

**Kodiak Launch Complex, Alaska  
Environmental Monitoring Studies  
December 2004  
STARS IFT 13C Launch**

*by*

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## Acknowledgments

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# Introduction

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This document provides the results of environmental monitoring studies done in support of the 14 December 2004 launch of the U.S. Air Force Strategic Target System (STARS) Integrated Flight Test (IFT) 13C from the Kodiak Launch Complex (KLC), Kodiak Island, Alaska. The three-stage rocket consisted of the first two stages of a decommissioned A-3 missile and an Orbis third stage. The University of Alaska Anchorage's Environment and Natural Resources Institute (ENRI) conducted these studies under contract to the Alaska Aerospace Development Corporation (AADC), the state-owned corporation that owns and operates KLC. ENRI also conducted the environmental monitoring studies for the first six KLC missions.

ENRI designed the IFT 13C environmental studies in accordance with the KLC Environmental Monitoring Plan (EMP), the findings and recommendations of the previous KLC environmental monitoring reports (ENRI 1999, 2000, 2001, 2002a,b,c,d), and resource agency input. The EMP had a design life of five missions provided that at least one of those missions included the largest booster that could be flown from KLC. That requirement was met in September 2001 with the launch of a Lockheed/Martin Athena, which was followed by the fifth launch from KLC later in the year. Following completion of the EMP studies, AADC requested that ENRI convene the agencies to review the summary findings (ENRI 2002d) and determine future courses of action. That meeting was held in March 2002. Attendees included the U.S. National Marine Fisheries Service (NMFS), Alaska Department of Environmental Conservation (ADEC), and Alaska Division of Governmental Coordination. All participants expressed an interest in continuing with the overarching intent of the EMP.

Subsequent to this, the U.S. Fish and Wildlife Service (USFWS) issued a letter addressing the effects of activities at KLC as they relate to the endangered short-tailed albatross (*Diomedea albatrus*) and the threatened population of Steller's eider (*Polysticta stelleri*). USFWS concurred with the finding that noise associated with rockets of the sizes being launched at KLC are not likely to adversely affect Steller's eiders or short-tailed albatross (Rappoport 2004). After the IFT 13C mission, USFWS requires no further monitoring of launches at KLC for effects to Steller's eiders.

The primary KLC environmental monitoring study area was set in a September 1996 meeting of AADC with representatives of the USFWS; NMFS; U.S. Department of Transportation, Federal Aviation Administration, Office of the Associate Administrator for Commercial Space Transportation; and ENRI. It focuses on the lands and waters within a circular area having a 6-mile radius extending out from the KLC launch pad (Figure 1). The IFT 13C environmental monitoring studies focused on the same study area and included rocket motor noise measurements, Steller's eider surveys, and environmental quality tasks.

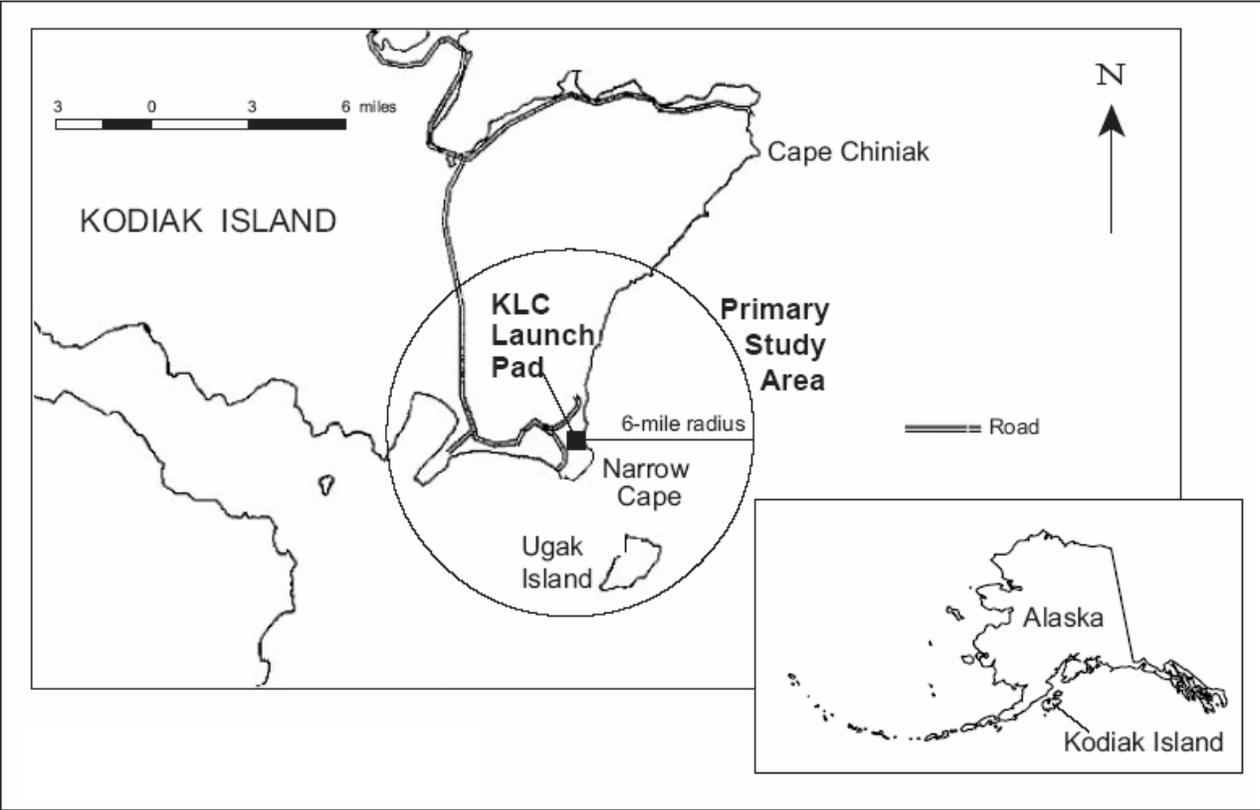


Figure 1. Primary study area.

# Rocket Motor Noise Measurements

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## Objectives

The principal objective of the KLC rocket motor noise measurements task is to monitor sound pressure levels at the Ugak Island Steller sea lion haulout. In keeping with an interim agreement with NMFS pending the issuance of an incidental take permit, this monitoring is to take place while sea lions are present at the haulout (June–September). A secondary objective is to monitor sound levels on Narrow Cape.

