM; provides ecological measures of conditions at the heads of fjords that will complement long-term oceanographic monitoring in adjacent waters. This study is augmented by ancillary studies and support from the ASLC and National Park Service through a partnership in the Oceans Alaska Science and Learning Center, the University of Alaska, Fairbanks, Alaska National Maritime Wildlife Refuge System, and Port Graham Corporation.

| | | | |
|---|---|---|---|
| Funding: | EVOS Funding Requested: | FY 05 | $ 92.7 |
| | (must include 9%GA) | FY 06 | $ 130.3 |
| | | FY 07 | $ 82.3 |
| | | | TOTAL: 309.8 |
| | Non-EVOS Funds to be Used: | FY 05 | $ 165 (pending FY 05-FY07) |
| | | FY 06 | $ 165 |
| | | FY 07 | $ 165 TOTAL: 495 |

Date: April 15, 2004

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# GEM RESEARCH PLAN

## I. NEED FOR THE PROJECT

### A. Statement of Problem

Since the mid 1970s, harbor seal populations at many locations in Alaska have dramatically declined (Pitcher 1990, Hoover-Miller 1994, 2004, Frost *et al.* 1999a, Mathews and Pendelton, 2000, Small *et al.* 2003). In the Gulf of Alaska, the decline has often been attributed to factors associated with a major oceanographic regime shift that began in 1975 (Anderson and Piatt, 1999), but specific condition(s) that caused the decline and how they acted on the seals are not yet understood (Brix 2003).

Harbor seals are inshore apex predators that occupy diverse nearshore haulout substrates including mud and sand bars, beaches and rocks, and glacial and pan ice (Hoover-Miller 1994). Nearshore haulout and foraging habitats within Gulf of Alaska fjords are strongly influenced by both watershed runoff and the flow of the Alaska Coastal Current. How those sources mix within the fjords is determined by the shape of the fjords and subsurface features (Syvitski *et al.* 1986, Burrell 1986, Gay and Armato 1998, Gay 2002, Hooge and Hooge 2002).

Fjord ecotypes include fjords with and without tidewater glaciers. In Alaska, roughly 10,000 harbor seal rely on glacial ice haulouts (J. Bengston, NMFS, pers. comm.). Warming conditions, since the late 1800s have caused thinning and recession of most glaciers, and all but about 50 tidewater glaciers in Alaska have retreated on shore (Molnia 2001). As tidewater glacial habitats diminish, seals and other species including Kittlitz's murrelets and sea otters, must adapt to associated ecological changes or they may fail to survive.

Research in Glacier Bay has shown numbers of seals declining at an annual rate of 5-11% between 1992 and 1998 despite stable or increasing numbers elsewhere in southeast Alaska (Mathews and Pendelton 2000, Small *et al*. 2003). Numbers of seals in Aialik Bay also have diminished; the number of pups born annually in recent years is one tenth that were born in 1979-1980 (Hoover-Miller 2004). Diminishing numbers of seals also have been identified in Disenchantment Bay (ANHSC 2003). Ecological conditions that attract seals to glacial ice habitats are not known. How changes in those conditions affect seals need to be identified.

While glacial ice habitats have been diminishing, tourism has intensified. The effects of tourism on harbor seals in glacial ice environments have been of concern for many years (Tetreau 1998, ANHSC 2003, Brix 2003, Hoover-Miller *et al* 2003a). Distinguishing the effects of tourism and changing environmental conditions is a challenge. In stressed seal populations, reducing adverse effects of tourism on seals is a priority.

The continued retreat of tidewater glacier habitats will alter a unique environment, stimulating nearshore changes that affect the survival of organisms dependent on glacial ice environments. Although the process is natural and likely to continue, it is important to understand how such changes affect local conditions and how well seals adapt to associated changes. In addition, it is important to minimize further stressors by assessing, mitigating, and monitoring human-caused perturbations.

## B. Relevance to GEM Program Goals and Scientific Priorities

This proposal is for providing maintenance support to an existing remote video monitoring system, established in 2002, in Aialik Bay. These data are being contrasted with similar data collected during baseline studies conducted from 1979-1981 when numbers of seals were much higher. Through this cameras system, temporal changes in the numbers of seals using glacial ice haulouts are being monitored, the effects of vessel activity on seals are being tracked, and ambient behaviors of undisturbed seals are recorded. Concurrent information on glacial activity, ice conditions, weather, and events including upstream movements of anadromous fish that are known to affect harbor seal activity are being tracked. This system has proven to be a valuable and comprehensive monitoring tool. In addition to the maintenance support, seed funding is requested for testing prototype digital still cameras at land-based haulouts in Day Harbor to obtain complementary information on haulout activity of harbor seals in a nearby fjord lacking tidewater glaciers.

Integration of the remote monitoring program into the GEM program, will provide insight into conditions at the head of a tidewater glacial fjord as it changes over time. This study is being complemented with ancillary studies and support from the Alaska SeaLife Center and National Park Service (NPS) through a partnership in the Ocean Alaska Science and Learning Center (OASLC), the University of Alaska, Fairbanks (UAF), Alaska National Maritime Wildlife Refuge System (ANMWFS), Port Graham Corporation (PGC) and others. A goal of this proposal is to incorporate long-term nearshore monitoring sites of harbor seals in fjords with and without tidewater glaciers into the GEM program. The primary study location, Aialik Bay, includes baseline data on glaciers since 1909 (Grant and Higgins 1913, Post 1980, Wiles 1992) and on harbor seals dating back to 1963 (Bishop 1967). In addition, Aialik Bay abuts extensively investigated oceanographic stations extending from Resurrection Bay and near Chiswell Island (e.g., Royer 1996, Weingartner *et al.* 2001).

The Mission of the GEM program is to: Sustain a healthy and biologically diverse marine ecosystem in the northern Gulf of Alaska and the human use of the marine resources in that ecosystem through greater understanding of how its productivity is influenced by natural changes and human activities.


Figure 1. Upper Aialik Bay

Fjords are complex mixing areas for cross-habitat processes and transfers. Within fjords, watershed and nearshore habitats merge with the Alaska Coastal Current. Differentiation between habitat types is obscure and is strongly influenced by physical features specific to each fjord (Burrell 1986, Syvitski *et al.* 1986). The GEM Program calls for building upward from oceanography through food and energy toward

the large body of information that has accumulated within the management agencies over the past century on the abundance and biology of single species of large vertebrates such as seabirds, pelagic and anadromous fish, and marine and coastal mammals (EVOS Trustee Council 2003). In watershed and nearshore habitats where human activities are most prominent, the GEM program also has identified the importance of finding measures of how anthropogenic factors combine with environmental factors to influence these ecosystems. To identify the degree and longevity of perturbations caused by humans on organisms requires, at a minimum, linking population trends of the organisms with environmental conditions and processes to help isolate the additional impacts related to human activities (EVOS Trustee Council 2003).

Fjords provide a spatial transition from watersheds to the open oceans, with strong physical and chemical gradients as fresh and salt waters mix (Syvitski *et al.* 1986). The presence of tidewater glaciers intensifies those gradients with the direct input of cold meltwater from glaciers and the melting of ice calved from the glacier. Low density, sediment laden waters flow as surface plumes towards the mouth of fjords. The plume typically generates vertical gradients in temperature, salinity and turbidity, often with a stratified circulation near the head of the bay (Syvitski *et al.* 1986, Burrell 1986, Gay and Armato 1998, Gay 2002, Hooge and Hooge 2002). Low density, turbid waters can inhibit forage fish and lower trophic level diversity and abundance (Syvitski *et al.* 1986, Carpenter 1983, Piatt 2002); nevertheless, high trophic level predators, such as harbor seals, kittiwakes, gulls, and murrelets are attracted to the heads of tidewater glacier fjords in large numbers (Hoover 1983, Murphy *et al.* 1992, Duffy 1999, Day and Nigro 1999, Mathews and Pendleton 2000).

The Gulf of Alaska marine ecosystem has undergone massive changes in recent years. For example, the relative dominance of the commercially important fish species changed in the mid-1970s; crab and shrimp declined while salmon and groundfish populations increased (Albers and Anderson 1985, Blau 1997, Francis and Hare 1994, Hollowed *et al.* 1994, Thompson and Zenger 1994). These changes coincided with decadal-scale North Pacific adjustments in the atmosphere and ocean (Mantua *et al*., 1997; Trenberth and Hurrell, 1994). Subsequent ecosystem changes followed in the 1970s and 1980s with declines in marine mammal and seabird populations (Hatch and Sanger 1992, Merrick *et al*. 1987, Springer 1998, Pitcher 1990). In addition Parker *et al*. (1995) and Minobe, (1997) show that many North Pacific fish stocks vary on decadal and longer time scales in conjunction with sea temperatures (e.g., Royer, 1993) and other environmental variables. While such correlations suggest that the GOA ecosystem is sensitive to interannual and interdecadal climate variations, the mechanistic links between climate variability and ecosystem change are not clear.

Linking ecological parameters with mechanisms causing changes in harbor seal population levels has proven to be elusive due to the lack of a coordinated effort across disciplines (e.g., see Gotthardt 2001). Ecosystem dynamics are complex. Advanced understandings of physical and biological processes driving the abundance and distribution of plankton, forage fish, and apex predators have been developed for the Gulf of Alaska and are being used by the GEM as conceptual models.

