2003 OASLC Cooperative Conservation Initiative Program
Aialik Bay Harbor Seal Research
2003 Progress Report

Harbor Seal Research Program

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Introduction

Tidewater glacial fjords are unique ecological habitats that are home to several species of marine mammals including harbor seals, *Phoca vitulina*. In the Kenai Fjords National Park harbor seals rely on the glacial ice from seven tidewater glaciers (Aialik, Pedersen, Holgate, Ogive, Anchor, Northwestern, and McCarty) for resting, molting, and giving birth. Since the mid-1970s, population levels of harbor seals elsewhere in the Gulf of Alaska have declined 80% in association with changing ecological conditions in the Gulf of Alaska.

Glacial environments are constantly in transition as global temperatures warm and cool. Most recently, the 'Little Ice Age' (ca. AD 1250 - 1900), was a period of global cooling that reached its maximum during the early 19th century (Bradley and Jones 1995; Overpeck *et al.* 1997) and included a major advance of Aialik Glacier (Wiles 1992). Since the early 1900s, tidewater glaciers throughout Alaska have receded and thinned and only about 50 tidewater glaciers currently remain (Molnia 2001.).

As glacial ice habitats diminish, species that occupy ice affected niches in the ecosystem are impacted. From 1980-2002, numbers of harbor seals in Aialik Bay declined from more than 1,600 to about 200 seals, a rate of decline exceeding that observed elsewhere in the Gulf of Alaska during the same time-period (Hoover-Miller 1994, Pitcher 1990, Small *et al*. 2003, Alaska SeaLife Center (ASLC)/Ocean Alaska Science Learning Center (OASLC) unpublished data). Numbers of seals in tidewater glacial fjords in Glacier Bay also are declining even though population trends at land haulouts in southeast Alaska are stable or increasing (Mathews and Pendleton 2000). In both locations, alternative land haulouts are available; suggesting that substrate availability and conditions associated with the Gulf of Alaska population decline may not be the only factors contributing to population loss.

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).

Besides natural ecological change, seals in the Kenai Fjords have been affected by increasing tourism. Aialik Bay is located about 80 km by water from Seward and is visited on a daily basis by numerous commercial and private vessels. Vessel traffic has increased dramatically since the Kenai Fjords National Park was established in 1980 and vessels and seals both concentrate near the glacier's face. From May-September, multiple tour-boats, kayaks, and other vessels visit upper Aialik Bay on a daily basis. Disturbances from near resting or pupping sites can increase the energetic requirements of seals; furthermore, during pupping and molting many seals are nutritionally stressed and need to minimize unnecessary energetic loss. Frequent disturbance may alter the location and time that seals haul out, although some seals appear to become habituated to common sources of disturbance (see Hoover 1994). 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 (e.g., Bishop 1967). Vessel behavior varies by operators and ice conditions. Observations taken in 1998 showed steady, ongoing interactions where seals were disturbed from the ice multiple times a day (NPS unpublished data); more recent studies show that vessels can be operated near the ice with little impact on the seals. In the last few years kayak traffic also has increased dramatically. This is a particular concern near Pedersen Glacier, where kayakers have displaced seals from the ice in a secluded haulout area.

The Department of Interior's Cooperative Conservation Initiative (CCI) Challenge Cost Share program is directed toward protection of natural resources on or near Federal lands. The Ocean Alaska Science and Learning Center (OASLC), a research and education partnership between the National Park Service and the Alaska SeaLife Center has received $110,000 to support research in Aialik Bay to assess natural and human-related factors affecting harbor seals in Aialik Bay and adjacent areas, make recommendations for habitat improvements, and identify conditions that contribute to habitat erosion.