## Methods

NMFS has stipulated that both sound intensity and frequency be recorded during KLC rocket launches in order to get a complete measure of sound. Several metrics are available for quantifying sound pressures, as described in ENRI 1999, 2000, 2001, 2002a, and 2002b. For the IFT 13C launch, ENRI used two Larson-Davis model 870/875 sound level monitors (SLM) to record A-weighted Sound Exposure Level (SEL), maximum ( $L_{\max}$ ), and peak metrics equal to or above 70 decibels (dB).

Both SLMs were deployed on Narrow Cape, since the IFT 13C launch took place in December when sea lions are not present in the area. Each was mounted on a permanent stanchion, one at the northwest corner of Narrow Cape and the other at the northeastern-most point of the Narrow Cape peninsula (Figure 2). ENRI calibrated the SLMs in the office and checked them soon after their retrieval from the field to verify calibration. They were deployed 8 hours before the IFT 13C launch and retrieved the next day after 18 hours of operation. The data were then downloaded for later analysis.

## Results

The sound pressure levels of rocket motor noise resulting from the IFT 13C launch were similar at the two Narrow Cape sites (Table 1). This was expected due to the close proximity of the two sites. The bulk of the sound energy at Narrow Cape was at low frequencies and generally less than 5,000 Hertz (Hz) (Figure 3), which is characteristic of rocket motors and almost identical to that seen for the first *atmospheric interceptor technology (ait-1)* launch from KLC in November 1998 (ENRI 1999).

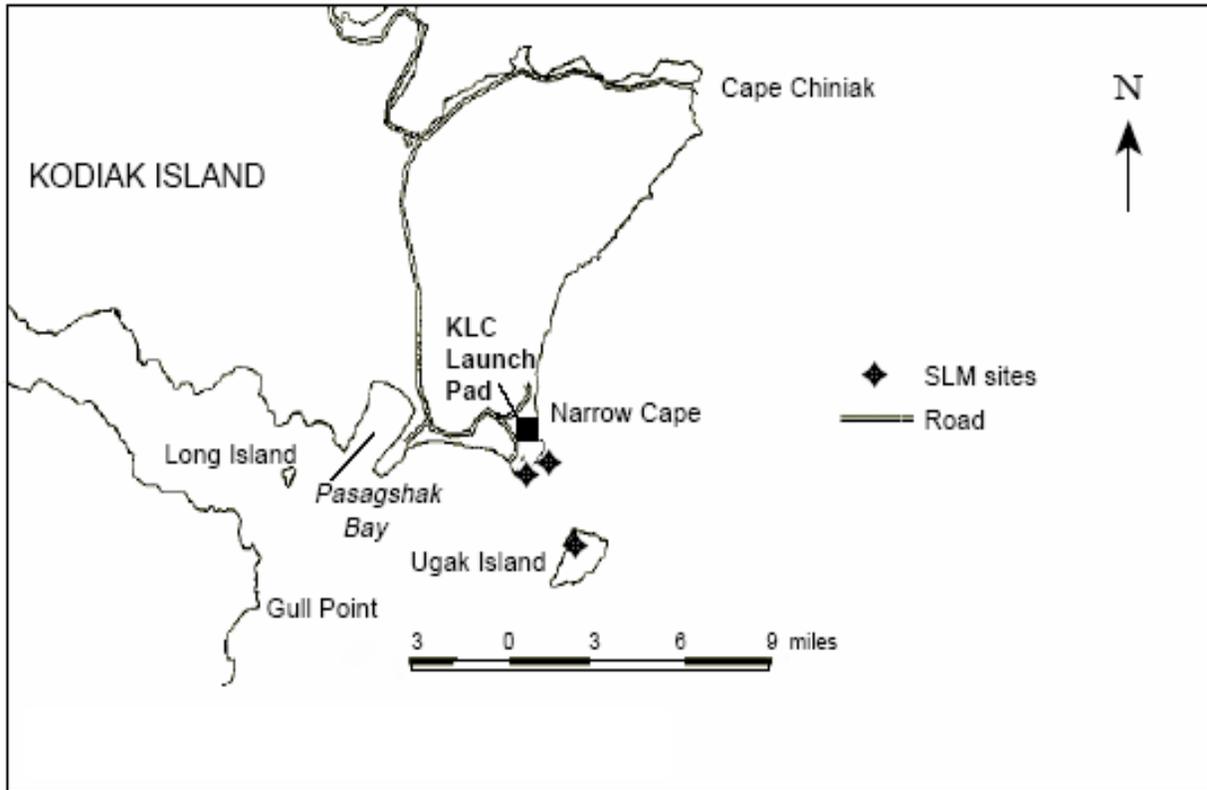


Figure 2. SLM recorder locations.

Natural background noise levels above 70 dB were prevalent at both sites during the IFT 13C monitoring period. There were over 300 exceedance events (sounds above 70 dB) recorded by the 870/875 SLMs in the 18 hour period of record. With the exception of helicopter noise and the rocket launch, all exceedances at or just above 70 dB can be connected to weather-related noise (wind and rain). Appendix A provides the record of noise-related data gathered by the 870/875 SLMs for the helicopter and IFT 13C launch.

Table 1. Noise measurement summary, IFT 13C launch, 14 December 2004.

Site	Duration (seconds)	Leq (dB)	SEL (dB)	L <sub>max</sub> (dB)	Peak (dB)
Northwest Narrow Cape	51.6	97.1	114.3	105.2	128.8
Northeast Narrow Cape	40.4	95.1	111.1	105.2	126.1

