Distribution, Habitat Use and Behavior of Cook Inlet Beluga Whales and Other Marine Mammals at the Port of Anchorage Marine Terminal Redevelopment Project June – November, 2008

Scientific Marine Mammal Monitoring Report for 2008

Prepared for

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January 2009

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1.0 Introduction

This report summarizes the Scientific Marine Mammal Monitoring Program conducted June 24 – November 14, 2008 in support of the Port of Anchorage Marine Terminal Redevelopment Project (MTRP). The program was developed in consultation with Integrated Concepts & Research Corporation (ICRC), based on the stipulations of the Marine Mammal Protection Act (MMPA) as administered by the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS). The monitoring program was designed to meet the scientific monitoring objectives set forth by NMFS, within the project scope agreed upon by the Port of Anchorage (POA), ICRC, NMFS, and the U.S. Department of Transportation, Maritime Administration (MARAD). The MARAD is the federal funding agency for all work associated with the MTRP, including this monitoring program. The scientific monitoring program was conducted by student observers from the Alaska Pacific University (APU) Marine Biology program.

This document presents information on Cook Inlet beluga whale (*Delphinapterus leucas*) and other marine mammal presence, habitat use, and behavior around the Port of Anchorage (Port) during Phase II of the MTRP during the summer and fall of 2008.

In addition to monitoring and data collection efforts, APU observers provided real-time information to the shore-based marine mammal observers working with the construction crew at the Port (marine mammal sightings, proximity of animals to the construction site). Data collected during 2008 are being added to existing data previously collected by LGL Alaska Research Associates, Inc. (LGL), to establish patterns of beluga whale distribution, habitat use, and behavior in the area of Upper Cook Inlet surrounding the MTRP footprint. During marine mammal monitoring and data collection activities, the particular emphasis was on documenting the presence of beluga whales within and near the construction area and evaluating, as practicable, the potential responses of beluga whales to construction activities. Providing real-time information to construction crews so that mitigation measures could be swiftly implemented enhanced the shore based protection program managed by the construction contractor.

2.0 Program Objectives

The Scientific Marine Mammal Monitoring Program was developed to address the following objectives:

1. Estimate the frequency at which beluga whales and other marine mammals are present in and adjacent to the MTR project footprint.
2. Characterize habitat use, movements and behavior of beluga whales during ice-free months in Knik Arm, Upper Cook Inlet, in proximity to the Port.
3. Observe, analyze and document potential changes in the behavior of beluga whales in response to in-water construction work, including pile driving and fill placement.
4. Inform the Construction Person-in-Charge (PIC) of the proximity of beluga whales to the MTRP construction area, so that in-water construction activities may be shut down if:
    a. any number of beluga whales approach within the safety zone of 200 m (656 ft) during impact or vibratory pile driving
    b. a group of whales (five or more) or a calf or calves approach within 350 m (1,148 ft) during impact pile driving activities
    c. a group of whales (five or more) or a calf or calves approach within 800 m (2,624 ft) during vibratory pile driving

APU field observers, under the direction of Associate Professor Dr. Leslie Cornick, staffed the shore-based monitoring station at Cairn Point, Elmendorf Air Force Base (EAFB). Data were collected as many as four days per week, in 4-hour shifts up to a maximum of 32 hours per week. Ms. Lindsey Kendall, APU Master of Science in Environmental Science (MSES) candidate, acted as field supervisor and trainer, as well as an additional point of contact for observers during their shifts.

3.0 Methods

3.1 Study Area and Observation Station

The study area included all waters of the Knik Arm of Upper Cook Inlet visible from the south-facing, on-shore monitoring station at Cairn Point, EAFB near Anchorage, Alaska (Figure 3.1). The station directly overlooks the MTRP construction area. At least two observers were on site during all observations shifts. An observation platform at the site provided height above sea level near the shoreline. The added height of the platform maximized the probability of detecting beluga whales in and around the Port. The selection of Cairn Point for the observation station was based on the results of whale monitoring conducted by LGL (Prevel Ramos *et al.* 2006). Cairn Point proved to be the

best place for sighting whales in the construction area and associated safety zones. The POA received a right of entry from EAFB to access Cairn Point for the purpose of conducting marine mammal monitoring activities. APU observers cooperated with POA and EAFB personnel and underwent all necessary training to ensure compliance with POA and EAFB safety and security policies.