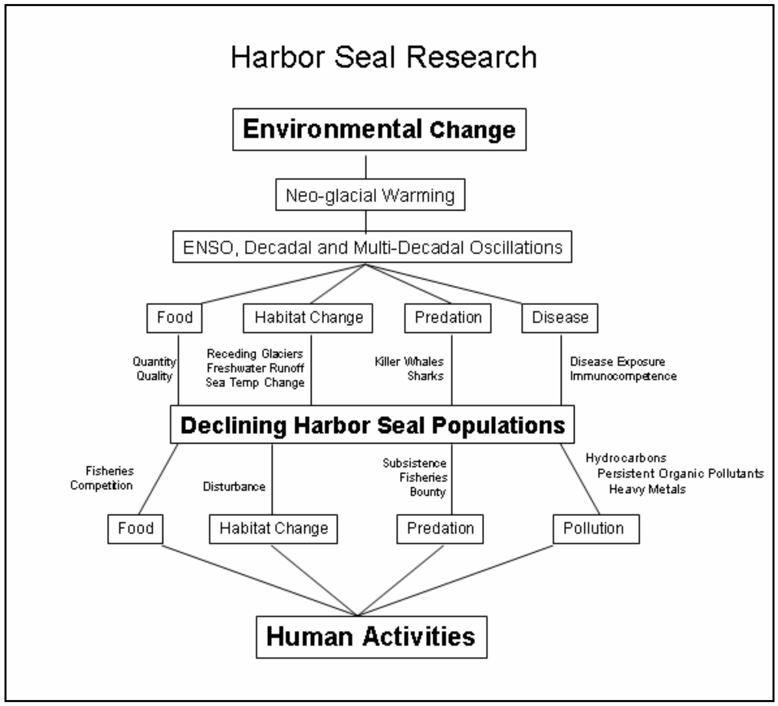

Figure 2. Conceptual model of factors influencing population change of harbor seals in the Gulf of Alaska.

To investigate potential factors contributing to the population decline of harbor seals in the Gulf of Alaska, the ASLC Harbor Seal Program developed a conceptual model to help guide research (Figure 2). The conceptual model balances factors influenced by environmental change, including food, habitat change, predation, and disease with factors, influenced by human activities, that affect food availability, habitat quality, predation levels and pollution exposure in similar ways. By contrasting similar effect pathways derived from natural and anthropogenic sources, the model aids researchers to more effectively focus efforts on the identification and mitigation of human activities that may be contributing to the population decline or inhibit recovery.

Current OASLC/CCI research in the Kenai Fjords National Park is directed toward identifying natural events and human activities that are affecting glacial ice habitats and how those events are affecting seal populations. The research also aims to identify human-related perturbations affecting harbor seals and mitigate the effects of those activities by fostering effective industry-sustained self-regulation and the dissemination of viewing guidelines pertinent to the Kenai Fjords. These would aid independent travelers in reducing their impact on seals as they explore the fjords.

Objectives

The objectives of this study are to: (A) identify seasonal variation in habitats and ecological conditions in the Kenai Fjords that are important to harbor seals and the fish they forage on and (B) to minimize the effects of visitor traffic and other human activities on seals hauled out on glacial ice. These objectives will be accomplished by: (1) using video monitoring to assess spatial and temporal changes of harbor seals and environmental conditions, including vessel activity, (2) documenting change in the status of the glaciers and ice available to harbor seals, and (3) hosting a workshop with vessel operators to develop means of minimizing the impact of vessel traffic on harbor seals.

Methods

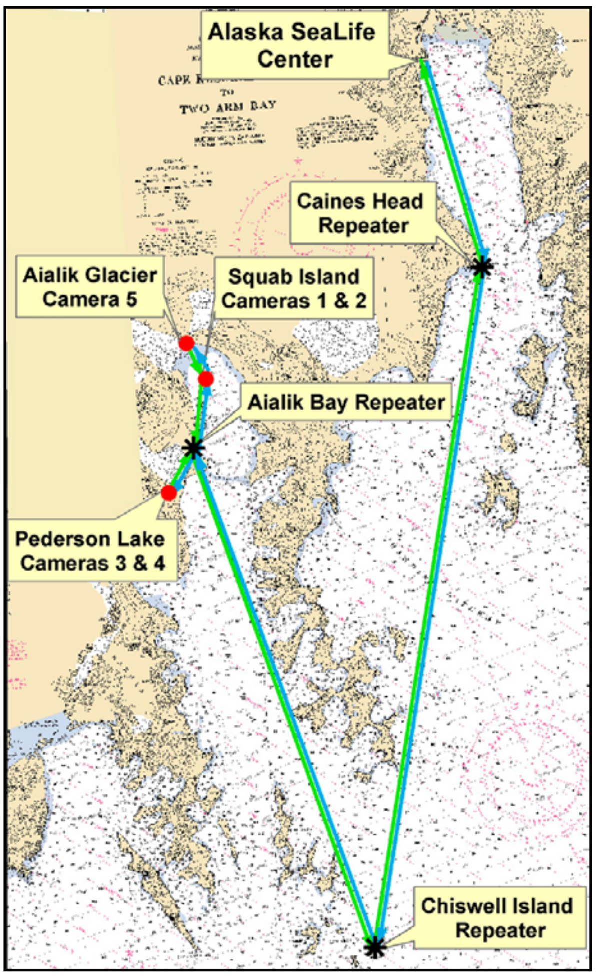

Figure 1. Location of video cameras in upper Aialik Bay, repeaters used for transmitting commands and video images, and pathway taken by transmitted signals

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.