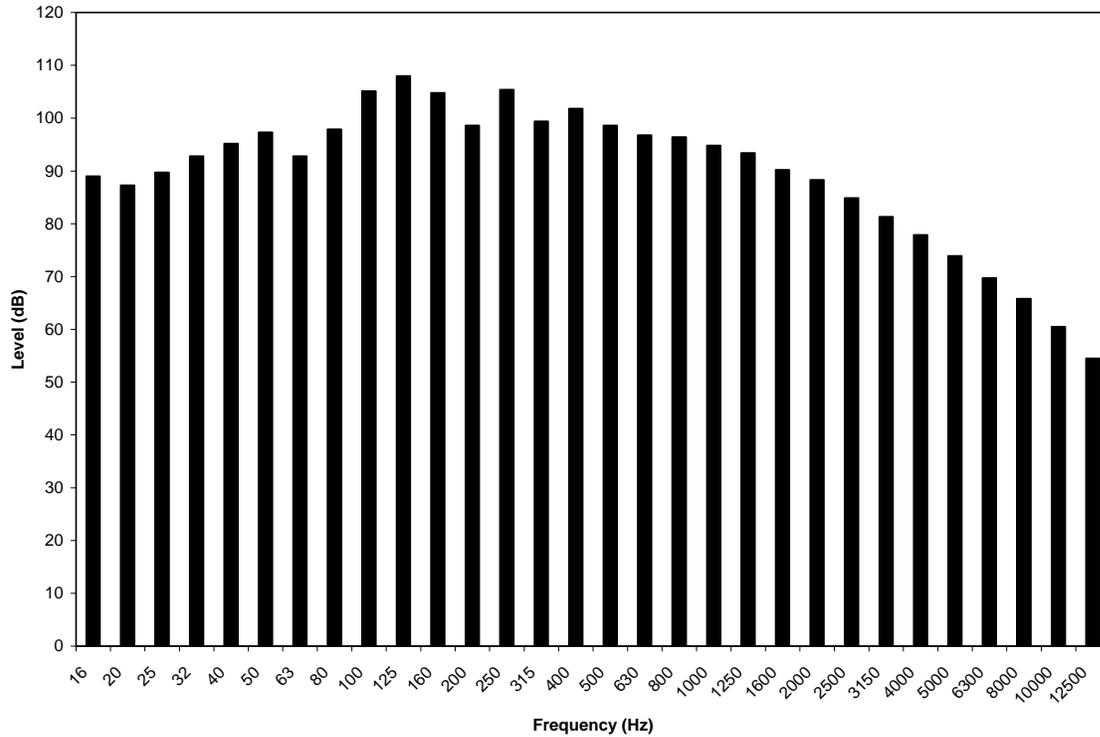


Figure 3. Event maximum spectra at Narrow Cape, IFT 13C launch, 14 December 2004.

## Discussion

The recorded sound levels at Narrow Cape were slightly higher but similar to previous KLC launches of similar sized rockets (Table 2), especially the two *ait* launches but also the Quick Reaction Launch Vehicle (QRLV). Differences are likely due to a different trajectory and local atmospheric conditions. Noises associated with the IFT 13C launch were similar to previous launches and were within the audible ranges of pinnipeds (Richardson et al. 1995).

Table 2. Noise parameters at Narrow Cape for *ait-1*, *ait-2*, QRLV, and IFT 13C launches.

Noise Metric	<i>ait-1</i>	<i>ait-2</i>	QRLV	IFT 13C
$L_{\max}$	104.9	103.2	95.2	105.2
SEL	113.4	110.7	102.4	114.3
Peak	124.2	124.1	112.0	128.8



# Steller's Eider Surveys

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## Objectives

The principal objectives of the KLC Steller's eider surveys task are to document whether rocket motor noise causes 50% or more of Steller's eiders in the primary study area to leave immediately after a launch; and if so, to determine if numbers reestablish to prelaunch levels within five days. USFWS and ENRI set the 50% benchmark during the EMP review process to account for the fact that the numbers of Steller's eiders in the study area are known to fluctuate greatly—from a few dozen to a thousand or more—over short time frames. If the 50% benchmark was reached, the EMP required AADC to consult with USFWS.

## Methods

The EMP stipulated that ten replicate aerial surveys be flown—five prelaunch and five postlaunch—using a fixed-wing aircraft with two observers. A Cessna 206 was the primary aircraft used for the IFT 13C study. The surveys were flown following the survey protocols in the EMP at the slowest possible safe airspeed at about 300 feet ASL. They began just north of the Burton Ranch (which is coincident to KLC) near Lone Point and proceeded south to Narrow Cape, southeastward across the strait between Narrow Cape and Ugak Island and around Ugak Island, back across the strait to Narrow Cape, westward to and around Pasagshak Bay, and then southwestward to just south of Gull Point where the surveys ended (Figure 4). The primary observer used a 1:63,360 scale U.S. Geological Survey map delineated with transect legs keyed to known points on the shore to aid in transect orientation.

Steller's eiders were the focus of the IFT 13C surveys, but all birds and marine mammals seen were identified and tallied by transect. The primary observer estimated weather variables with the potential to impact bird counts (e.g. visibility, precipitation, and glare). All data were collected verbally using a tape recorder and subsequently entered into a Microsoft Excel spreadsheet for analysis. The Student's *t*-test was used to compare mean bird abundance and taxa richness (number of species) pre- and postlaunch. Due to small sample sizes (prelaunch  $n = 4$ ; postlaunch  $n = 2$ ), a conservative alpha of 0.10 was used to reduce the likelihood of type II error (i.e., failing to detect a statistically significant difference). Analysis of covariance (ANCOVA) was used to statistically remove the influence of any weather variable deemed to impact bird richness or abundance. Such an analysis removes variability caused by covariates (i.e., weather) and allows an unbiased examination of the independent variable in question (i.e., rocket motor noise).