3.2 Sampling Effort

Marine mammal monitoring was conducted up to 4 days per week in 4 hour shifts up to 32 hours per week, covering the full range of tidal cycles as practicable during hours of access to the observation station (Monday through Friday 07:00 – 19:00, Saturday 10:00 – 18:00). Observation start and end times were adjusted accordingly as daylight hours decreased. A total of 611.50 hours of observation was completed from June 24 through November 14, 2008. Monthly totals are summarized in Table 3.1. Monitoring days were scheduled to provide a sample of beluga whale use of the area under varying conditions (e.g., noise, vessel traffic, environmental conditions), while accommodating the logistical, safety and security concerns of POA, EAFB, ICRC and APU.

Table 3.1. Summary of Observational Effort by Month.

	Days	Hours
June	4	27.67
July	19	150.17
August	17	120.50
September	14	133.83
October	22	128.00
November	10	51.33
Total	**86**	**611.50**

Figure 3.1. Map of study area with 500 x 500 m grid overlay. Grid cells encompassing the project footprint are D9 – I9. Cairn Point observation station is in grid cell J9.

3.3 Sampling Protocols

3.3.1 Environmental Conditions

Environmental data pertaining to sighting conditions were logged hourly during observation sessions. These conditions included air temperature, wind speed, sea state (Beaufort scale), glare (when present), percent cloud cover and precipitation.

3.3.2 Port of Anchorage Activities

The number and type of vessels at the Port were documented during monitoring sessions throughout the observation period. Project activities, including pile driving, dredging and in-water fill placement, were noted at regular intervals during all observation periods in order to facilitate examination of beluga whale occurrence and behavior with respect to these activities.

3.3.3 Beluga Whale Observations

Beluga whale observations were conducted following the method described by Prevel Ramos *et al*. (2006). Observers conducted 10-minute scan samples of the study area with the naked eye and using Bushnell 7 x 50 binoculars with an internal compass. If beluga whales were observed, the following sighting information was documented on a marine mammal monitoring form (Appendix I): date, time, number of whales sighted, age class (adult, sub-adult, calf; estimated by color), heading, activity, location and group swimming formation (Funk *et al*. 2005).

In addition to basic sighting information (date, time and number of whales), detailed data were collected as feasible and practicable regarding the locations, movements, and behavior of beluga whales near the Port according to the protocol developed by Funk *et al*. (2005). A grid-cell mapping system was used, with distances estimated by eye, to estimate beluga whale distribution and location. Focal group sampling was used to document the behavior of whales. In addition to this scientific monitoring program, the construction contractor conducting in-water work at the Port was required to have shore-based observers to watch for marine mammals and implement shut-down procedures as necessary. The POA requested that all POA staff and users report observations of marine mammal activity at the Port.

Other marine mammals were also recorded during the scan samples described above. However, beluga whales were by far the most frequently observed, and were the only marine mammals present in the study area long enough to document behavior and movements.

3.3.4 Theodolite Tracking

A tripod-mounted surveyor's theodolite (Topcon DT-200) connected to a laptop computer was used to track beluga whale movement patterns following Prevel Ramos *et al*. (2006). In short, horizontal (azimuth) and vertical (declination) readings from the theodolite were used to calculate the position of whales. Accurate assessment of whale group locations was facilitated by precise measurement of height and location of the station and input of tide tables to account for tidal variation during the sample. Tide tables were derived from J Tides (<http://www.arachnoid.com/JTides>) a tidal prediction program that incorporates a worldwide database of tide and current reporting stations. The Anchorage (Knik Arm) NOAA reporting station located at the POA was used for the purposes of this study.

Fixes of multiple objects provided information about distance between objects (e.g., whales) and orientation (toward, away or neutral). Location and other data were captured by instantaneous download into *Pythagoras* software (free download and information available at http://www.tamug.edu/mmrp/pythagoras/) for calculation of position, movement, and distance in real time, as well as time stamping of horizontal and vertical angle-fix information, input of other observations (e.g., group size, behavior, and environmental parameters), and rapid, real-time longitude-latitude position and movement pattern calculations. GIS-compatible whale tracks were calculated to estimate distances between whales and shore.