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 receive 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

In 2003 population trends of harbor seals in Alaska were monitored using multiple daily surveys conducted from three video camera sites: Squab Island, North Aialik Glacier, and Pedersen Glacial Lake. Daily counts were taken during morning (0800-1100) mid-day (1100-1500) and afternoon (1500-1800) windows. 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 (Beaufort scale) were recorded. Ice conditions were documented using standardized scans of the upper bay from Squab Island. Analysis of seals with pups and seals without pups were conducted separately.

Covariates of haulout were 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). 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, Adkinson et al. 2003, Jemison and Pendleton 2001). In long-term longitudinal studies, seasonal functions add additional complexity (e.g. see Jemison and Pendleton 2001).

Preliminary screening of data from Aialik Bay identified substantial inter-annual variations in recent years. To model seasonal variation in attendance without making assumptions as to the shape of seasonal attendance patterns, highest counts observed periodically throughout the year were identified. Those counts were assumed to represent the number of seals hauling out under optimal conditions. Peak counts did not necessarily occur on a regular or predictable basis. A smoothing-spline, created using JMP 5.01 statistical software, was applied to those points and the lambda value was adjusted to provide a smooth, continuous representation of seasonal changes in maximum counts. Daily predicted maximum numbers of seals were determined based on the smoothed curve. Daily predicted maximum numbers were 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 were normalized as a proportion of the daily expected numbers of seals calculated for that day. ANOVA was 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 were 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.

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 allowed. These data are being contrasted to evaluate abnormal elevations of specific behaviors associated with vessel proximity. It also will allow detailed review of interactions to help develop effective navigation recommendations for minimizing 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 related activity accounts for vessel interactions and sightings, kayak interactions and sightings, and time spent following vessel activities. Active observation includes times when the cameras were used for population surveys, ice scans or other vessel related activity. Non-active observation included when the cameras were in a fixed and stationary position, blue screen due to darkness and poor image quality or when cameras were not properly functioning due to technical difficulties affecting camera movements. 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. In 2002 video records constituted about 75 days (1789 h); in 2003 video records constituted about 91 days (2192h).

Table 1. Summary of vessel interaction and activity levels and video observation effort in Aialik Bay during 2002 and 2003.

	Vessel Interaction (hours)	**Vessel Related Activity (hours)**	**Active (hours)**	**Non-Active (hours)**
2002	53.06 (f=114)	60.90 (f=365)	394.50	1349.50
2003	26.73 (f=89)	88.72 (f=162)	368.27	1823.28

Results and Discussion

Population Trends

Numbers of seals in Aialik Bay declined more than 85% between 1980 and 1989 (Figure 2). Maximum counts obtained from 1979-1981 averaged 1,336 seals. By 1989 maximum numbers diminished 80% to an average maximum annual count of 261 seals (based on years when more than 3 counts were taken). The rate of decline was steepest from 1981-1989. From 1989-2003, numbers of seals have remained low but relatively stable. Reduced numbers of seals near Aialik Glacier occurred concurrently with a widespread population decline of harbor seals in the Gulf of Alaska (Figure 3). Similar to total seal counts, pups showed an extensive reduction in numbers between the periods 1979-1981 and 1994-2003. From 1979-1981, maximum counts averaged 283 pups. From 1984-2003 (for years when more than three counts were made) average maximum counts decreased 87% to 37 pups.