Research conducted near long-term GLOBEC/LTOP monitoring sites has the greatest potential for achieving GEM's goal for refining models and long-term developing cross-disciplinary monitoring; and long-term monitoring sites near Seward are the core Gulf of Alaska monitoring. Documenting how harbor seals in key nearshore habitats near Seward respond to specific physical and biological processes will aid in developing linkages between oceanographic

parameters and population dynamics of harbor seals. Such linkages are important as harbor seals remain an EVOS-related injured species and may be able to serve as an indicator of environmental conditions throughout coastal Alaska.

Seward has had a long history for monitoring oceanographic events. The long-range objective of this effort is to establish a comprehensive, ecosystem-based, approach for investigating and monitoring the population dynamics, reproductive rates, and health and condition of harbor seals that links with oceanographic and watershed parameters.

Three major research efforts have provided insight into the ecology and population dynamics of harbor seals in the Gulf of Alaska. Intensive research of harbor seals in Alaska was first conducted by the ADFG from 1975-1979 as part of the Outer Continental Shelf Environmental Assessment Program (Pitcher and Calkins, 1979). Subsequent research by the ADFG primarily focused on population trend monitoring at four locations. It was during this time that a major population decline was detected at Tugidak Island (Pitcher, 1990). In 1993, the ADFG, funded by U.S. Congressional appropriations, led investigations of potential causes of the decline (Lewis 1996; Small *et al*. 1997, 1999; Small 1998, 2001). They contrasted movements, foraging habits, population dynamics, genetics, and health and condition indices between seals in southeast Alaska, where the population is stable and increasing with those near Kodiak Island where seals declined from 1976-1994, but then began to recover at a rate of 4.9% annually (Jemison and Pendleton 2001). In 1989, K. Frost and others began investigating population trends, movements, and foraging ecology of seals in Prince William Sound to assess the impact and recovery of harbor seals to the EVOS (Frost and Lowry 1993, 1994; Frost *et al*. 1994, 1995, 1996, 1997, 1998 and 1999a, b). Small *et al.* (2003) have documented continuing declines in numbers of seals in central and eastern PWS. Recent mitochondrial DNA analysis by the NMFS, Southwest Fisheries Science Center shows spatial differentiation between groups of harbor seals of a finer scale than was previously considered (O'Corry-Crowe *et al*. 2003). Figure 2 shows genetic strata indicated by mDNA genetic analysis for the central Gulf of Alaska. These data indicate that seals on the Kenai Peninsula have experienced significant long-term effects from limited genetic exchange with seals from Prince William Sound and the Kodiak Archipelago. With differing environmental conditions affecting each area, it is important to understand regional population trends and ecological events affecting seals at a finer scale than previously assumed.

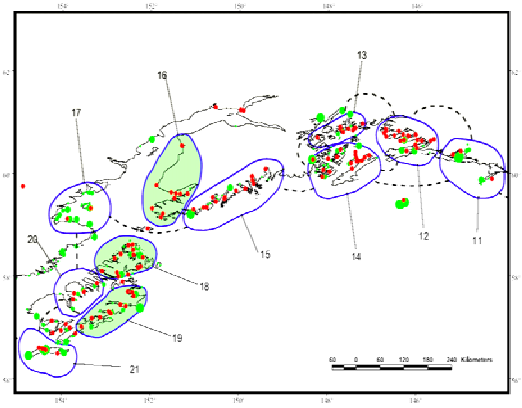


Figure 2. Genetic strata of harbor seals in the central Gulf of Alaska on connectivity matrix generated by Boundary Rank from analysis of mitochondrial DNA from O'Corry-Crowe *et al.* (2003).

Within the last two decades, tourism has greatly expanded in southcentral Alaska. Aialik Bay, located about 80 km by water from Seward, is visited on a daily basis by numerous commercial and private vessels. Vessel traffic to Aialik Bay increased dramatically since the Kenai Fjords National Park was established in 1980. From May-September, multiple tour-boats, kayaks, and other vessels visit glacial harbor seal haulout areas in upper Aialik Bay on a daily basis. Displacement of seals from resting or pupping sites increases the energetic requirements of seals,

especially young pups; furthermore, during pupping and molting many seals are nutritionally stressed and need to minimize unnecessary energetic loss. Disturbances occurring while females are giving birth and shortly thereafter have the potential for causing permanent mother-pup separations resulting in the death of newborn pups (Bishop 1967). Frequent disturbance can alter the location and time that seals haul out; in some locations, however, seals have habituated to common sources of disturbance (Hoover 1994). Observations taken in Aialik Bay and Northwestern Fjord in 1998 showed steady, ongoing interactions where seals were disturbed from the ice multiple times a day (NPS, unpublished) recent studies indicate that vessels can be operated near the ice with little impact on the seals, but that they do not always do so (Hoover-Miller 2004). In the last few years kayak traffic also has been growing. This is of particular concern near Pedersen Glacier, where kayakers have been observed displacing seals from the ice in a remote, secluded area.

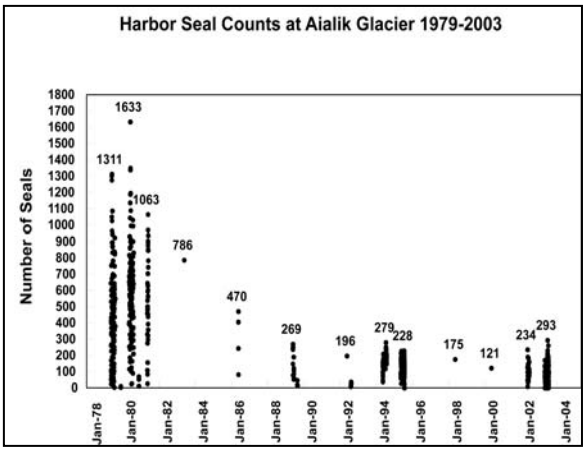

Figure 3. Daily maximum counts (dots) of harbor seals near Aialik Glacier from 1979-2003.

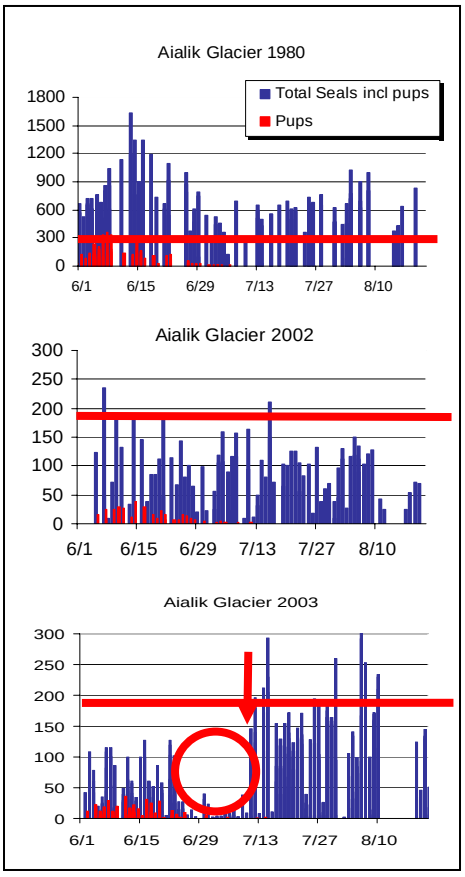

Figure 3. Comparison of seasonal attendance of harbor seals near Aialik Glacier in 1980, 2002, and 2003. Blue bars are all seals, and red bars indicate numbers of pups. Horizontal reference lines indicate maximum levels of seals counted in 2002.

Aialik Bay has had an extended research history. Studies of harbor seals have been conducted in upper Aialik Bay by Bishop (1967). From 1979-1981, the National Park Service funded baseline studies of harbor seal numbers, natural history, habitat, and response to small vessel disturbance prior to the anticipated increase in tourism associated with the creation of the Kenai Fjords National Park (Murphy and Hoover 1981, Hoover 1983). Since that time, changing ice conditions and frequent vessel traffic may have made seals increasingly susceptible to adverse effects from disturbance. Subsequent counts have been made from 1982 and 2001 by the National Park Service (NPS) personnel and A. Hoover-Miller (Hoover 1989, Tetreau 1998; NPS unpublished; Hoover-Miller unpublished). VHF Telemetry was used to identify proportion of seals hauled out on ice during molting surveys (Withrow and Cesarone (1999). In 2002 the ASLC and the Ocean Alaska Science and Learning Center established remotely controlled video monitoring to continue population monitoring in upper Aialik Bay. Since the early 1980s the numbers of seals counted has decreased from as many as 1,600 seals in 1980 to current counts of less than 300 seals.

Recent data collected in Aialik Bay, illustrate marked fluctuations in numbers of seals on the ice associated with environmental conditions (Figure 4; Hoover-Miller 2003b, 2004), that appears to be partially associated with local prey availability. During 1980, seals showed bimodal haulout attendance with peaks during pupping (June) and molting (July-September), a pattern typically seen at most harbor seal haulouts (e.g., Jemison and Pendleton 2001).

The horizontal reference line identifies the level of highest counts in 2002 and indicates current population levels. During 2002, counts were not bimodal but tended to be highest early in pupping and decreased over time through the molt. In 2003, counts were relatively low during pupping and high during the molt. Unexpectedly low numbers of seals (circle), followed by exceptionally high attendance corresponded to the arrival of osmerid anadromous forage fish to streams at the head of Aialik Bay (arrow). High counts in July and August likely indicate increased time spent hauled out and immigration of some seals from other areas.