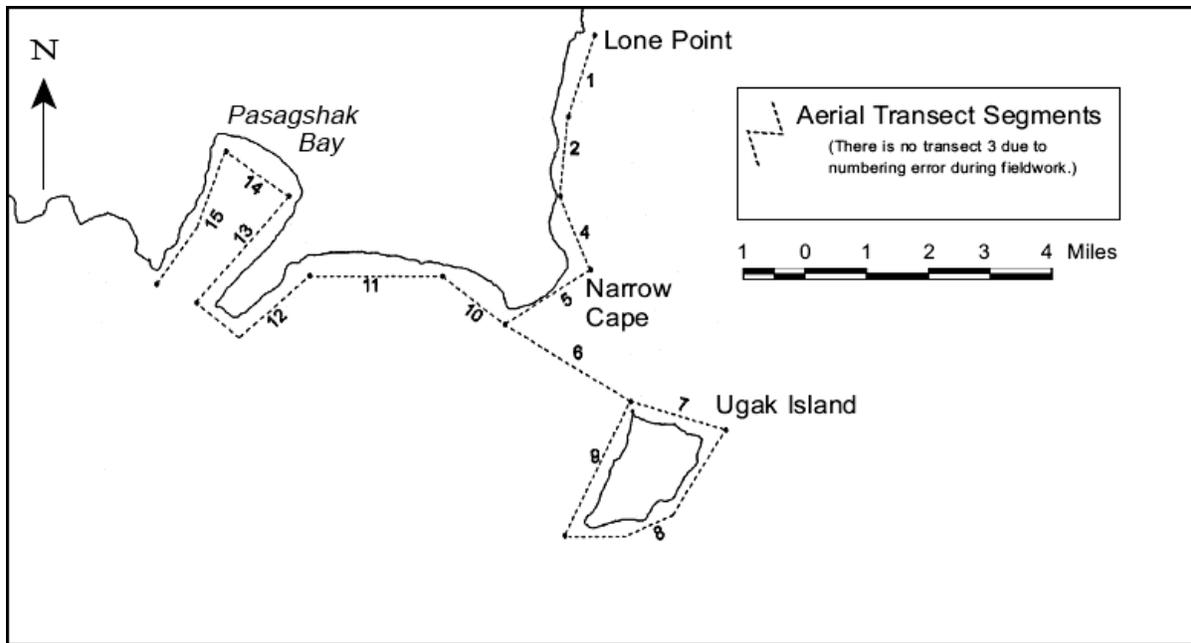


Figure 4. Bird survey aerial transects.

## Results

Six aerial bird surveys were successfully flown—four prelaunch and two postlaunch. Appendix B provides the date, time, and weather conditions for each survey. Strong winds on the second survey made viewing, identifying, and counting birds difficult. That count could be inaccurate and should be viewed with caution. Weather conditions for the other survey dates were generally conducive to locating, counting, and identifying birds. Prelaunch surveys started on 4 December (10 days before launch) and ended on 10 December (4 days before launch). Due to adverse weather conditions and launch postponements, no surveys were flown the three days immediately prior to or on the day of the launch. The 14 December after-dark launch did not allow an immediate postlaunch survey to be flown, and adverse weather prohibited flying the first postlaunch survey until the morning of 16 December. No Steller's eiders were observed during any of the surveys. Postlaunch surveys were discontinued after 17 December due to poor flying conditions and the lack of Steller's eiders in the area.

A total of 12 bird taxa were sighted during the six aerial surveys (Table 3). Birds of unknown species were tallied as a distinct taxon only in counts where no similar species were present. During all surveys, gull sp. represents both glaucous-winged gulls and mew gulls (gull sp. represents two taxa during surveys where individual glaucous-winged gulls were not identified). Individuals of two species accounted for 88% of the total birds tallied. Black scoter (*Melanitta nigra*) was the most common taxon in terms of numbers, followed by long-tailed duck (*Clangula hyemalis*), and unidentified gulls (*Larus* spp.) (Table 3). Appendix C provides bird data by transect. Other bird species observed in the study area during the study period, but not along any of the transects, include mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), green-

Table 3. Aerial bird survey data, December 2004.

Species	Prelaunch				Postlaunch	
	4 Dec	6 Dec	8 Dec	10 Dec	16 Dec	17 Dec
Black Scoter	445	437	695	955	649	424
Surf Scoter	12	–	3	50	–	–
White-winged Scoter	17	–	–	–	1	33
Common Eider	–	–	–	40	–	–
Harlequin Duck	10	3	–	–	27	–
Long-tailed Duck	105	280	16	185	49	56
Bald Eagle	1	–	–	–	–	–
Pigeon Guillemot	–	–	2	–	–	–
Glaucous-winged Gull	2	6	–	–	–	–
Gull sp.	25	31	19	148	79	27
Loon sp.	1	–	–	1	–	1
Cormorant sp.	5	3	9	7	7	17
Total Birds	623	760	744	1386	812	558

winged teal (*Anas crecca*), bufflehead (*Bucephala albeola*), common goldeneye (*Bucephala clangula*), Barrow's goldeneye (*Bucephala islandica*), red-breasted merganser (*Mergus serrator*), common merganser (*Mergus merganser*), horned grebe (*Podiceps auritus*), sharp-shinned hawk (*Accipiter striatus*) and gray-crowned rosy finch (*Leucosticte tephrocotis*).

The number of bird taxa observed during the prelaunch surveys ranged from 6 to 10 (mean = 7.8 ± 1.7), and 7 taxa were observed on both postlaunch surveys (Table 3). Gull sp. represents at least 2 taxa for surveys where no glaucous-winged gull were observed. Bird counts were highly variable, ranging from 623 to 1386 (mean = 878 ± 344) prelaunch and from 558 to 812 (mean = 685 ± 180) postlaunch (Table 3). No statistically significant difference between pre- and postlaunch data was detected for either taxa richness or bird abundance. Likewise, no rocket launch effect was detected when considering only transects 4 and 10, which are the transects closest to the launch pad and likely subject to noise funneling due to local topography. Bird taxa richness was not related to any weather variable (see Appendix B).

Both harbor seals (*Phoca vitulina*) and gray whales (*Eschrichtius robustus*) were observed during the six aerial surveys (See Appendix C for marine mammal data by transect.) Transect 8 on the far side of Ugak Island appeared to be a preferred haulout site for harbor seals. Seals were observed there three times during the study period; numbers ranged from 25 to 75 individuals. Individuals or pairs of seals were observed on transect 6, 7, and 10. Other harbor seal haulouts observed during the surveys include the mouth of the Sacramento River (north of the study area), Long Island, and in Portage Bay (west of the study area). Gray whales were observed in the

open water off Pasagshak Point (transect 12), between Narrow Cape and Ugak Island (transect 6), and along transect 1 during four of the six surveys. Gray whales were also observed along transect 6 by the sound monitoring and security reconnaissance crews throughout the study period. Both species were present pre- and postlaunch. No sea otters or sea lions were observed during any of the surveys.