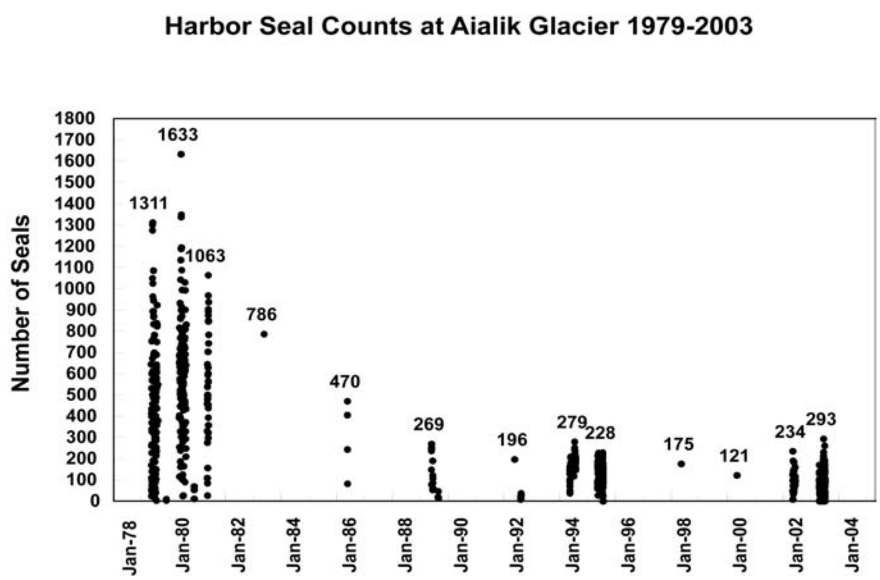

Figure 2. Numbers of seals (including pups) counted near Aialik Glacier from 1979-2003 (Hoover 1983, NPS unpublished, Hoover-Miller unpublished, and ASLC/OASLC this study).

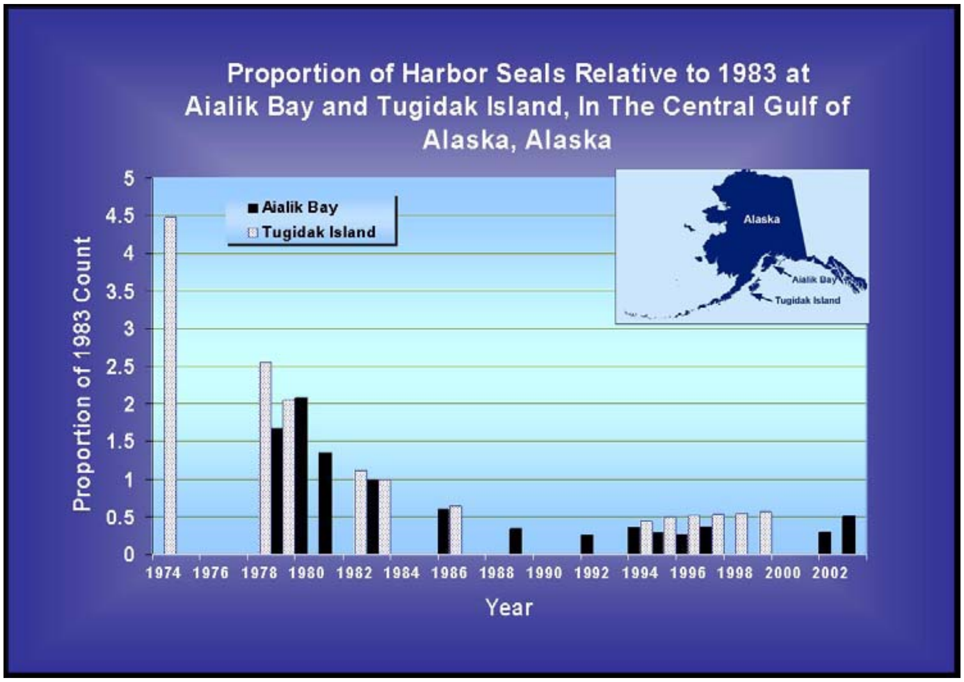

Figure 3. Comparison of population trends, normalized relative to 1983 counts, of harbor seals on glacial ice near Aialik Glacier and seals using land haulouts on southwest Tugidak Island.

Figures 2 and 4 indicate strong inter-annual variation in attendance and pup productivity from 1979-1981 with 1980 showing the highest counts of seals and of pups seen during the study period whereas in 1979 and 1981 lower numbers of seals and pups were counted. In 1979 numbers of seals on the ice were adversely influenced by weather conditions that appeared to reduce pup survival (Hoover 1983). Nevertheless, pups represented 19% of the total maximum counts in 1979 and 22% in 1980 and 1981. In 1989 the proportion of pups (34%) was considerably higher than proportions seen in previous years whereas from 1994-2003 the proportion of pups ranged from 11-14% for those years when more than 3 counts were taken.