Besides harbor seal research, Aialik Bay has been subject of a variety of oceanographic and ecological research studies (e.g., Grant and Higgins 1913, Feder *et al.* 1979, Post 1980, Murphy and Hoover 1981, Carpenter 1983, Murphy *et al.* 1984, 1992; Crowell *et al.* 1996, 1998, Gay and Armato 1998, NPS, unpublished, ADF&G unpublished, ASLC unpublished) that render a historical database from which temporal comparisons can be made. In addition it is adjacent to waters that have received extensive oceanographic monitoring dating back to 1970 (Royer 1996) and abuts a focal region for global-scale, long-term oceanographic monitoring conducted by the University of Alaska, GEM, and Gulf of Alaska Global Ocean Ecosystem Dynamics (GLOBEC) and the Long-Term Observation Program (LTOP). In addition, forage fish, oceanographic, and ecosystem monitoring of the Chiswell Island Steller sea lion rookery is being conducted by the ASLC. By integrating this study into the GEM program, results from the study will contribute to a more comprehensive understanding of nearshore and fjord ecosystems within a focal research area used for global-scale environmental monitoring.

## II. PROJECT DESIGN

### A. Objectives

1. Continued use of remote video cameras in Aialik Bay to contribute to studies on long term population trends of harbor seals, and the influence of environmental conditions on seal attendance. Hypotheses associated with long term monitoring include:

   a) Specific hypothesis relative to current population trends address whether

      $H_o$: number of seals without pups are the same between years

      $H_o$: number of female/pup pairs are the same between years

      $H_o$: number of seals during peak haulout during the molt ($1^{st}$ week of August) are the same between years

      $H_o$: number of seals during the optimal trend monitoring period used by ADF&G (approximately 17 August) are the same between years

   b) Evaluation of haulout activity relative to environmental conditions

      Ho: haulout activity relative to covariates date, time of day, time, and weather conditions in current years are the same as during baseline studies.

$H_o$: haulout activity relative to covariates date, time of day, time, and weather conditions in recent years are the same between years.

c) Evaluation of vessel traffic and tourism on harbor seals.

$H_o$: the response of seals to vessels is the same between years

$H_o$: vessel behavior is the same between years

$H_o$: haulout covariates, including day of year, time of day, tide and weather, have the same influence during periods of high and low vessel activity

2) Test five prototype still digital cameras, developed by the NMFS National Marine Mammal Lab, in Day Harbor to evaluate if still camera imagery provides suitable imagery for more economical, less labor intensive monitoring of haulouts in Day Harbor (a nearby fjord lacking tidewater glaciers).

## B. Procedural and Scientific Methods

### Methods

**Objective 1: Aialik Bay Video Monitoring System**

The remote video operating system in Upper Aialik Bay consists of two camera sites at Aialik Glacier and one camera site at Pedersen Glacier. Three repeater sites (located above Pedersen Lagoon, Chiswell Island, and Caines Head) are used to transmit signals between Aialik Bay and the Alaska SeaLife Center. The primary camera site is located on the highest point (125 feet above sea level) on Squab Island and is approximately 2 km from the face of the glacier. A secondary camera site is located on a rocky bluff on the north edge of Aialik Glacier, at an elevation of 700 ft. The camera site at Pedersen Glacier is located on the south edge of Pedersen Lake, approximately 1 km from Pedersen Glacier's face. In 2002 video records constituted about 75 days (1789 h); in 2003 video records constituted about 91 days (2192h). In 2002-2003 cameras were actively operated 350-400 h; when not actively operated, they are generally parked in a manner that when light and weather conditions permit, incidental observations can be made.

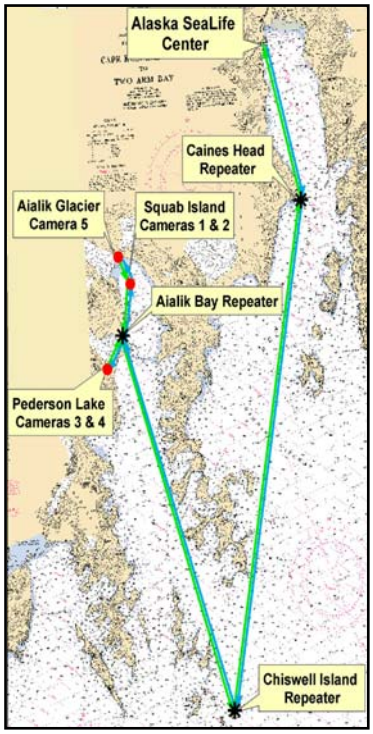


Figure 5. Location of video cameras in upper Aialik Bay, repeaters used for transmitting commands and video images, and pathway taken by transmitted signals.

The cameras developed, installed, and maintained by SeeMore Wildlife Inc. include a 300x (25x optical) lens, and have pan, tilt, zoom, and windshield wiper cleaning capabilities. A microprocessor on the camera circuit board controls all operation. The camera motors, processor and electronics are housed in waterproof, temporarily submersible housing. Cameras can be programmed to 40 preset positions. The cameras are connected to the main processor board for processing video

and audio by a cable. The processor board also provides and monitors power to cameras and transmission equipment.

Video signals from the camera sites are received and retransmitted via microwave signals at each repeater and receiving sites via a microwave receiver. At the receiver site at the ASLC the Microwave Receiver demodulates the microwave transmission sent from the Caines Head Repeater site. The receiver outputs a standard video and audio signal, which is displayed on a television monitor. The Video Splitter splits the video signals from the microwave receiver and sends signals to a television monitor, a Time-lapse VCR, and computers at two camera operation centers located within the ASLC.

**Population Monitoring**

Population trends of harbor seals in Alaska are monitored using multiple daily surveys conducted from up to three video camera sites: Squab Island (2002-2003), North Aialik Glacier (2003), and Pedersen Glacial Lake (2002-2003). In 2002, primary daily counts were taken during mid-day (1100-1500). In 2003 methods were modified to include, daily counts during morning (0800-1100), mid-day (1100-1500), and afternoon (1500-1800). Additional counts were taken as time permitted. To evaluate the effects of varying environmental conditions on numbers of seals hauled out, concurrent information on time, date, weather conditions, tide height and velocity (based on upper Resurrection Bay) and sea state (modified Beaufort scale) were recorded. Ice conditions were documented using standardized scans of the upper bay from Squab Island.

**Vessel Interactions**

The frequency of vessel traffic, approach characteristics, and the responses of seals were recorded using remote video cameras. Interactions were evaluated from sequential video images stamped with time and date. The ambient behaviors of undisturbed seals were sampled as viewing opportunities allow. These data were being contrasted to evaluate abnormal elevations of specific behaviors associated with vessel proximity. The video images also allow detailed review of interactions to help develop effective navigation recommendations to minimize adverse human impacts.

Vessel sightings and interactions were recorded on Interaction Data Sheets. Observers noted date, camera, location, begin and end time, vessel class, vessel name, whether seals were observed before a vessel was detected, and whether seals were observed entering water while the vessel was present. As viewing opportunities allowed, interactions were described and vessel approach, movement, and heading in relation to focal pods of seals and movement and/or recovery of focal pod were recorded. Counts, if applicable, were conducted approximately every 5 minutes on the focal pod and/or entire glacial face area. For an interaction/sighting that occurred at Aialik Glacier, both the Squab Is. and Glacier Cliffs cameras were used to contrast perspectives of each camera for subsequent geospatial analysis and feasibility of distance estimations. All data recorded on the sheets were subsequently entered into an Interaction Database. In addition, counts were recorded in a Seal Count Spreadsheet and vessel activity entered into an Activity database.

Table 1 summarizes vessel interaction and activity levels and video observation effort in Aialik Bay during 2002 and 2003. "Vessel Interactions" are defined as periods where vessels and seals are in the same vicinity and their respective behaviors can be monitored; it does not imply that the vessels displaced seals or otherwise affected their behavior in a discernable manner. "Vessel Present" includes all time vessels were sighted or tracked and accounts for vessel interactions and sightings, kayak interactions and sightings, and time spent following vessel activities. Differences in both recorded and/or observed hours and frequency are a result of revisions of protocols and expanded observer duties from 2002 to 2003.

| | **Vessel Interaction (hours)** | **Vessel Present (hours)** |
|---|---|---|
| **2002** | 53.06 (f=114) | 60.90 (f=365) |
| **2003** | 26.73 (f=89) | 88.72 (f=162) |

## Objective 2: Day Harbor

Prototype fixed still cameras will be used to determine the feasibility initiating long-term monitoring of harbor seals using land haulouts in Day Harbor (Figure 6). Remote controlled video cameras are used in Aialik Bay due ice movements and the need to constantly adjust the camera's position to track seals. Such technology is more labor intensive than remote monitoring system that involve fixed cameras. In Day Harbor video monitoring is not required as approximately 100 seals use land based haulouts at known, fixed, locations. For such haulouts, fixed cameras are able to capture count data without the need for labor-intensive real-time camera operations. Prototype cameras using Nikon CoolPix 5700 cameras in weather proof housing operated by a time-lapse controller board will be identical to cameras developed by the NMFS NMML (Brix 2003, Boveng, NMFS, pers. comm.). Five cameras will be installed for viewing regularly used haulout rocks within the western Pupping and Molting Haulout area in Day Harbor. The cameras will be placed to test near and distance viewing capabilities.