3.3.5 500m x 500m Grid

In order to maintain sighting consistency and allow for simplified display of spatial data with respect to the Project footprint, APU also continued to employ a grid system (500m x 500m grids) to monitor the locations and movements of beluga whales in Knik Arm (Funk *et al*. 2005). Observers used a combination of compass bearings taken from binoculars and landmarks to place whale groups in grid cells during each sampling interval. Grid cell locations were updated as the whales moved through the area. The MTR Project footprint is located within cells D9 to I9 of the grid.

3.3.6 Group Size, Composition and Behavioral Sampling

When whales were sighted during scan samples, detailed focal group behavior was sampled continuously until whales were out of view (Martin and Bateson 1986, Mann 2000). Behavioral state (traveling, milling, resting, feeding), swimming formation, inter-individual distance/group spread and noteworthy behavioral events (e.g., spy hopping, vocalizations, rapid chases) were documented for each group.

3.4 Data Entry and Analysis

All observations including marine mammal activity, environmental conditions and vessel activity were documented on standardized datasheets (Appendix I). Data were then checked for accuracy and entered into SPSS v. 15 for Windows and/or Microsoft Excel for Windows for storage and analysis.

3.4.1 Environmental Conditions

Environmental conditions were summarized for each month in order to characterize the predominant viewing conditions.

3.4.2 Temporal Distribution

Beluga whale sightings were summarized by time of day, month, tidal stage and season (summer and fall). One-way ANOVA or chi-squared goodness of fit tests were used to examine differences in mean durations of whale sightings (ANOVA) and number of groups and total number of whales (chi-squared) across time of day, tidal stage and season. Alpha levels were set at $p < .05$. All values are reported as mean ± 1 standard error unless otherwise noted.

Sampling intervals were classified into their observational hour by the start time of the interval. Observational hours were defined as each hour on the hour from 08:00 – 19:00 in order to encompass the entire range of effort hours.

Tidal stages derived from J-Tides were verified, and if necessary corrected, based on the NOAA Tides and Currents website (www.tidesandcurrents.noaa.gov). Tide data from the Anchorage (Knik Arm) NOAA reporting station located at the Port (station ID 9455920) were used for the purposes of this study. Daily tidal heights were classified into six stages, each two hours long and defined as hours before (-) or after (+) low tide (Figure 3.2).

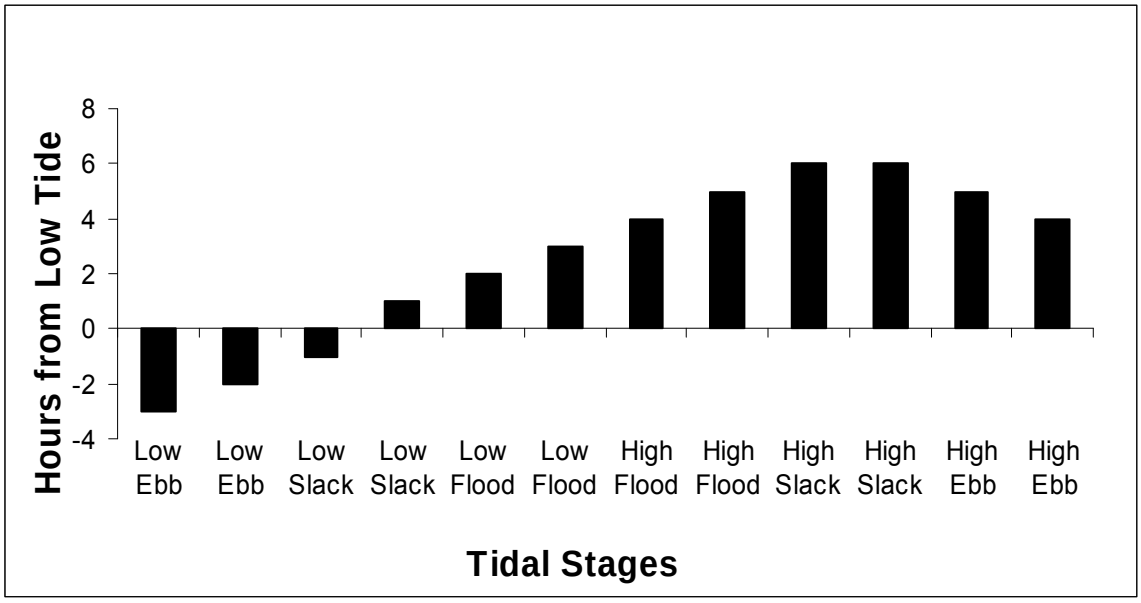


Figure 3.2 Classification of daily tidal cycles into six stages of two hours each. The stages are defined as hours from low tide.