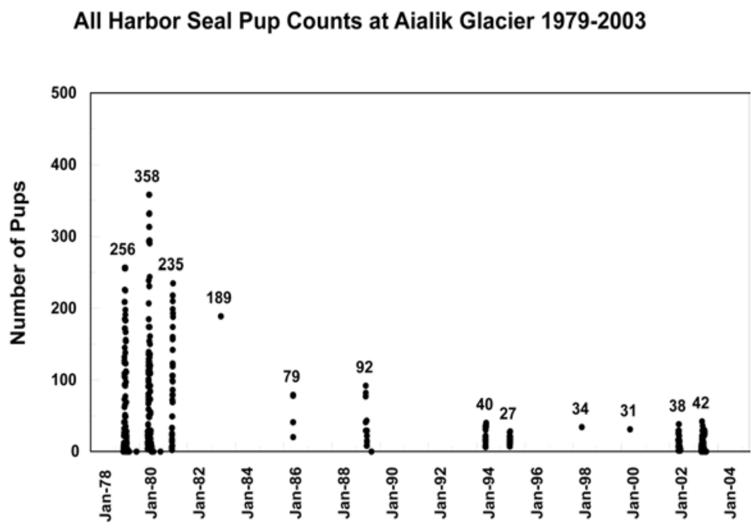

Figure 4. Numbers of pups counted from 1979-2003.

The proportions of pups counted on the ice are influenced by both reproductive rates and the haulout behavior of seals without pups. Young pups rely on haulouts for resting and nursing. For those reasons, numbers of pups at haulouts show less variability relative to environmental conditions than attendance of older seals not caring for pups (e.g., see Frost et al. 1995). Comparisons of the proportions of pups counted and the numbers of seals not attending pups provide information on the reproductive strength of the population as well as a measure of unusual activity levels of seals not caring for pups.

Proportions of pups in counts would be expected to be higher when reproductive effort is high, but also may be high under potentially stressful conditions when seals without young dependent pups may haulout less frequently in order to forage. Count data taken from 1979-1981 and the precipitous decline in numbers of seals and pups in subsequent years suggest continued stressful conditions existed through 1989. By 1994 numbers of seals and pups appeared to have stabilized but population recovery has not been evident. Whether numbers of seals near Aialik Glacier are remaining depressed because of foraging constraints, ice conditions, predator pressure, or other factors is not known at this time.

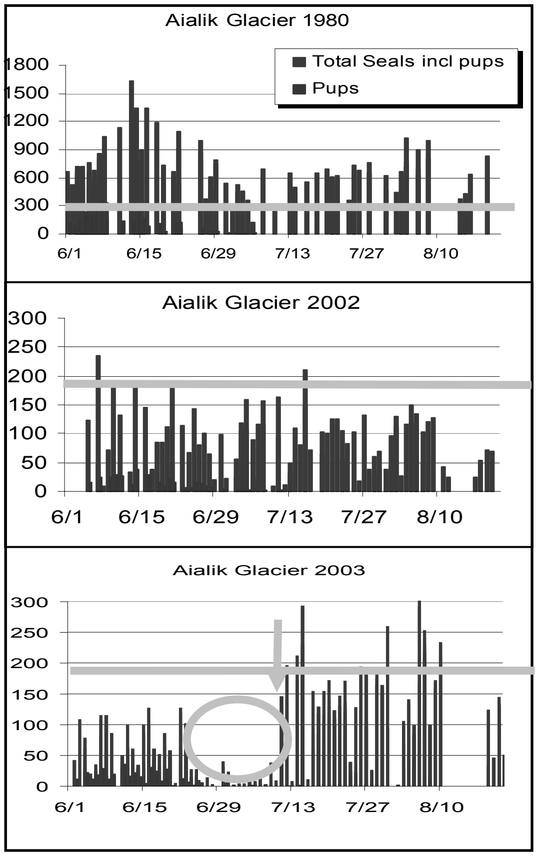

Figure 5. Comparison of seasonal attendance of harbor seals near Aialik Glacier in 1980, 2002, and 2003. Grey reference lines indicate maximum numbers of seals counted in 2002.

Haulout Behavior

Attendance patterns of seals changed between those seen in 1979-1980, 2002 and 2003. Reduced seasonal variation near Aialik Glacier has been apparent in recent years (Figure 5). During 1980, seals showed typical bimodal haulout attendance with peaks during pupping (June) and molting (July-September) that generally is observed for most harbor seal populations. In 2002 decreasing attendance levels were observed throughout the summer while in 2003 counts were low during pupping and increased abruptly in July.

Unexpectedly low numbers of seals (gray circle, bottom panel, Figure 5), followed by exceptionally high attendance corresponded to the arrival of anadromous osmerid and salmonid forage fish to streams at the head of Aialik Bay (gray arrow). High counts in July and August likely indicate increased time spent hauled out and immigration of some seals from other areas.