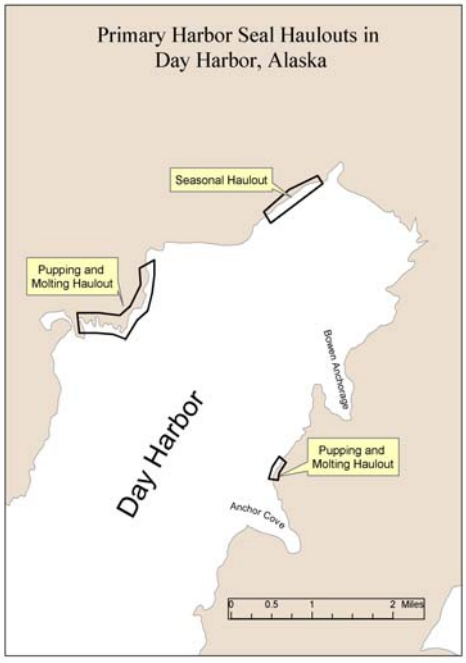


Figure 6. Primary harbor seal haulout areas in Day Harbor.

Images will be taken every 15 minutes. Images from prototype cameras will be used to assess: (1) reliability of operation, (2) image degradation resulting from weather, temperature, lighting, and other field conditions, (3) ability of cameras to capture images suitable to count seals, (4) the ability of cameras to capture images suitable to recognize individual seals, (5) assess image processing time, (6) quality of results. Results will be compared with bi-monthly aerial surveys to evaluate how well the technology reflects regional haulout site attendance and to determine the sampling frequency needed to monitor seal haulout activity.

## C. Data Analysis and Statistical Methods

Covariates of haulout are being contrasted between baseline studies (1979-1981) and recent investigations (2002-2003). Covariate categories included time from solar noon, tidal height, tidal velocity, and weather (sun, overcast, rain, wind>20 kts). Analysis of seals with pups and seals without pups are conducted separately. In previous studies in Aialik Bay and elsewhere (Hoover 1983), strong seasonal differences in attendance have been documented with greater numbers of seals hauling out during pupping and molting periods. For population studies using relatively short survey windows, seasonal effects often are modeled as a linear or quadratic function (e.g., Small et al 2003, Adkison et al. 2003, Jemison and Pendleton 2001). In long-term longitudinal studies, seasonal functions add additional complexity that requires assumptions about interannual variation for modeling (e.g. Jemison and Pendleton 2001). Because interannual variations are substantial in Aialik Bay and are valuable for assessing environmental change (Figure 4), modeling is not based on assumed seasonal attendance patterns. To model seasonal attendance without making assumptions as to the shape of seasonal attendance patterns, highest counts observed periodically throughout the year are identified. Those counts are assumed to represent the number of seals hauling out under optimal conditions. Because counts taken during optimal conditions do not occur on a regular or predictable basis, a smoothing-spline, created using JMP 5.01 statistical software, is applied to those points and the lambda value is adjusted to provide a smooth, continuous representation of seasonal changes in maximum counts. Daily predicted maximum numbers of seals are determined based on the smoothed curve. Daily predicted maximum numbers are used as an approximation for the number of seals expected to haulout under optimal conditions on a particular date. To evaluate effects of potential covariates, other than date, counts are normalized as a proportion of the daily expected numbers of seals calculated for that day. ANOVA is used to contrast each potential covariate with the proportion of seals hauled out to evaluate how numbers of seals changed relative to the covariate. To evaluate the combined effects of covariates, multivariate, least squares effect tests are used to model the effects of time (relative to solar noon), weather, and tide height on (1) the proportion of seals without pups and (2) the proportion of seals with pups relative to expected numbers under optimal conditions.

The frequency of vessel traffic, approach characteristics, and the responses of seals are recorded in a database. Vessel sightings and interactions also are recorded on Interaction Data Sheets. Observers record date, camera, location, begin and end time, vessel class, vessel name, whether seals were observed before a vessel was detected, and whether seals were observed entering water while the vessel was present. As viewing opportunities allowed, interactions are described and vessel approach, movement, and heading in relation to focal pods of seals and movement and/or recovery of focal pod were recorded. Counts, if applicable, are conducted approximately every 5 minutes on the focal pod and/or entire glacial face area.

Video images are captured using remote video cameras. For interactions with suitable images, interactions are evaluated from sequential video images stamped with time and date. In addition, ambient behaviors of undisturbed seals are sampled as viewing opportunities allow. These data are being contrasted to evaluate abnormal elevations of specific behaviors associated with vessel proximity. The images also will allow detailed review of interactions by researchers and vessel operators to help develop effective navigation recommendations using community involvement, to aid in minimizing adverse human impacts.

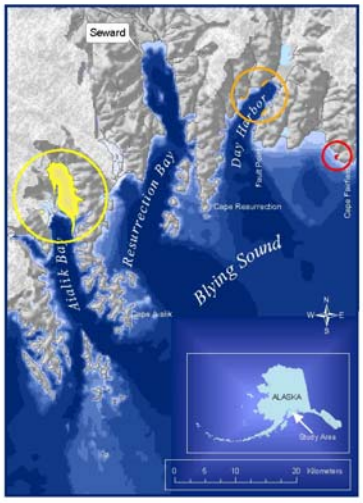


Figure 7. Location of Aialik Bay and Day Harbor. Circles identify areas harbor seal haulout.

Due to the oblique angle of the Squab Island database, distances between vessels and seals cannot be accurately measured unless seals are in line, directly perpendicular to the camera. Beginning in 2003, the Aialik Glacier camera is being used to aid the development of distance estimates. For an interaction/sighting that occurred at Aialik Glacier, both the Squab Is. and Glacier Cliffs cameras are used to contrast perspectives of each camera for subsequent geospatial analysis. All data recorded on the sheets are subsequently entered into an Interaction Database. In addition, counts are recorded in a Seal Count Spreadsheet and vessel activity entered into an Activity database.

## D. Description of Study Area

Aialik Bay Study Area

The project will be undertaken in Aialik Bay and Day Harbor (Figure 7); boundaries are: 60.08, -149.03, 59.87, -149.77.

Aialik Bay, a 20-km-long fjord, has a single, shallow (13 m deep) sill separating a 9-km-long upper basin from the lower fjord. It opens directly to the Gulf of Alaska. Located 25 km southwest of the ASLC, Aialik Bay hosts three glacial ice haulout areas (Aialik Glacier, Pederson Glacier, and Holgate Arm). The two major haulout areas used by harbor seals are under observation using remote video cameras.

Day Harbor, is a 10-km-long fjord, located 21 km southeast of ASLC. Ellsworth glacier, located about 3 km from the head of the harbor, is abutted by a glacial lake that drains into the head of the bay via a turbid stream.

## E. Coordination and Collaboration with Other Efforts

The study in Aialik Bay has developed through a strong collaboration between the Alaska SeaLife Center and National Park Service, through the Ocean Alaska Science and Learning Center, the Port Graham Corporation, the US Fish and Wildlife Service. In addition this research is interfacing with research being conducted near the Chiswell Islands by the Alaska SeaLife Center Steller Sea Lion Program. Since 2001, the OASLC has supported the development and maintenance of the system. In 2003 Cooperative Conservation Initiative Funds provided to OASLC have initiated research to aid in restoration of tidewater glacial fjord habitat and reversal of impacts to selected apex marine species. Additional funding has been requested through the Cooperative Conservation Initiative to support ecosystem research that will include oceanographic monitoring within Aialik Bay, and bi-monthly aerial surveys of the outer Kenai Peninsula from McCarty Fjord through Johnstone Bay.

The presence of humans in the Kenai Fjords National Park and adjacent areas has grown markedly during the past 23 years. Once a location visited by a few commercial fishermen and the occasional recreational boater, upper Aialik Bay has now become a primary destination for Park visitors. Currently more than 75,000 people travel by vessels ranging in size from 100 ft tour-vessels though small kayaks to glacial haulouts in Aialik Bay and neighboring Northwestern Fjord. The impact of park visitors on wildlife has the potential for causing extensive disruption of already ecologically stressed species, particularly marine birds and mammals that directly interact with vessels.

Constant enforcement of regulations can be effective but is costly and can create animosity between regulators and user groups. Proactive measures taken by the tour industry has markedly reduced the impact of vessel traffic. Studies of harbor seals using remotely-controlled video cameras has further reduced impact. The combination of industry initiated mitigation reinforced with monitoring has proven to be a powerful tool for reducing impact.

Although, a “big brother” effect created by the video camera monitoring has probably resulted in more careful vessel operations, video records are providing greater opportunities for refining recommendations by identifying specific vessel activities that seal’s are sensitive to and provide a good communication tool. In addition the video records are facilitating the assessment of ambient levels of activity normally exhibited by seals not affected by vessels. These evaluations are an ongoing research priority.

In spring 2004, the ASLC is sponsoring a workshop with commercial vessel operators and kayak outfitters to report on research findings and identify steps that can be taken to further reduce the impact of vessels on wildlife in the fjords. Kayakers and independent travelers, however, do not necessarily have the knowledge, organization, and/or initiative to take the proactive steps adopted by the tour industry. Workshop participants will address means of informing such groups.