3.4.3 Spatial Distribution

Sightings were summed for all grid cell locations where beluga whales were sighted during the observation period and classified according to whether the whales were observed outside, adjacent to or within the MTRP footprint (grid cells D9 – I9). Habitat use of whales in each location was calculated as number of groups sighted, total number of whales and total observation time.

Habitat use and movement were mapped using ArcGIS ArcInfo 9.3 to display whale track lines obtained from theodolite fixes and translated in Pythagoras. Habitat use was determined by overlapping track lines with grid cells and summing the total number of whales per group within each grid cell. Beluga sightings during tidal stages were determined by overlapping track lines with grid cell and correlating the time of day whales were observed with the tidal stage.

3.4.4 Group Size and Structure; Behavior

Mean group size and structure were analyzed for all sightings and according to whether the whales were observed outside, adjacent to or within the project footprint. Behavioral states were summarized for all whale groups observed and unusual behaviors noted.

3.4.5 Other Marine Mammals

Sightings of other marine mammals were rare, and were summarized by month and location within the study area. Brief descriptions of behavior are provided as applicable.

4.0 Results

From June 24 through November 14, 2008 a total of 283 beluga whales were sighted in the vicinity of the Port of Anchorage. 54 groups of belugas (more than one individual) were documented. These data are outlined below.

4.1 Environmental Conditions

Monthly environmental conditions are summarized in Table 4.1. Overall sighting conditions during the entire study period were moderate to excellent, with only 8 days of poor overall conditions. Beaufort sea state was most often rated as a 1 or a 2 [1]. Glare sufficient to obstruct sightings was present during 32 days of observations. However, glare was most often reported in the months with the highest number of whale sightings (Aug – Sep), suggesting that glare did not substantially affect the results.

Table 4.1. Environmental Conditions by Month.

Month	Overall Conditions	Primary Sea State	Mean Wind Speed (km/hr)	Temperature (°C)	Mean Visibility (km)	Mean Cloud Coverage (%)
June	Moderate	1	6.6	16.1	10	67
July	Excellent	1	3.3	15.2	10	84
August	Excellent	1	2.1	15.9	10	75
September	Excellent	2	2.7	11.3	10	77
October	Excellent	2	3.3	2.1	10	59
November	Moderate	2	3.1	-2.0	8	83

Overall conditions and primary sea state are reported as most frequently observed. Wind speed, temperature, visibility and % cloud cover are reported as means.

4.2 Temporal Distribution of Beluga Whales

4.2.1 Beluga whale sightings by time of day

Monitoring shifts ranged from as early as 08:00 to as late as 19:00, with shifts scheduled as either morning (usually 08:00 to 12:00) or afternoon (either 12:00 – 16:00 or 14:00 – 19:00). Effort hours were largely evenly distributed across this time range, with some tapering of the earliest morning and latest afternoon hours in November as light levels

[1] The Beaufort Sea state scale is defined as: 0 = mirror-like; 1 = ripples without foam crest; 2 = small wavelets, crests do not break; 3 = large wavelets, scattered white caps; 4 = small waves, fairly frequent white caps.

decreased. The fewest effort hours occurred during the period of 12:00 – 13:00, which was the hour when shift changes were often occurring.

Beluga whale sightings by time of day are summarized in Figure 4.1. Sightings occurred during all observation periods, with peaks in the total number of whales sighted in the late morning (10:00 – 12:00) and late afternoon (4:00 – 5:00). The greatest number of groups was also seen in the late morning (10:00 – 12:00). The lack of sightings during the 12:00 and 13:00 hours is likely an artifact of reduced effort during that period due to observer shift changes. There was a significant peak in the duration of sightings during the 13:00 and 14:00 periods ($F_{9,64}$ = 2.898, p = .01).