Inter-annual Variation in Seasonal Counts

To contrast seasonal variation in attendance, the spline-smoothed curves of selected maximum counts of seals without pups by day of year are shown in Figure 6 for 1979-80, 2002. In 1979-1980, seals showed typical bimodal haulout with greater numbers during pupping and molting (Figure 6). In contrast, during 2002 numbers were highest during pupping and declined as the season progressed. Some, but not all, of the decrease corresponded to greater numbers hauling out near Pedersen Glacier (see below). In 2003, numbers of seals were low during pupping and precipitously dropped in late June. By mid-July numbers abruptly increased to levels not seen since 1989. The increased numbers of seals in the upper bay corresponded to the arrival of forage fish to lagoons at the head of the bay and may include seals from other haulout areas.

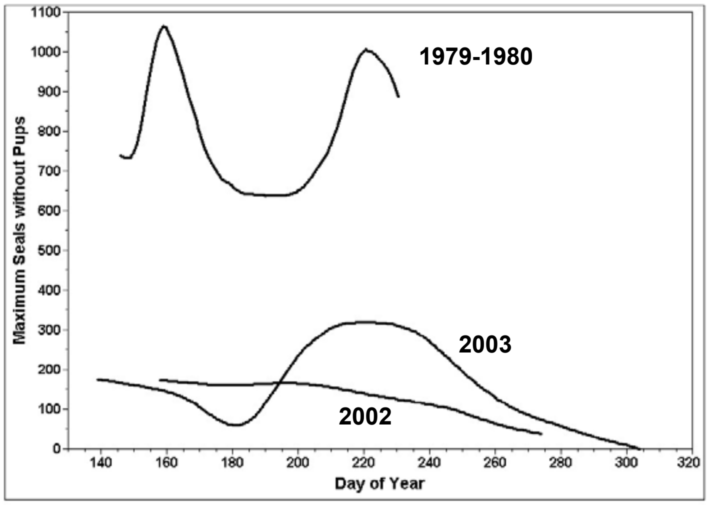

Figure 6. Spline-smoothed curves of selected maximum counts of seals without pups by day of year in 1979-80, 2002, and 2003 illustrating changes in seasonal haulout attendance of seals without pups.

Pedersen Glacier

Seals were first identified using ice in Pedersen Lake as a haulout substrate during the early 1990s (NPS, unpublished). Seasonal attendance in Pedersen Lake has not been described. During both 2002 and 2003 fewest seals hauled out in June. Attendance increased in July and peaked in August and September, when adult seals were molting. Attendance at Aialik Glacier decreased during this period and by late September and October (2003) seals infrequently hauled out on the ice near Aialik Glacier.

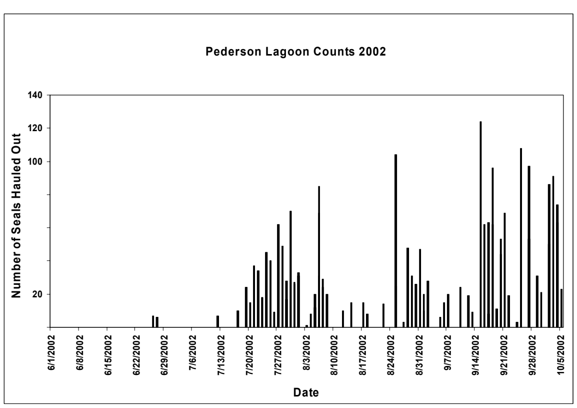

Figure 5. Maximum daily counts of harbor seals at Pedersen Lake during 2002. Few seals were sighted in June, when seals pup; peak counts were during the August-October molting period.

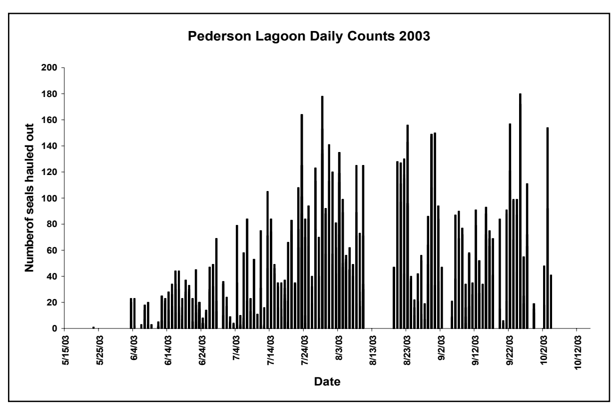

Figure 6. Maximum daily counts of harbor seals at Pedersen Lake during 2003. A few pups were sighted in June that may have been born there; peak counts were from late July through the end of observations in October. Periods lacking counts were not monitored due to weather or camera system malfunction.