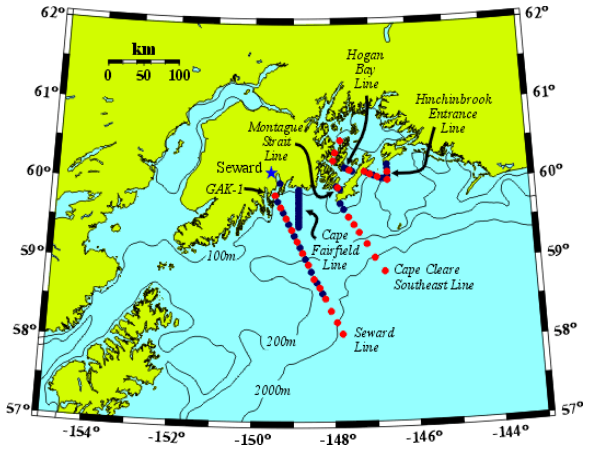


Figure 7. Gulf of Alaska GLOBEC oceanographic sampling sites.

The University of Alaska has been monitoring physical hydrographic conditions of Alaska Coastal Current (ACC) waters near Resurrection Bay since 1970. GEM supported research is continuing and expanding the capabilities of the GAK1 buoy. The Gulf of Alaska GLOBEC program, provides extensive physical, chemical and biological oceanographic data from ship based transects and mooring buoys of shelf waters off Resurrection Bay, Cape Fairfield, and in Prince William Sound. Data collection began in October 1997 and will continue through 2004. These are pertinent to our research in that the Cape Fairfield line samples waters entering Day Harbor and the Resurrection Bay line samples waters entering Aialik Bay. The GAK1 buoy provide continuous data on waters adjacent to the two fjords. Data obtained by these programs include temporal data on physical parameters, nutrient concentration, primary production, zooplankton species composition, abundance, and biomass, and the abundance of juvenile salmon. A recent NSF mesoscale study conducted by the Institute of Marine Science has been providing finer resolution to physical, chemical, and biological processes in shelf waters between Prince William

Sound and Gore Point. Linking findings from research in upper Aialik Bay with results from ancillary studies of the Alaska Coastal Current would be a valuable contribution to GEM's goals and objectives.

Table 2. Partial list of oceanographic research being conducted in the vicinity of Aialik Bay and Day Harbor.

| Ancillary studies | Year | Research partner | Location Relative to Study Site | |
|---|---|---|---|---|
| Bi-monthly Aerial Surveys | 2004+ | OASLC/CCI | Upper/Lower Aialik | McCarty Fjord to Johnstone Bay |
| Glacier Monitoring | 2004 | OASLC/USGS | Upper Aialik | Comparison with Grant and Higgins (1913) |
| Meteorologic measurements | 2004+ | ASLC | Upper Aialik | Squab Island |
| Chiswell Island Forage Fish Surveys | 2003, 2004 | ASLC/UAF | ACC/GOA, Lower Aialik | Upper Aialik in 2004 funding pending |
| Chiswell Island Steller Sea Lion Studies | 2001+ | ASLC | GOA, Lower Aialik | Ongoing long-term monitoring |
| Oceanographic sampling | 2004/2005 | OASLC/CCI | Upper/Lower Aialik | Aialik Bay, 2004 funding pending |
| GAK 1 Buoy | 1970+ | UAF/EVOS | ACC near Aialik | EVOS 030340 |
| Chiswell Ridge Buoy | 2003+ | UAF/ASLC | ACC near Aialik | |
| GLOBEC Resurrection Bay and Fairfield Lines | 1997-2004 | UAF/GLOBEC | ACC into Aialik | |
| Transient Killer Whale studies | 2002+ | ASLC/NGOS | Lower/Upper Aialik | |
| Mesoscale Study | 2003 | UAF/NSF | ACC near Aialik Bay & Day Hbr | |

## III. SCHEDULE

### A. Project Milestones

Objective 1. Continue use of remote video cameras in Aialik Bay to contribute to studies on long term population trends of harbor seals, and the influence of environmental conditions on seal attendance.

| | |
|---|---|
| March 2005 | Renew Maintenance Contract with SeeMore Wildlife. |
| April 30, 2005 | Reinstall cameras and begin restoring system |
| May 15, 2005 | System fully functional, begin recording data |
| October 15, 2005 | Winterize system for dormancy; begin data analysis |
| | |
| March 2006 | Renew Maintenance Contract with SeeMore Wildlife. |
| April 30, 2006 | Reinstall cameras and begin restoring system |

| | |
|---|---|
| May 15, 2006 | System fully functional, begin recording data |
| October 15, 2006 | Winterize system for dormancy; begin data analysis |
| January 2007 | Participate in Marine Science in Alaska Symposium |
| March 2007 | Renew Maintenance Contract with SeeMore Wildlife. |
| April 30, 2007 | Reinstall cameras and begin restoring system |
| May 15, 2007 | System fully functional, begin recording data |
| October 15, 2007 | Winterize system for dormancy; begin data analysis |
| January 2008 | Participate in Marine Science in Alaska Symposium |

Objective 2. Test five prototype still digital cameras, developed by the NMFS National Marine Mammal Lab, in Day Harbor to evaluate if still camera imagery provides suitable imagery for conducting parallel studies in Day Harbor (a nearby fjord lacking tidewater glaciers)

| | |
|---|---|
| October 2004 | Order parts and assemble cameras. |
| | Test system in town to identify operating constraints and ensure winter operations. |
| March 2005 | Install cameras at haulout sites in Day Harbor |
| May 2005 | Initiate monthly downloads of images |
| July 2005 | Preliminary review of images, |
| | Identify deficiencies in images and coverage capabilities. |
| September 2005 | Analyze images from pupping and molting, contrast with aerial surveys |
| | If images and sampling capability suitable for remote monitoring, |
| | Finalize design for system necessary to completely cover major Day Harbor haulouts; |
| | Begin seeking funding for complete system |

**B. Measurable Project Tasks**

FY 05, 1st quarter (October 1, 2004-December 31, 2004)

October: Project funding approved by Trustee Council

October 31 Order parts and assemble cameras for Day Harbor.

November 30 Test still camera system in Seward to identify operating constraints and ensure winter operations.

FY 05, 2nd quarter (January 1, 2005-March 31, 2005)

January 12-16 (tentative): Annual GEM Workshop

March 31 Renew Maintenance Contract with SeeMore Wildlife.

FY 05, 3rd quarter (April 1, 2005-June 30, 2005)

April 15 Install prototype still cameras at haulout sites in Day Harbor

April 30 Begin preparing video cameras system for summer operation

May 15 System fully functional, begin recording data

FY 05, 4th quarter (July 1, 2005-September 30, 2005)

Sept 1 Annual Report

FY 06, 1st quarter (October 1, 2004-December 31, 2004)

October 15 Winterize system for dormancy; begin data analysis

November 30 Test still camera system in Seward to identify operating constraints and ensure winter operations.

December 31 Submit manuscript for publication

FY 06, 2nd quarter (January 1, 2005-March 31, 2005)

January 12-16 (tentative): Annual GEM Workshop

March 2005 Renew Maintenance Contract with SeeMore Wildlife.

March 31 Submit manuscript for publication

FY 06, 3rd quarter (April 1, 2005-June 30, 2005)

April 30 Begin preparing video cameras system for summer operation

May 15 System fully functional, begin recording data

FY 06, 4th quarter (July 1, 2005-September 30, 2005)

Sept 1 Annual Report

FY 07, 1st quarter (October 1, 2004-December 31, 2004)

October 15 Winterize system for dormancy; begin data analysis

FY 07, 2nd quarter (January 1, 2005-March 31, 2005)

(dates not yet known) Annual GEM Workshop

March 31 Renew Maintenance Contract with SeeMore Wildlife.

FY 07, 3rd quarter (April 1, 2005-June 30, 2005)

April 30 Reinstall cameras and begin restoring system

May 15 System fully functional, begin recording data

FY 07, 4th quarter (July 1, 2005-September 30, 2005)

Sept 1 Annual Report

Sept 30 Winterize system for dormancy

FY 08, 3rd quarter (April 1, 2005-June 30, 2005)

April 15 Submit final report. This will consist of a draft manuscript for publication to the Trustee Council Office

## IV. RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

### A. Community Involvement and Traditional Ecological Knowledge (TEK)

The Alaska SeaLife Center is focused on developing strong relationships with local communities. Through a Memorandum of Understanding with the Port Graham Corporation, Pat Norman and Walter Meganack Jr. have facilitated our research in Aialik Bay by enabling us to place the Aialik Bay repeater site on Port Graham Corporation land. The ASLC harbor seal program works closely with Monica Riedel, Executive Director of the Alaska Native Harbor Seal Commission. Our research routinely incorporates TEK we have obtained through attendance at Annual meetings of the Alaska Native Harbor Seal Commission, information in the Whiskers database developed from interview with hunters and key community members. In April 2004 the Alaska SeaLife Center is hosting the ANHSC annual meeting and conducting a BioSampling training that includes hunters from Bristol Bay and Anchorage and students from Port Graham. In May 2004, the ASLC, in conjunction with the OASLC, also are hosting a workshop with local vessel operators to integrate their knowledge of the response of wildlife to vessel activities with our findings and to jointly develop recommendations for further minimizing the impact of vessel activity on harbor seals.