## **Discussion**

No Steller's eiders were present in the survey area during the study period, so no conclusions can be drawn regarding the effects of rocket motor noise on this species. Bird taxa richness was not influenced by the IFT 13C launch and did not correlate to any weather variable considered. However, richness did show considerable count-to-count variation, which is likely the result of one or more unmeasured and possibly interacting variables. During a previous launch survey, ENRI (2002b) found that bird numbers were positively correlated with rising barometric pressure. However, this information was not recorded during this survey. Bird abundance and taxa richness showed considerable natural variation from survey to survey, much of which was attributable to weather. During the IFT 13C study period, the highest total number of birds was on the overall most favorable weather day (survey 4), and the lowest was on the least favorable weather day (survey 6). Such natural variability can mask the effects of episodic and relatively subtle environmental disturbances on the bird community, allowing the detection of only long-term disturbances. This caveat considered, the data from this and the other bird studies done for previous KLC launches (ENRI 1999, 2000, 2001, 2002a,b,c) strongly suggest that rocket operations are not having any measurable sustained effect on sea duck or seabird habitat use patterns around the facility.

# Environmental Quality

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## Objectives

The objective of the KLC environmental quality task is to detect any adverse effects to soil, water, and vegetation attributable to rocket flight operations. Solid rocket motors on firing release large quantities of exhaust products that consist chiefly of hydrogen chloride, carbon monoxide, nitrogen oxides, and aluminum oxide.

## Methods

For the IFT 13C launch, ENRI monitored environmental quality at KLC by taking basic surface water chemistry data to detect any changes in aquatic chemistry. Samples were taken at streams 2, 7, and 8 within the primary study area and at a reference (R) stream near Lake Rose Tead in the Pasagashak Drainage (Figure 5). ENRI added the reference stream for the IFT 13C studies in response to the March 2002 agency review meeting and at the request of NMFS and ADEC that a stream outside of the primary study area be included in the sampling regime.

Water pH, temperature, and conductivity were measured in situ following the launch using a Hanna HI 98129 Ph, EC/TDS and temperature meter. Temperature is reported as degrees Celsius (°C), and conductivity as microSiemens per centimeter ( $\mu\text{S}/\text{cm}$ ).

Water samples were collected for alkalinity analyses in clean 300 milliliter (ml) nalgene bottles and kept in a cooler until analysis. Alkalinity is typically expressed as milligrams calcium carbonate per liter ( $\text{mg CaCO}_3/\text{L}$ ). The minimum reporting limit (MRL) was  $4.0 \text{ mg CaCO}_3/\text{L}$ . The alkalinity water samples were taken to Analytica Alaska in Anchorage for analyses.

ENRI also collected water samples for total aluminum and perchlorate analyses. Samples for the aluminum analyses were collected in clean 300 ml nalgene bottles, each containing 5 ml nitric acid (2 molar concentration). Samples for the perchlorate analyses were collected in clean 300 ml nalgene bottles and refrigerated until analysis at Columbia Analytical in Kelso, Washington. U.S. Environmental Protection Agency (USEPA) method 6020 with a MRL of 2.0 micrograms per liter ( $\mu\text{g}/\text{L}$ ) (parts per billion [ppb]) was used for the aluminum analysis; USEPA method 314.0 with a MRL of  $5.0 \mu\text{g}/\text{L}$  (ppb) was used for the perchlorate analysis.

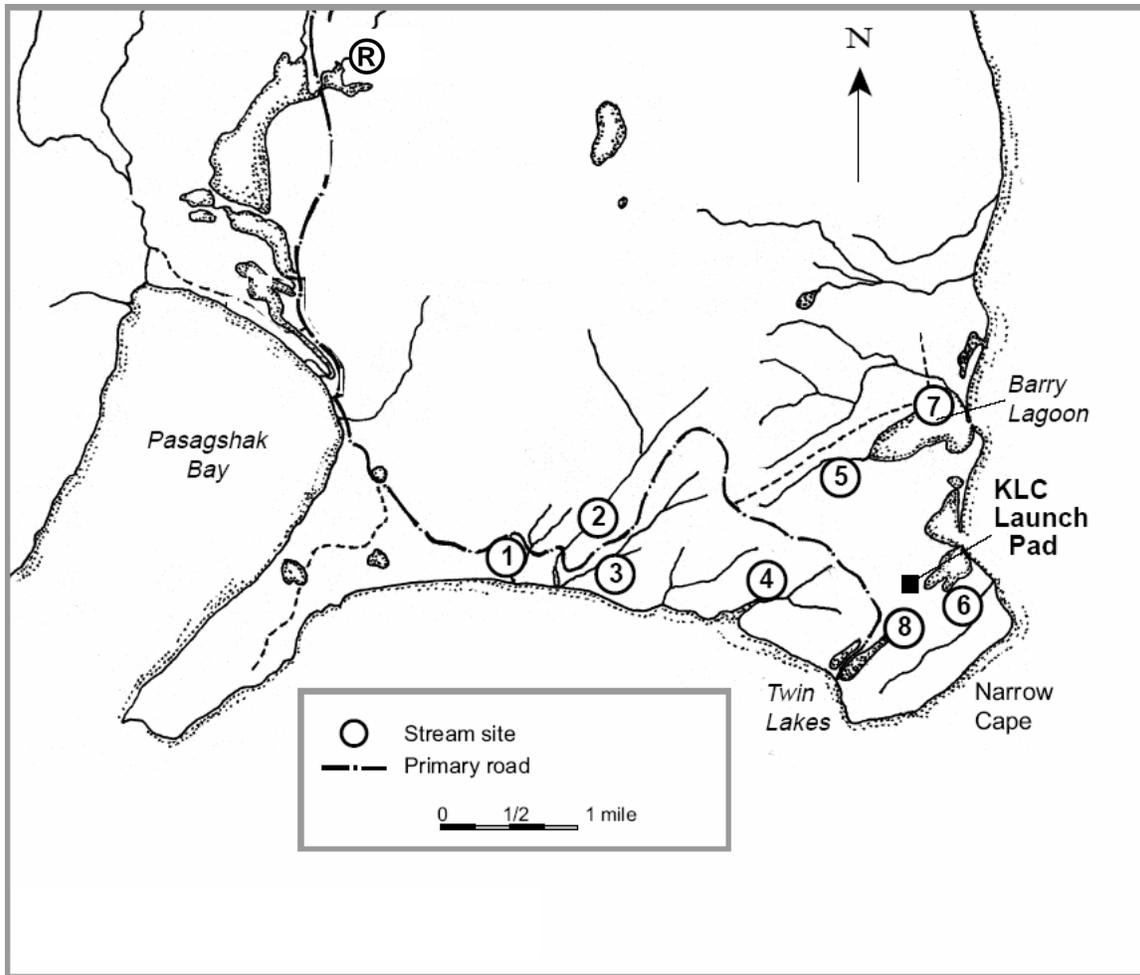


Figure 5. Water quality study sites.