Environmental Covariates Affecting Haulout

Numbers of seals present at haulouts are affected by covariates including date, time-of-day, tidal stage, and weather. Hoover (1983) described haulout behavior of seals near Aialik Glacier, with peak haulout in midday,

In 1997 and 1998, Withrow and Cesarone (1999) used VHF radio telemetry to estimate the proportion of seals not present on the ice during molt-season aerial surveys. Data logging receivers positioned near ice concentrations recorded presence and absence of seals every 20 minutes. Date and time of day were important covariates that strongly influenced haulout behavior. Wind direction, speed, and tidal state influenced haulout behavior to a lesser degree. Greatest numbers of seals were hauled out between 12:00 and 19:00 hours at Pedersen Glacier with a peak between 12:00 and 14:00h. At Aialik Glacier most seals hauled out between 10:00 and 19:00 with peak numbers between 10:00 and 13:00. Near Aialik Glacier, results of Withrow and Cesarone (1999) were similar to those of Hoover (1983), with peak numbers hauling out by 13:00 h near Aialik Glacier.

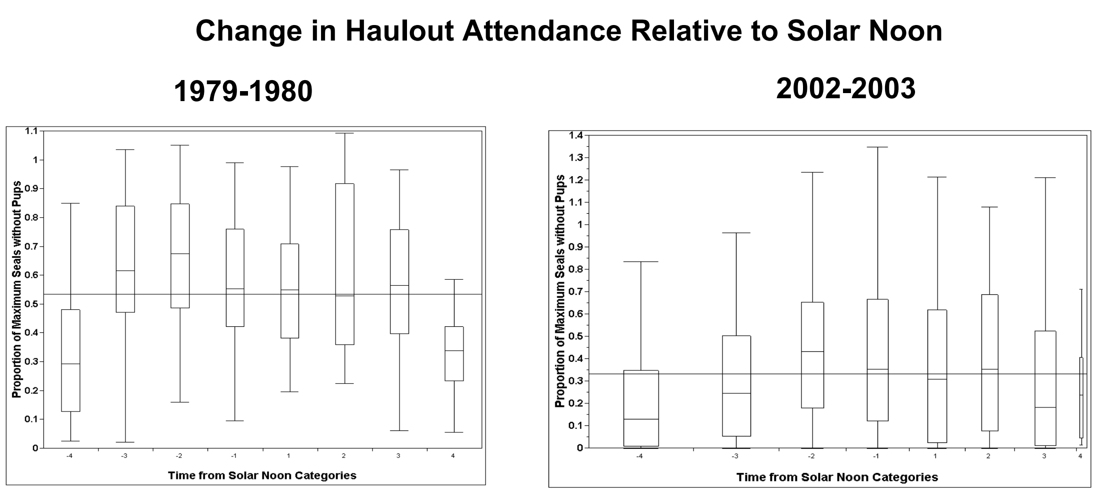

Figure 7. Box plots identifying median, 25% and 75% quartiles, and range in the proportion of seals without pups hauled out relative to Solar Noon between 1979-80 and 2002-2003. Time categories refer to the number of hours before (-) and after (+) solar noon; categories are 1 = within 1 h, 2 = 1-2 h, 3 = 2-4 h, and 4 = 4-10 h of solar noon. Diurnal haulout patterns were stronger in 1979-80, when population levels were higher, than in 2002-03.

Counts obtained in 2002 and 2003 at Aialik and Pedersen Glaciers showed different tendencies, particularly with seals near Aialik Glacier. Diurnal haulout patterns that showed greatest attendance around mid-day now favor haulout in mid-to late- afternoon and had a much weaker effects. The reasons that diurnal timing of haulout has changed since 1998 is not known. Factors that may have influenced haulout patterns include increased human activity and differences in foraging behavior.

Vessel Interactions

The current study uses the remote video camera system to identify frequency of vessel traffic by size class (kayaks, <80ft motorized, >80ft motorized) and the amount of time vessels spend around the glacier haul out. Responses of seals to vessels have been characterized according to vessel movement characteristics, seal reproductive class and seal behavioral response. These data have been contrasted with baseline study data of 1979-1980 when vessel interactions were infrequent and with 1996 data from the National Park Service when vessel interactions were frequent and vessel operators had yet to establish viewing guidelines.

In 2000 and 2001, Kenai Fjords Tour Vessel Operators Association developed and subsequently revised guidelines for viewing marine mammals in the wild to preserve viewing experience for visitors to the Kenai Fjords. Prior to the voluntary guidelines, Tetreau (1998) documented nearly half of 28 observed interactions resulted in large numbers of seals (>20) leaving the ice in response to vessel activity. In 2002, the video camera system was installed on Squab Island and in Pedersen Lake. That year only 3% of 107 observed interactions resulted in more than 20 seals entering the water, although 39% of interactions resulted in smaller numbers leaving the ice. The following year, when the presence of our cameras was more widely known, only 18% of 89 observed interactions resulted in interactions causing seals to enter the water. The combination of voluntary efforts, reinforced by the video observing system, has markedly reduced the frequency and intensity of interactions causing seals to leave the ice.