The Alaska SeaLife Center has used local vendors to the greatest extent possible for studies on the Kenai Peninsula. The ASLC video monitoring studies have helped SeeMore Wildlife Inc., a local business in Homer, Alaska, develop a technology that they are currently using throughout the world and are a component of this study. Vessel support needed in addition to that available at the ASLC or NPS also will be provided by local vendors. Aerial surveys, being conducted in parallel with this study are being provided by Scenic Mountain Air, a local vendor.

Analysis of video recordings of vessel interactions and ambient behavior of harbor seals has provided research opportunities for Seward High School students participating in the ASLC World of Work program.

### B. Resource Management Applications

The video monitoring project has strong resource management applications that are directly applicable to resource concerns of the National Park Service and the Port Graham Corporation. Increased tourism has magnified the potential for conflicts between human activities and stressed populations of harbor seals. Observations using video cameras enhance our ability to identify vessel behaviors that appear well tolerated by seals and those that seals appear most sensitive to. Video images also help demonstrate how vessels affect seals. Ongoing research has documented reduced impacts by larger vessels but also identified a growing problem with kayak traffic (Hoover-Miller et al. 2004). The impact and mitigation of those impacts will be a priority task of this project.

## V. PUBLICATIONS AND REPORTS

Two publications are planned to be submitted in FY06:

(1) Ecology of Glacial Ice Inhabiting Harbor Seals in Aialik Bay in *Marine Mammal Science*, December 2006

(2) Effects of vessels on harbor seals in a tidewater glacial fjord. Publication TBD, March 2007

## VI. PROFESSIONAL CONFERENCES

Funds are being requested to attend:

16th Biennial Conference on the Biology of Marine Mammals, November 2005, San Diego to present a paper.

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## Abbreviated Curriculum Vitae

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**Professional Experience**:

**Harbor Seal Program Manager**. Alaska SeaLife Center (2002 to present). Manage harbor seal program at the Alaska SeaLife Center, facilitate integration of new projects, manage budgets, logistics, and program facilities, supervise personnel, and coordinate with outside investigators and ASLC departments regarding program activities.

**Co-owner**. Pacific Rim Research (1983 to present). Marine mammal research with emphasis on population dynamics and ecology. Selected projects include monitoring population dynamics of seals at select locations on the Kenai Peninsula; a review of harbor seal population trends and the impact of the *Exxon Valdez* oil spill on harbor seals in Prince William Sound; several contracts with the Marine Mammal Commission to evaluate the possible use of a Geographic Information System for conserving marine mammals in Alaska and developing species accounts with management recommendations for Steller sea lions and harbor seals in Alaska; and consultation with the Alaska Native Harbor Seal Commission regarding harbor seal research and the collaboration of traditional knowledge with scientific research.

**Technical Specialist**. National Park Service, Kenai Fjords National Park (1989-1990). Designed and coordinated biological studies, including monitoring the impact of T/V Exxon Valdez on harbor seals, Glaucous-winged gulls, bald eagles, and intertidal organisms in the Kenai Fjords National Park.

**Research Assistant**. Institutes of Marine Science and Arctic Biology, University of Alaska, Fairbanks. (1978-1983). Conduct population and ecological studies on harbor seals and Glaucous-winged gulls in Aialik Bay to assess the impact of humans on wildlife in the Kenai Fjords National Park. Contributed to field, literature, and lab research on ecology, behavior, population dynamics, disturbance of marine mammals and birds in the Gulf of Alaska, Bering and Chukchi seas, and the morbidity and mortality of marine mammals.

**Selected Reports and Publications**:

Fay, F. H., B. P. Kelly, P. H. Gehnrich, J. L. Sease, and A. A. Hoover. 1984. Modern populations, migrations, demography, trophics, and historical status of the Pacific walrus. Final Report. Research Unit 611. NOAA Outer Continental Shelf Environmental Assessment Program. Anchorage. Alaska. 142 pp.

Hoover, A. A. 1983. Behavior and ecology of harbor seals (*Phoca vitulina richardsi*) inhabiting glacial ice in Aialik Bay, Alaska. M.Sc. Thesis. University of Alaska, Fairbanks. 133 pp.

Hoover, A. A. 1988. Harbor seals (*Phoca vitulina*). In: Selected marine mammals of Alaska: species accounts with management recommendations, 1991 update. Jack Lentfer (ed.). Marine Mammal Commission. Washington D.C.

Hoover-Miller, A.A. 1989. Impact assessment of the T/V *Exxon Valdez* oil spill on harbor seals in the Kenai Fjords National Park 1989 Unpublished Report, Kenai Fjords National Park, Seward, Alaska. 21 pp.

Hoover-Miller, A.A. 1992. Assessment of the possible use of a cooperative/coordinated geographic information system (GIS) to facilitate access to, and integration and analysis of, data bearing upon the conservation of marine mammals in Alaska. Final report for MMC contract T75136297. NTIS PB93-128429.

Hoover-Miller, A. A. 1994. Harbor seals (*Phoca vitulina*): Biology and Management in Alaska. Report to the Marine Mammal Commission. Contract Number T75134749. Washington, D.C. 45 pp.

Hoover-Miller, A. A. 1995a. Report of the Workshop on Enhancing Methods for Locating, Accessing, and Integrating Population and Environmental Data Related to Marine Resources in Alaska. April 5-7, 1994, Hotel Captain Cook, Anchorage, Alaska.

Hoover-Miller, A. A. 1995b. Recommendations for an Alaska Native Harbor Seal Commission Traditional Knowledge Program. Report to the Alaska Native Harbor Seal Commission, Cordova, AK. 13pp.

Hoover-Miller, A., S. Atkinson, P. Armato. (in press) Glacial Ice Inhabiting Harbor Seals in Aialik Bay, Kenai Fjords National Park. (Alaska Park Science. National Park Service. Alaska Support Office. Anchorage Alaska.

Hoover-Miller, A., S. Atkinson, P. Armato. 2003 Temporal changes in haulout behavior of harbor seals in a tidewater glacial fjord. 15th Binnial Conference on the Biology of Marine Mammals. Greensboro, NC. USA. 14-19 December 2003. (Poster abstract)

Hoover-Miller, A., S. Conlon, P. Armato. 2003. Vessel Disturbance Studies of Harbor Seals in Aialik Bay, Alaska. Viewing Marine Mammals in the Wild: Emerging Issues, Research and Management Needs,15th Biennial Conference on the Biology of Marine Mammals, Greensboro, NC. Abstract.

Hoover-Miller, A. M. Kurihara, S. Conlon, K. Mashburn, and S. Atkinson. 2004. Pregnancy rates of harbor seals in Alaska. Marine Science in Alaska. 2004 Symposium. Abstract.

Hoover-Miller, A. A, K. R. Parker, and J. J. Burns. 2001. A reassessment of the impact of the Exxon Valdez oil spill on harbor seals (*Phoca vitulina richardsi*) in Prince William Sound. Marine Mammal Science. 17(1):111-135.

Murphy, E. C. and A. Anne Hoover. 1981 Research study of the reactions of wildlife to boating activity along Kenai Fjords coastline. Final Report for the National Park Service, Anchorage, Alaska. Contract No. CX-9000-8-0151. 125 pp.

Murphy, E. C., R. H. Day, K. L. Oakely, and A. A. Hoover. 1984. Dietary changes and poor reproductive performance in Glaucous-winged Gulls. Auk. 101:532-541.

Murphy, E. C., A.A. Hoover, R.H. Day, K.L. Oakley. 1992. Intracolony variability during periods of poor reproductive performance at a glaucous-winged gull colony. The Condor. 94:598-607

## Abbreviated Curriculum Vitae

**Name**: Shannon Atkinson, Ph.D., Professor of Marine Science, and Science Director
**Address**: University of Alaska Fairbanks, and Alaska SeaLife Center, PO Box 1329, Seward AK 99664
**Telephone**: (907) 224-6346 **Fax**: (907) 224-6360 **E-Mail**: shannon_atkinson@alaskasealife.org
**Education**: Ph.D. Murdoch University, School of Veterinary Studies, 1985
M.Sc. University of Hawaii, Department of Animal Science, 1981
B.Sc. University of Hawaii, Department of Animal Science, 1978

**Professional Experience**

Professor of Marine Science, University of Alaska Fairbanks, and Science Director Alaska SeaLife Center 2000-present
Associate Researcher, Hawaii Institute of Marine Biology, University of Hawaii 1991- 2000
Affiliate Researcher, Hawaii Institute of Marine Biology, University of Hawaii 1989-1991
Experimental Scientist, Commonwealth Scientific and Industrial Research Organization (CSIRO), Division of Animal Production, Western Australia 1986-1988

**Administrative Experience**

- Acting Project Manager, National Fish and Wildlife Foundation grant to conduct research on Steller sea lions. Feb-Dec 2000 $650,000
- Principal Investigator, National Marine Fisheries Service grant for Steller sea lion research. Oct 2000-Dec 2001 $900,000
- Principal Investigator, Fish and Wildlife Service grant to conduct research on Spectacled and Steller's Eiders. Dr. T. Hollmen is Program Manager. April 2001-present. $550,212; Aug 2002-present $736,000; July 2003-present $872,495
- Principal Investigator, National Marine Fisheries Service grant to conduct research on Steller sea lions. Mr. D. Calkins is Program Manager. May 2001-present; $5,987,000; July 2002-present. $4,987,000; July 2003- present $4,637588 (pending)
- Principal Investigator, National Marine Fisheries Service grant to conduct research on harbor seals. Ms. A. Hoover-Miller is Program Manager. June 2002-present $439,000; July 2003-present $310,822
- Principal Investigator, Fish and Wildlife Service grant to conduct research on sea otters. Mr. D. Calkins is Interim Program Manager. July 2003 –present $685,515

**Teaching Experience**

20 MS and PhD students whose committees I have or am currently chairing
13 MS and PhD students whose committees I am a member of
11 undergraduate students who have done directed research
4 students to whom I have served as a mentor (2 veterinary students and 1 foreign veterinarian)

**Awards**

1. U.S. Dept of Commerce, NOAA. Marine Environmental Stewardship Award for Marine Debris Removal Project, Northwestern Hawaiian Archipelago. 1998.
2. Vice President Al Gore's National Performance Review- Silver Hammer Award for Marine Debris Removal Project, Northwestern Hawaiian Archipelago. 1999.