## Results

In situ water chemistry (pH, temperature, and conductivity) values were all normal for the time of year and show no effects from KLC launches (Table 4). Alkalinity measures were below 20 mg CaCO<sub>3</sub>/L for all water bodies tested and were consistent with previous results in the area. This indicates a low buffering capacity in these waters. All water chemistry measurements were consistent with recorded values for the area, as well as those from previous analyses (ENRI 1999, 2000, 2001, 2002a,b,c,d).

Total recoverable aluminum was detected at very low levels for the four water bodies sampled and ranged from 11.2 µg/L at stream 8 to 82.0 µg/L at stream 2 (Table 5). Perchlorate was not detected at any site (Table 5).

Table 4. Water chemistry results.

Stream	Date	Temperature (°C)	pH	Conductivity (µS)	Alkalinity (mg CaCO <sub>3</sub> /L)
2	7 Dec	2.7	7.4	52	12.4
	16 Dec	3.9	7.2	52	9.5
7	7 Dec	2.4	7.4	51	8.6
	16 Dec	4.2	7.2	51	8.6
8	7 Dec	1.9	7.2	108	8.6
	16 Dec	3.0	7.5	98	7.6
R	7 Dec	5.2	7.1	25	7.6
	16 Dec	4.0	7.3	23	5.7

Table 5. Total aluminum and perchlorate concentration (ND = not detected).

Stream	Total Aluminum (µg/L)		Perchlorate (µg/L)	
	7 Dec	16 Dec	7 Dec	16 Dec
2	23.8	82.0	ND	ND
7	63.0	31.7	ND	ND
8	11.2	11.2	ND	ND
R	15.0	30.6	ND	ND

## Discussion

All measured water chemistry parameters (pH, temperature, and conductivity) as well as alkalinity remained normal for the area, which continues to indicate no effects to environmental quality from the KLC launches.

Total recoverable aluminum was detected in low concentrations in the four water bodies sampled and did not vary significantly pre- and postlaunch; values were similar to those detected from previous launches (ENRI 2002c,d). Importantly, there was no associated decrease in pH to warrant concern from aluminum toxicity as powdered aluminum is rapidly oxidized to aluminum oxide, which is non-toxic at the pH that prevails in surface waters surrounding KLC (U.S. Air Force 2000). Perchlorate was not detected in any water body tested near KLC. This was expected, as perchlorate would only be present at KLC if a rocket launch failed over land.



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# Appendix A

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## KLC STARS IFT 13C Sound Event Data

Northeast Narrow Cape	18
Northwest Narrow Cape	20

# Northeast Narrow Cape

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## Sound Event 1: Helicopter

**Date: 14 Dec 04**

**Time: 15:53:37 Duration: 120.2**

**Leq: 84.7 SEL: 105.5 Lmax: 95.0 Peak: 113.5 Uwpk: 123.0**

### Event Time History:

75 76 75 75 75 75 75 75 75 74 75 75 75 75 75 75 76 77 76  
75 75 75 75 75 74 74 74 74 75 75 75 75 75 75 74 74 75 76  
76 75 75 75 74 74 75 74 74 75 75 76 76 75 75 74 75 75 74 74  
74 74 74 74 74 74 74 74 75 76 75 75 75 75 74 75 76 77 78 78  
80 80 80 81 81 83 84 85 85 85 87 87 87 87 88 89 90 90 90 89  
91 92 92 92 93 94 95 95 94 93 90 87 84 80 76 73 69 66 64 63  
63 63 64 62 61 59 59

### Event Max spectra:

16 = 94.1 20 = 81.9 25 = 101.2 31.5 = 88.2 40 = 95.8  
50 = 86.7 63 = 81.0 80 = 85.8 100 = 82.6 125 = 79.6  
160 = 94.8 200 = 88.4 250 = 88.7 315 = 87.6 400 = 86.0  
500 = 84.9 630 = 84.7 800 = 84.2 1000 = 84.4 1250 = 84.3  
1600 = 83.5 2000 = 81.9 2500 = 80.3 3150 = 79.1 4000 = 77.7  
5000 = 76.9 6300 = 75.5 8000 = 75.2 10000 = 75.9 12500 = 75.8  
UnWgt = 104.7 A Wgt = 94.3 C Wgt = 102.2 D Wgt = 100.2

### Event Leading Edge spectra:

16 = 83.9 20 = 82.5 25 = 79.9 31.5 = 78.6 40 = 74.7  
50 = 77.4 63 = 70.1 80 = 67.1 100 = 67.4 125 = 66.1  
160 = 66.6 200 = 68.1 250 = 70.6 315 = 69.4 400 = 68.0  
500 = 65.6 630 = 65.1 800 = 65.2 1000 = 67.7 1250 = 63.4  
1600 = 60.9 2000 = 62.3 2500 = 59.5 3150 = 60.5 4000 = 59.4  
5000 = 61.0 6300 = 61.4 8000 = 60.7 10000 = 65.1 12500 = 58.0  
UnWgt = 88.9 A Wgt = 75.4 C Wgt = 84.7 D Wgt = 81.5

### Event Trailing Edge spectra:

16 = 85.7 20 = 86.4 25 = 87.2 31.5 = 79.3 40 = 81.6  
50 = 80.7 63 = 74.3 80 = 73.9 100 = 68.4 125 = 66.0  
160 = 75.8 200 = 75.3 250 = 72.6 315 = 70.4 400 = 69.2  
500 = 67.6 630 = 68.2 800 = 67.9 1000 = 68.0 1250 = 66.2  
1600 = 66.2 2000 = 64.6 2500 = 62.7 3150 = 60.8 4000 = 58.9  
5000 = 57.9 6300 = 56.7 8000 = 56.1 10000 = 55.0 12500 = 58.5  
UnWgt = 92.8 A Wgt = 77.2 C Wgt = 88.9 D Wgt = 83.3