1996 Northwestern Fjord /Aialik Bay	Number of incidences/sighting Number in ( ) is the percent of the number where outcome was determined			
Number Seals Entered Water	Kayak	< 80 ft	>80 ft	**All Vessels**
0	2 (67%)	4 (29%)	6 (55%)	**12 (42%)**
<6	0	3 (21%)	0	**3 (11%)**
>20	1 (33%)	7 (50%)	5 (45%)	**13 (46%)**
Total outcome Determined	**3**	**14**	**11**	**28**
2002 Aialik Bay	**Number of incidences/sighting** Number in ( ) is the percent of the number where outcome was determined			
Number Seals Entered Water	Kayak n=3	<80 ft	>80 ft	**All Vessels**
0	2 (67 %)	14 (64%)	47 (57%)	**63 (59%)**
<6	0	7 (32%)	27 (33%)	**34 (32%)**
6-20	1 (33%)	1 (4%)	5 (6%)	**7 (6%)**
>20	0	0	3 (4%)	**3 (3%)**
Total outcome Determined	**3**	**22**	**82**	**107**
undeterminable	0	1	10	**11**
2003 Aialik Bay	**Number of incidences/sighting** Number in ( ) is the percent of the number where outcome was determined			
Number Seals Entered Water	Kayak* n=11	< 80 ft	>80 ft	**All Vessels**
0	3 (43%)	24 (85%)	46 (85%)	**73 (82%)**
<6	0	3 (11%)	6 (11%)	**9 (10%)**
>20	4 (57%)	1 (4%)	2 (4%)	**7 (8%)**
Total outcome Determined	**7**	**28**	**54**	**89**
undeterminable	4	7	14	

*includes interactions from Pedersen Lagoon

Our observations and those of Murphy and Hoover (1983) have identified several factors pertaining to a vessel's presence that affect the likelihood of seals leaving the ice. The direction and speed from which the vessel approaches and departs in conjunction with its size and any noise that it generates can elicit responses from seals. While the vessel is visiting the glacier area both the odor and manner in which it maneuvers may affect seals. Yet these factors often can be subtle when directly observing seals. Using the recorded video from the remote camera system, interactions can be reviewed at length to assess the seal's response. A general pattern of indirect approach and silent drifting when in the vicinity of ice haulouts is generally tolerated by the seals.

Seals appear more sensitive to direct approaches, nearby maneuvering, and rapid departures. Seals seem especially sensitive to small vessels, particularly kayaks.

Seal sensitivity to kayaks is of concern because kayaking is a rapidly growing activity in the fjords and kayakers have the ability to access seals in previously protected areas, such as Pedersen Lake. Unlike the tour vessel operators who developed viewing guidelines, kayak tour operators and kayakers are more independent, thus their visits are not as easy to predict or track. The effects of kayakers are most evident in Pedersen Lake where kayakers can travel among ice used by seals and camp on adjacent shores.

Instances of major interactions have been observed, where all or a majority of seals have entered the water due to nearby kayakers. When such interactions coincide with low tide, the seals are unable to leave the lake because of the shallow entrance. The seals must therefore remain in the water until they feel sufficiently safe to haul out on the ice or until the tide rises enough for the seals to leave the lake through the shallow stream channel. Recovery time and energetic costs associated with this sort of interaction during both pupping and molting are of concern and will be investigated in the future

<u>Mitigating Human Impact</u>

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 vessel ranging in size from 100 ft tour-vessels to 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 creates negative impressions on Park visitors. 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, the “big brother” effect created by the video cameras has probably resulted in more careful vessel operations, video records are providing greater opportunities for identifying specific vessel activities that seal’s are sensitive to. 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 addition ongoing activities include disseminating information to commercial and independent vessel operators and facilitating dialogue between vessel operators and researchers.

In spring 2004, a workshop is planned 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. To aid in informing independent visitors of measures that can be taken to reduce their impact on wildlife, the ASLC is designing a laminated informational card. This card will aid in the recognition of common marine mammals, depict escalating disturbance levels for harbor seals and sea otters, and provide recommendations for minimizing impact. These cards will be designed for attachment to kayaks or other exposed locations for quick reference.

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