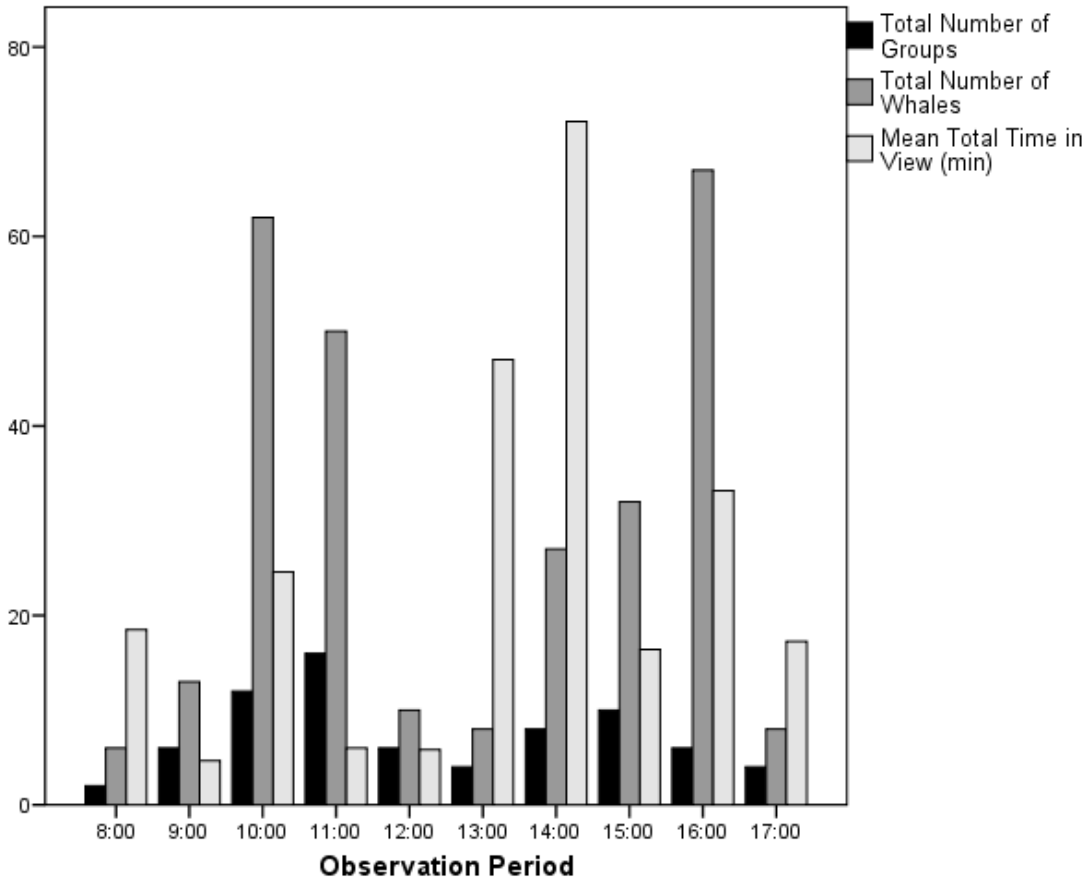
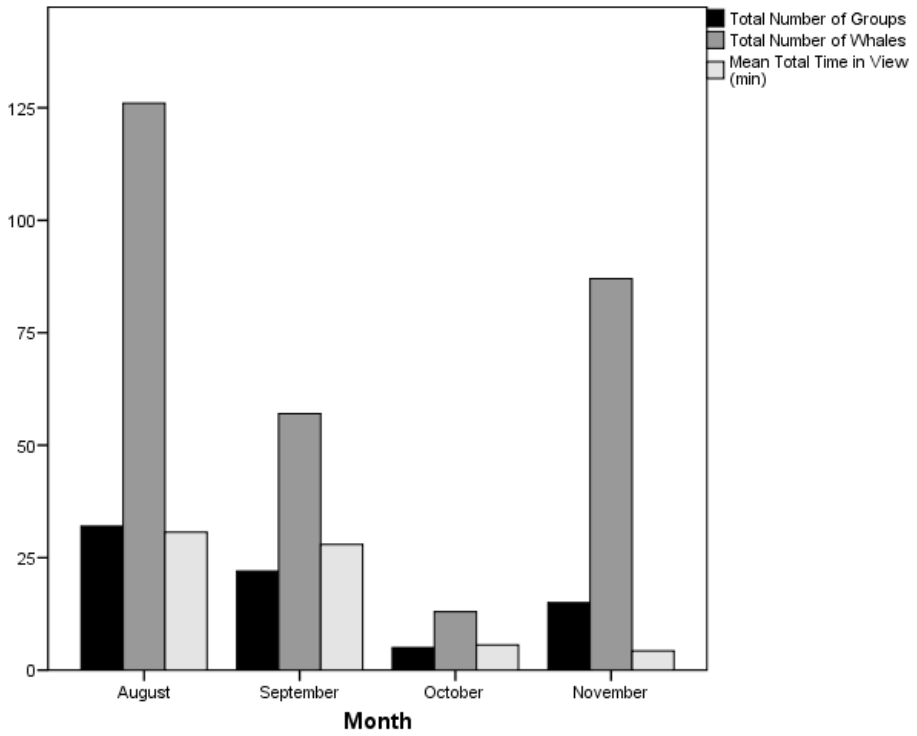