**Selected Relevant Publications (on marine topics)**

1. **Atkinson, S**, Gilmartin, WG and Lasley, BL. (1993) Testosterone reduction after injection of gonadotropin releasing hormone in male Hawaiian monk seals. J. Reprod. Fert. 97:35-38.
2. **Atkinson, S**, Becker, BL, Johanos, TC, Pietraszek, JR and Kuhn, BCS. (1994) Rproductive status and morphology of female Hawaiian monk seals that were fatally injured by male seals. J. Reprod. Fert. 100:225-230.
3. Pietraszek, JR and **Atkinson, S**. (1994) Concentrations of oestrone sulfate and progesterone in plasma and saliva, vaginal cytology, and bioelectric impedance during the oestrous cycle of the Hawaiian monk seal. Mar. Mamm. Sci. 10:430-441.
4. Iwasa, M and **Atkinson, S**. (1996) Analysis of corpora lutea to estimate reproductive cycles of wild Hawaiian monk seals (*Monachus schauinslandi*). Mar. Mamm. Sci. 12: 182-198.

5. Goodman-Lowe, G, **Atkinson, S**, and Carpenter, JR. (1997) Initial defecation time and rate of passage of digesta in adult Hawaiian monk seals. Can. J. Zool. 75:433-438.
6. **Atkinson, S**. (1997) Reproductive biology of seals. Reviews of Reproduction. 2:175-194.
7. Silvers, LE, **Atkinson, S**, Iwasa, M, Combelles, C and Salden, D. (1997) A large placenta encountered in the Hawaiian winter grounds of the humpback whale, *Megaptera novaeangliae.* Mar. Mamm. Sci. 14: 175-180.
8. Mazzuca, L, **Atkinson, S** and Nitta, E. (1998) Deaths and entanglements of humpback whales in the main Hawaiian Islands, 1973-1995. Pac. Sci. 52:1-13.
9. Theodorou, J. and **Atkinson, S**. (1998) Monitoring of total androgen in saliva from captive Hawaiian monk seals. Mar. Mamm. Sci. 14: 304-310.
10. Crow, GL, Atkinson, MJ, Ron, B, **Atkinson, S**, Skillman, DK, and Wong, TF. (1998) Relationship of water chemistry to serum thyroid hormones in captive sharks with goitres. Aquatic Chemistry. 4:469-480.
11. **Atkinson, S**, Ragen, T, Gilmartin, WG, Becker, BL and Johanos, TC. (1998) Use of a GnRH agonist to suppress testosterone in wild Hawaiian monk seals. Gen. Comp. Endo. 112:178-182.
12. Palmer, J., **Atkinson, S**., Yoshida, W., Stalcup, A., and Landers, J. (1998) Charged chelate- capillary electrophoresis of endogenous corticosteroids. Electrophoresis 19 p. 3045-3051.
13. Goodman-Lowe, GD, Carpenter, JR and **Atkinson, S**. (1999) Assimilation efficiency of prey in the Hawaiian monk seal, *Monachus schauinslandi*. Can. J. Zool. 77:653-660.
14. Mazzuca, L, **Atkinson, S**, Keating, B and Nitta, E. Mass strandings of cetaceans in the Hawaiian Archipelago, 1957-1995. Aquatic Mammals. 25:105-114.
15. **Atkinson, S**, Combelles, C, Vincent, D, Nachtigall, P, Pawloski, J, and Breese, M. (1999) Monitoring of progesterone in captive female false killer whales, *Pseudorca crassidens*. Gen. Comp. Endo. 115:323-332.
16. Crow, GL, Ron, B, **Atkinson, S** and Rasmussen, LEL. Serum T4 and T3 concentrations in immature whitetip reef sharks, *Triaenodon obesus*. J Exp. Zool. 284:500-504.
17. Goodman-Lowe, GD, Carpenter, JR, **Atkinson, S**, and Ako, H. Nutrient, Fatty Acid, Amino Acid and Mineral Analysis of Natural Prey of the Hawaiian monk seal, *Monachus schauinslandi*. Comp. Biochem. Physiol. Part A 123:137-146.
18. West, KL, **Atkinson, S**, Carmichael, MS, Sweeney, JC, Krames, B, and Krames, J. Progesterone concentration in bottlenose dolphin milk in relation to reproductive status. Gen. Comp. Endo. 2000. Feb, vol. 117.
19. **Atkinson, S.** (2000) Novel Approaches to endocrinologic monitoring in marine mammals. Rep. Bottlenose Dolphin Repro. Workshop San Diego, CA June 3-6 1999
20. Feinholz, DM, and **Atkinson, S**. (2001) Possible etiologies of yellow coloration in dolphin calves. Aqua. Mamm. 26: 191-195.
21. Robeck, TR, **Atkinson, S**, and Brook F. (2001) Reproduction. *In* CRC Handbook of Marine Mammal Medicine. 2nd Edition. Dierauf , LA and Gulland, FMD. Eds. CRC Press pg. 193-236.
22. **Atkinson, S**. (2001) Male reproductive systems. *In* Encyclopedia of Marine Mammals. Academic Press. Pgs 700-704.
23. **Atkinson, S**, Atkinson, MJ, and Tarrant, AM. (2003) Estrogens from sewage in the coastal marine environment. Envir. Health Persp. 111:531-535. published on-line http://dx.doi.org/
24. Oki, C and **Atkinson, S**. (2003) Circadian patterns of cortisol and thyroid hormones in the harbor seal (*Phoca vitulina*) during summer and winter seasons. Gen. Comp. Endo. In Press.
25. Willcox, MK, Woodward, LA, Ylitalo, GM, Buzitis, J, **Atkinson, S**, and Li, QX. (2003) Organochlorines in the free-ranging Hawaiian monk seal (*Monachus schauinslandi*) from French Frigate Shoals, North Pacific Ocean. The Science of the Total Environment. 2003
26. **Atkinson, S.** and Oki, C. Body condition, cortisol, and thyroxine concentrations in juvenile Hawaiian monk seals from an ecosystem beyond optimal carrying capacity. Comp. Biochem. Physiol. Accepted.

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| Budget Category: | Proposed FY 05 | Proposed FY 06 | Proposed FY 07 | TOTAL PROPOSED |
|---|---|---|---|---|
| Personnel | $0.0 | $0.0 | $0.0 | $0.0 |
| Travel | $1.7 | $3.0 | $1.8 | $6.5 |
| Contractual | $76.5 | $74.5 | $73.7 | $224.7 |
| Commodities | $0.0 | $2.0 | $0.0 | $2.0 |
| Equipment | $11.0 | $40.0 | $0.0 | $51.0 |
| Subtotal | $89.2 | $119.5 | $75.5 | $284.2 |
| General Administration (9% of Subtotal) | $8.0 | $10.8 | $6.8 | $25.6 |
| Project Total | $97.2 | $130.3 | $82.3 | $309.8 |

Cost-share Funds:
In this box, identify non-EVOS funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal.

NPS/OASLC: 2004 Support: $44 salaries, $6 intern stipends related to Aialik Bay ecology per year, continuation requested.
NPS/CCI: 2003 Support: $14 bi-monthly aerial surveys; $41 cameras, $8 outreach, $9 interns, $5 travel, $5 supplies, 2004 continuation pending .
With GEM support for cameras, available funding will support CTD and plankton sampling in Aialik Bay
Port Graham Corporation: Real estate for Aialik Bay repeater site
USFWS, ANMWR: Real estate for Squab and Chiswell Islands repeater site

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**FY 05-07**

Date Prepared:

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3A
TRUSTEE
AGENCY
SUMMARY

## *EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL
## DETAILED BUDGET FORM FY 05 - FY 07

| Personnel Costs: | | GS/Range/ | Months | Monthly | | Personnel |
|---|---|---|---|---|---|---|
| Name | Description | Step | Budgeted | Costs | Overtime | Sum |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| Subtotal | | | 0.0 | 0.0 | 0.0 | |
| | | | | | **Personnel Total** | $0.0 |

| Travel Costs: | Ticket | Round | Total | Daily | Travel |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | Sum |
| RT to EVOS Annual Meeting | 0.1 | 2 | 4 | 0.1 | 0.6 |
| RT to Alaska Native Harbor Seal Commission Meeting (Location TBD) | 0.5 | 1 | 3 | 0.2 | 1.1 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $1.7 |