## Sound Event 2: STARS IFT 13C Launch

**Date: 14 Dec 04**

**Time: 20:43:30 Duration: 40.4**

**Leq: 95.1 SEL: 111.1 Lmax: 105.2 Peak: 126.1 Uwpk: 132.5**

### Event Time History:

66 66 64 64 63 63 62 61 63 68 70 71 74 80 95 98 104 104 102 101  
100 98 97 95 95 93 93 91 89 89 87 87 84 83 81 79 77 75 75 73  
76 75 74 74 72 70 69 69 69 68 68 66 65 64 67 67 67 67 65 64  
63

### Event Max spectra:

16 = 91.6 20 = 98.1 25 = 94.9 31.5 = 96.1 40 = 104.0  
50 = 103.8 63 = 106.1 80 = 104.4 100 = 105.4 125 = 101.1  
160 = 99.6 200 = 103.5 250 = 103.8 315 = 104.3 400 = 102.0  
500 = 99.5 630 = 98.8 800 = 95.4 1000 = 95.4 1250 = 93.4  
1600 = 92.0 2000 = 89.7 2500 = 86.9 3150 = 83.7 4000 = 79.7  
5000 = 76.1 6300 = 73.1 8000 = 69.9 10000 = 67.0 12500 = 60.2  
UnWgt = 114.9 A Wgt = 106.0 C Wgt = 114.3 D Wgt = 111.3

### Event Leading Edge spectra:

16 = 83.2 20 = 81.6 25 = 84.5 31.5 = 80.4 40 = 82.2  
50 = 80.7 63 = 78.9 80 = 77.6 100 = 77.6 125 = 75.8  
160 = 70.0 200 = 70.3 250 = 72.7 315 = 74.4 400 = 76.6  
500 = 75.7 630 = 75.0 800 = 73.5 1000 = 72.1 1250 = 70.1  
1600 = 68.4 2000 = 65.4 2500 = 60.2 3150 = 53.8 4000 = 48.5  
5000 = 45.1 6300 = 43.9 8000 = 43.7 10000 = 43.6 12500 = 41.3  
UnWgt = 91.8 A Wgt = 81.0 C Wgt = 89.3 D Wgt = 85.0

### Event Trailing Edge spectra:

16 = 87.9 20 = 88.2 25 = 86.8 31.5 = 86.5 40 = 80.4  
50 = 77.5 63 = 82.1 80 = 86.5 100 = 87.2 125 = 85.2  
160 = 78.1 200 = 84.4 250 = 80.2 315 = 82.1 400 = 79.5  
500 = 77.8 630 = 75.0 800 = 70.8 1000 = 68.6 1250 = 62.6  
1600 = 57.1 2000 = 50.5 2500 = 46.3 3150 = 43.2 4000 = 41.2  
5000 = 39.8 6300 = 39.2 8000 = 38.8 10000 = 39.0 12500 = 39.2  
UnWgt = 96.7 A Wgt = 82.8 C Wgt = 94.6 D Wgt = 89.4

# Northwest Narrow Cape

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## Sound Event 1: Helicopter

**Date: 14 Dec 04**

**Time: 15:57:58 Duration: 135.4**

**Leq: 93.0 SEL: 114.3 Lmax: 103.5 Peak: 124.5 Uwpk: 128.8**

### Event Time History:

82 82 82 83 83 84 83 82 82 82 83 84 84 84 83 83 83 83 84 83  
83 84 84 84 84 83 84 84 84 84 83 83 84 84 84 83 83 83 83 82  
82 83 83 84 84 84 84 84 84 84 83 84 84 84 83 83 83 83 83 83  
84 84 84 83 82 82 83 83 82 82 84 86 86 86 86 88 89 89 89 89  
91 93 95 96 96 95 94 94 94 94 97 97 97 96 96 99 102 103 103 102  
103 102 103 102 103 101 97 93 89 85 82 78 74 71 69 68 68 67 67 66  
66 69 70 68 65 63 62

### Event Max spectra:

16 = 110.5 20 = 90.3 25 = 100.9 31.5 = 96.7 40 = 97.8  
50 = 92.5 63 = 98.5 80 = 101.6 100 = 97.5 125 = 89.9  
160 = 100.8 200 = 97.0 250 = 97.0 315 = 97.6 400 = 95.9  
500 = 95.1 630 = 93.7 800 = 93.4 1000 = 93.6 1250 = 93.8  
1600 = 93.1 2000 = 90.6 2500 = 89.4 3150 = 89.1 4000 = 87.7  
5000 = 86.6 6300 = 85.4 8000 = 84.8 10000 = 83.9 12500 = 84.5  
UnWgt = 113.4 A Wgt = 103.6 C Wgt = 110.1 D Wgt = 109.4

### Event Leading Edge spectra:

16 = 92.3 20 = 88.4 25 = 90.2 31.5 = 86.2 40 = 82.2  
50 = 80.7 63 = 75.4 80 = 73.2 100 = 76.3 125 = 73.0  
160 = 72.7 200 = 72.3 250 = 75.3 315 = 73.5 400 = 74.4  
500 = 71.3 630 = 69.1 800 = 69.8 1000 = 81.3 1250 = 68.2  
1600 = 65.0 2000 = 67.0 2500 = 66.2 3150 = 65.5 4000 = 66.5  
5000 = 67.2 6300 = 67.1 8000 = 66.9 10000 = 69.6 12500 = 63.0  
UnWgt = 96.6 A Wgt = 83.6 C Wgt = 92.1 D Wgt = 88.1

### Event Trailing Edge spectra:

16 = 95.0 20 = 90.8 25 = 91.9 31.5 = 87.0 40 = 88.3  
50 = 84.1 63 = 80.1 80 = 76.8 100 = 70.8 125 = 68.4  
160 = 69.0 200 = 67.6 250 = 68.9 315 = 66.4 400 = 63.0  
500 = 61.3 630 = 60.8 800 = 59.7 1000 = 59.7 1250 = 59.7  
1600 = 58.7 2000 = 57.0 2500 = 55.4 3150 = 54.5 4000 = 53.9  
5000 = 53.7 6300 = 53.2 8000 = 52.2 10000 = 50.2 12500 = 48.2  
UnWgt = 98.8 A Wgt = 71.0 C Wgt = 93.7 D Wgt = 82.0