Figure 4.1. Beluga whale observations by time of day.

4.2.2 Beluga whale sightings by month and season

The vast majority of beluga whales were observed during the month of August (Fig. 4.2), with another peak in November due to two large groups that were observed near the end of the observation period. No whales were observed during June or July. This translates to a seasonal trend of slight increase in beluga whales in the fall (Sep – Nov) over the summer (Jun – Aug), however, this trend is not statistically significant (Fig. 4.3).

Figure 4.2. Beluga whale observations by month.



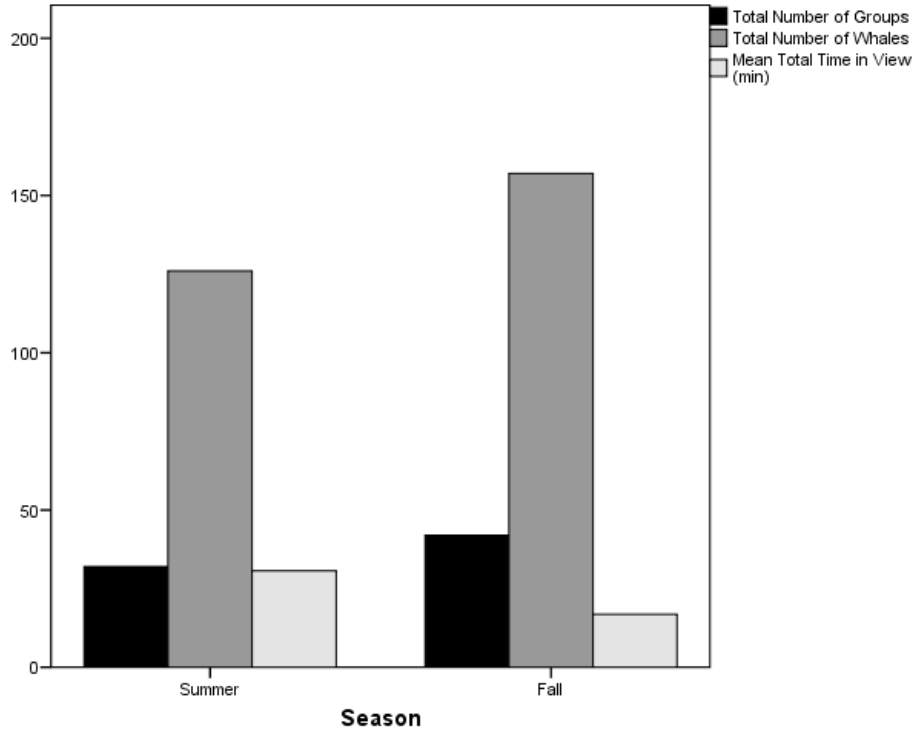


Figure 4.3. Beluga whale observations by season.