**FY 05**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

*EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

| **Contractual Costs:** | Contract Sum |
|---|---|
| Description | |
| SeeMore Wildlife Systems 6 mo maintenance contract | 36.0 |
| Helicopter and vessel travel | 13.0 |
| Facilities cost (rent) at Alaska SeaLife Center | 9.0 |
| Indirect costs at Alaska SeaLife Center (26.22% of direct costs, excluding equipment items costing > $5000) | 18.5 |
| If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total** | $76.5 |
| **Commodities Costs:** | Commodity Sum |
| Description | |
| **Commodities Total** | $0.0 |

**FY 05**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| New Equipment Purchases: | Number of Units | Unit Price | Equipment Sum |
|---|---|---|---|
| Description | | | |
| Prototype remote time-lapse still cameras @ $2,200 ea | 5 | 2.2 | 11.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | **New Equipment Total** | $11.0 |

| Existing Equipment Usage: | Number of Units | Inventory Agency |
|---|---|---|
| Description | | |
| | | |

**FY 05**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Equipment
DETAIL

## *EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL
## DETAILED BUDGET FORM FY 05 - FY 07

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Personnel |
|---|---|---|---|---|---|---|
| Name | Description | Step | Budgeted | Costs | Overtime | Sum |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 0.0 | 0.0 | 0.0 | |
| | | | | | **Personnel Total** | $0.0 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Travel |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | Sum |
| RT to EVOS Annual Meeting | 0.1 | 2 | 4 | 0.1 | 0.6 |
| 16th Biennial Conference on Biology of Marine Mammals (San Diego) | 0.8 | 1 | 8 | 0.2 | 2.4 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $3.0 |

**FY 06**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| **Contractual Costs:** | Contract Sum |
|---|---|
| Description | |
| SeeMore Wildlife Systems 6 mo maintenance contract | 36.0 |
| Helicopter and vessel travel | 13.0 |
| Facilities cost (rent) at Alaska SeaLife Center | 9.0 |
| Indirect costs at Alaska SeaLife Center (26.22% of direct costs, excluding equipment items costing > $5000) | 16.5 |
| If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total** | $74.5 |

| **Commodities Costs:** | Commodity Sum |
|---|---|
| Description | |
| Publication Costs: Ecology of Glacial Ice Inhabiting Harbor Seals in Aialik Bay | 1.0 |
| Publication Costs: Effects of vessels on harbor seals in a tidewater glacial fjord. | 1.0 |
| **Commodities Total** | $2.0 |

**FY 06**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

*EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 05 - FY 07

| New Equipment Purchases: Description | Number of Units | Unit Price | Equipment Sum |
|---|---|---|---|
| 3 Year Capital Lease in support of 3 camera sites and 1 repeater sites | 4 | 10.0 | 40.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | **New Equipment Total** | $40.0 |

| Existing Equipment Usage: Description | Number of Units | Inventory Agency |
|---|---|---|
| | | |

**FY 06**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Equipment
DETAIL

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| **Personnel Costs:** | | GS/Range/ | Months | Monthly | | Personnel |
|---|---|---|---|---|---|---|
| Name | Description | Step | Budgeted | Costs | Overtime | Sum |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | | | | | | 0.0 |
| | Subtotal | | 0.0 | 0.0 | 0.0 | |
| | | | | | **Personnel Total** | $0.0 |

| **Travel Costs:** | Ticket | Round | Total | Daily | Travel |
|---|---|---|---|---|---|
| Description | Price | Trips | Days | Per Diem | Sum |
| RT to EVOS Annual Meeting | 0.1 | 2 | 4 | 0.1 | 0.6 |
| RT to Alaska Native Harbor Seal Commission Meeting (Location TBD) | 0.6 | 1 | 3 | 0.2 | 1.2 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | | 0.0 |
| | | | | **Travel Total** | $1.8 |

**FY 07**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Personnel
& Travel
DETAIL

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| **Contractual Costs:** | Contract Sum |
|---|---|
| Description | |
| SeeMore Wildlife Systems 6 mo maintenance contract | 36.0 |
| Helicopter and vessel travel | 13.0 |
| Facilities cost (rent) at Alaska SeaLife Center | 9.0 |
| Indirect costs at Alaska SeaLife Center (26.22% of direct costs, excluding equipment items costing > $5000) | 15.7 |
| **Contractual Total** | $73.7 |

| **Commodities Costs:** | Commodity Sum |
|---|---|
| Description | |
| **Commodities Total** | $0.0 |

**FY 07**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Contractual & Commodities DETAIL

**_EXXON VALDEZ_ OIL SPILL TRUSTEE COUNCIL**
**DETAILED BUDGET FORM FY 05 - FY 07**

| **New Equipment Purchases:** Description | Number of Units | Unit Price | Equipment Sum |
|---|---|---|---|
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | | 0.0 |
| | | **New Equipment Total** | $0.0 |

| **Existing Equipment Usage:** Description | Number of Units | Inventory Agency |
|---|---|---|
| | | |

**FY 07**

Project Number: 050749
Project Title: Ecology of Harbor Seals in a Tidewater Glacier Fjord
Agency: NOAA

FORM 3B
Equipment
DETAIL

## BUDGET JUSTIFICATION

### FY2005

**Travel: $1,700**

Two round-trips to the EVOS Annual Meeting in Anchorage have been requested with roundtrip mileage ($100 each) and per diem for 2 days for each person ($100/day). One round-trip to the Alaska Native Harbor Seal Commission Meeting has also been budgeted. The location is yet to be determined; therefore, mileage ($100), airfare ($400) and $200/day per diem for 3 days has been requested.

**Contractual: $76,500**

The maintenance contract through SeeMore Wildlife Services, Inc., for the video monitoring system totals $36,000 over 6 months ($6,000/month for May-October). An additional $13,000 is requested for helicopter and vessel travel to reach the camera sites from Seward. $9,000 is requested to cover facility rental costs at the Alaska SeaLife Center. This amount covers office space for the PI and a research technician plus a small amount of laboratory space used to analyze video signals. Indirect costs of $18,500 are calculated as 26.22% of direct costs excluding equipment items costing greater than $5,000 each. This indirect rate is the federally-negotiated rate for the Alaska SeaLife Center.

**New Equipment Purchases: $11,000**

Five prototype remote time-lapse still cameras are being requested at $2,200 each.

### FY2006

**Travel: $3,000**

Two round-trips to the EVOS Annual Meeting in Anchorage have been requested with roundtrip mileage ($100 each) and per diem for 2 days for each person ($100/day). One round-trip to San Diego for the 16$^{th}$ Biennial Conference on Biology of Marine Mammals has also been budgeted. Mileage and airfare ($800) and $200/day per diem for 8 days are requested.

**Contractual: $74,500**

The maintenance contract through SeeMore Wildlife Services, Inc., for the video monitoring system totals $36,000 over 6 months ($6,000/month for May-October). An additional $13,000 is requested for helicopter and vessel travel to reach the camera sites from Seward. $9,000 is requested to cover facility rental costs at the Alaska SeaLife Center. This amount covers office space for the PI and a research technician plus a small amount of laboratory space used to analyze video signals. Indirect costs of $16,500 are calculated as 26.22% of direct costs excluding equipment items costing greater than $5,000 each. This indirect rate is the federally-negotiated rate for the Alaska SeaLife Center.

**Commodities Costs: $2,000**

Publications costs for two journal articles are requested at $1000 each. The articles working titles are: "Ecology of glacial ice-inhabiting harbor seals in Aialik Bay" and "Effects of vessels on harbor seals in a tidewater glacial fjord."

**New Equipment Purchases: $40,000**

During FY2006, the capital lease with SeeMore Wildlife Systems, Inc., supporting the video monitoring equipment will be due for renewal. The lease cost for three camera sites and one repeater site will total $40,000.

**FY2007**

**Travel: $1,800**

Two round-trips to the EVOS Annual Meeting in Anchorage have been requested with roundtrip mileage ($100 each) and per diem for 2 days for each person ($100/day). One round-trip to the Alaska Native Harbor Seal Commission Meeting has also been budgeted. The location is yet to be determined; therefore, mileage ($100), airfare ($500) and $200/day per diem for 3 days has been requested.

**Contractual: $73,700**

The maintenance contract through SeeMore Wildlife Services, Inc., for the video monitoring system totals $36,000 over 6 months ($6,000/month for May-October). An additional $13,000 is requested for helicopter and vessel travel to reach the camera sites from Seward. $9,000 is requested to cover facility rental costs at the Alaska SeaLife Center. This amount covers office space for the PI and a research technician plus a small amount of laboratory space used to analyze video signals. Indirect costs of $15,700 are calculated as 26.22% of direct costs excluding equipment items costing greater than $5,000 each. This indirect rate is the federally-negotiated rate for the Alaska SeaLife Center.

**COST SHARE FUNDS**

- NPS/OASLC: 2004 Support: $44 salaries, $6 intern stipends related to Aialik Bay ecology per year, continuation requested.
- NPS/CCI: 2003 Support: $14 bi-monthly aerial surveys; $41 cameras, $8 outreach, $9 interns, $5 travel, $5 supplies, 2004 continuation pending . With GEM support for cameras, available funding will support CTD and plankton sampling in Aialik Bay
- The Port Graham Corporation provides real estate for Aialik Bay repeater site.
- USFWS and ANMWR provide real estate for the Squab Island and Chiswell Island repeater sites.