## Sound Event 2: STARS IFT 13C Launch

**Date: 14 Dec 04**

**Time: 20:42:25 Duration: 51.6**

**Leq: 97.1 SEL: 114.3 Lmax: 105.2 Peak: 128.8 Uwpk: 129.5**

### Event Time History:

59 59 59 58 59 58 58 60 61 62 69 79 90 95 98 98 98 98 99 99  
100 101 103 103 105 104 104 103 101 100 99 98 96 96 95 94 92 91 89  
88 87 86 84 83 83 84 84 84 81 80 77 75 75 75 73 72 72 71 70 70  
70 69 67 66 65 65 63 63 64 64 65 66

### Event Max spectra:

16 = 89.0 20 = 87.3 25 = 89.7 31.5 = 92.8 40 = 95.2  
50 = 97.3 63 = 92.8 80 = 97.9 100 = 105.1 125 = 108.0  
160 = 104.8 200 = 98.6 250 = 105.4 315 = 99.4 400 = 101.8  
500 = 98.6 630 = 96.8 800 = 96.4 1000 = 94.8 1250 = 93.4  
1600 = 90.2 2000 = 88.3 2500 = 84.9 3150 = 81.3 4000 = 77.9  
5000 = 73.9 6300 = 69.7 8000 = 65.8 10000 = 60.5 12500 = 54.5  
UnWgt = 113.7 A Wgt = 105.3 C Wgt = 113.5 D Wgt = 110.9

### Event Leading Edge spectra:

16 = 90.8 20 = 91.4 25 = 93.4 31.5 = 92.8 40 = 93.2  
50 = 93.8 63 = 93.2 80 = 88.0 100 = 89.2 125 = 91.3  
160 = 89.6 200 = 93.2 250 = 96.6 315 = 96.3 400 = 91.8  
500 = 92.3 630 = 91.4 800 = 89.1 1000 = 87.6 1250 = 85.7  
1600 = 83.1 2000 = 79.5 2500 = 74.9 3150 = 68.3 4000 = 59.4  
5000 = 51.9 6300 = 44.2 8000 = 40.0 10000 = 38.0 12500 = 38.2  
UnWgt = 105.4 A Wgt = 97.9 C Wgt = 104.5 D Wgt = 102.3

### Event Trailing Edge spectra:

16 = 89.1 20 = 92.0 25 = 87.3 31.5 = 82.6 40 = 83.6  
50 = 82.9 63 = 90.4 80 = 91.4 100 = 84.6 125 = 84.5  
160 = 87.8 200 = 81.1 250 = 81.3 315 = 80.4 400 = 77.9  
500 = 77.4 630 = 74.2 800 = 71.5 1000 = 64.1 1250 = 58.3  
1600 = 53.2 2000 = 47.7 2500 = 44.8 3150 = 41.3 4000 = 37.7  
5000 = 35.7 6300 = 35.5 8000 = 35.5 10000 = 36.5 12500 = 37.9  
UnWgt = 98.9 A Wgt = 82.6 C Wgt = 96.8 D Wgt = 90.4



## Appendix B

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### KLC STARS IFT 13C Weather Data

Table 1. Bird survey weather data, 4–17 December 2004 24

Table 1. Bird survey weather data, 4–17 December 2004.

Date	Survey Time		% Cloud Cover	Visibility (mi)	Wind		Precipitation	Glare	Wave Height (ft)	Comments
	Start	Stop			Direction	(mph)				
4 Dec	1215	1257	100	20–30	west	5–10	none	none	less than 2	
6 Dec	1140	1235	100	10	southeast	20–25	light rain	none	4–6	turbulent
8 Dec	1100	1150	100	10	east	10	none	none	4–6	
10 Dec	230	330	10	20–30	west	calm	none	slight	0	
16 Dec	1000	1100	100	5	southeast	10–15	light rain	none	6–8	
17 Dec	1000	1050	100	3	southeast	10–15	none	none	6–8	low fog

## Appendix C

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### **KLC STARS IFT 13C Bird Survey Data**

Table 1. Bird survey by transect, 4 December 2004	26
Table 2. Bird survey by transect, 6 December 2004	27
Table 3. Bird survey by transect, 8 December 2004	28
Table 4. Bird survey by transect, 10 December 2004	29
Table 5. Bird survey by transect, 16 December 2004	30
Table 6. Bird survey by transect, 17 December 2004	31







Table 4. Bird survey by transect, 10 December 2004.

Species	Transect														Total
	1	2	4	5	6	7	8	9	10	11	12	13	14	15	
<b>Birds</b>															
Black Scoter					30	20		30	40		550	250	25	10	955
Surf Scoter												50			50
White-winged Scoter															0
Harlequin Duck															0
Long-tailed Duck		10	10		15					35	25	70	20		185
Common Eider						20			20						40
Pigeon Guillemot															0
Bald Eagle															0
Mew Gull															0
Glaucous-winged Gull															0
Gull Sp.	3	25	5	1	75	10	2		1	3		10	3	10	148
Loon Sp.								1							1
Cormorant Sp.				1			1		3			1		1	7
<b>Total Birds</b>	<b>3</b>	<b>35</b>	<b>15</b>	<b>2</b>	<b>120</b>	<b>50</b>	<b>3</b>	<b>31</b>	<b>64</b>	<b>38</b>	<b>575</b>	<b>381</b>	<b>48</b>	<b>21</b>	<b>1386</b>
<b>Mammals</b>															
Gray Whale											2				
Harbor Seal							75								



Table 6. Bird survey by transect, 17 December 2004.

Species	Transect														Total
	1	2	4	5	6	7	8	9	10	11	12	13	14	15	
<b>Birds</b>															
Black Scoter	2	3			117			125	9	3	10	133	20	2	424
Surf Scoter															0
White-winged Scoter					1			20			2		10		33
Harlequin Duck															0
Long-tailed Duck									1			10	20	25	56
Common Eider															0
Pigeon Guillemot															0
Bald Eagle															0
Mew Gull															0
Glaucous-winged Gull															0
Gull Sp.			1		10		1	1		10	2			2	27
Loon Sp.					1										1
Cormorant Sp.		1	1		15										17
<b>Total Birds</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>144</b>	<b>0</b>	<b>1</b>	<b>146</b>	<b>10</b>	<b>13</b>	<b>14</b>	<b>143</b>	<b>50</b>	<b>29</b>	<b>558</b>
<b>Mammals</b>															
Gray Whale															
Harbor Seal							25		2						