4.2.3 Beluga whale sightings by tidal stage

Whale sightings (number of groups) were evenly distributed across ebb and slack tidal stages, with the exception of very few sightings during high flood stages (Figure 4.4). There were no significant differences in the mean time whales were in view across any of the tidal stages. The greatest total number of whales were observed during low and high ebb tides, however 72 of the 111 whales observed during high ebb were in November, including two large groups (n = 57) traveling south on November 7.

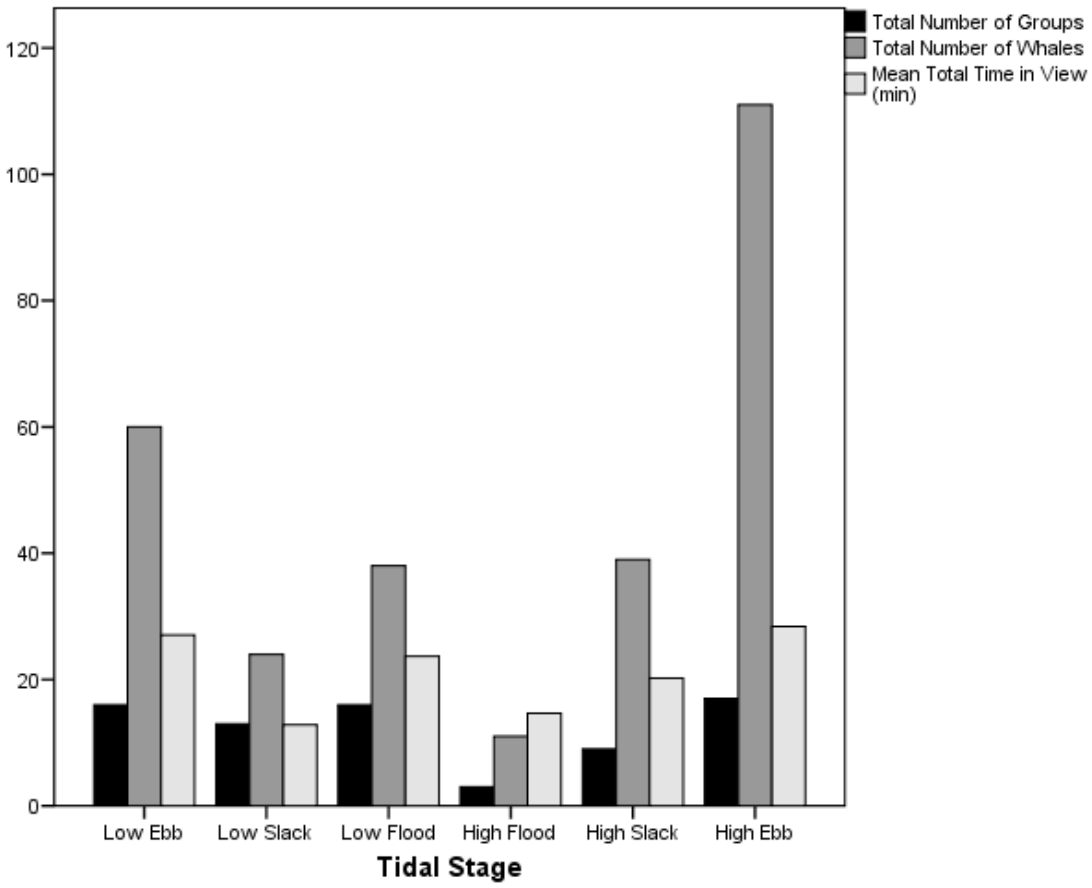


Figure 4.4. Beluga whale sightings by tidal stage.

4.3 Spatial Distribution of Beluga Whales

4.3.1 Spatial distribution relative to the MTRP footprint

Twenty-five of the sightings, approximately 34% of the total sightings, were observed in grid cells within the MTRP footprint, and another 5 sightings were adjacent to the project footprint. The total time belugas spent within or adjacent to the MTRP footprint was approximately 12.27 hours (736 minutes), ~ .02 % of the total observation time. However, the greatest concentration of whale observations (184 out of 283 individual whales, 65%) occurred within or adjacent to the MTRP footprint (Fig. 4.5).

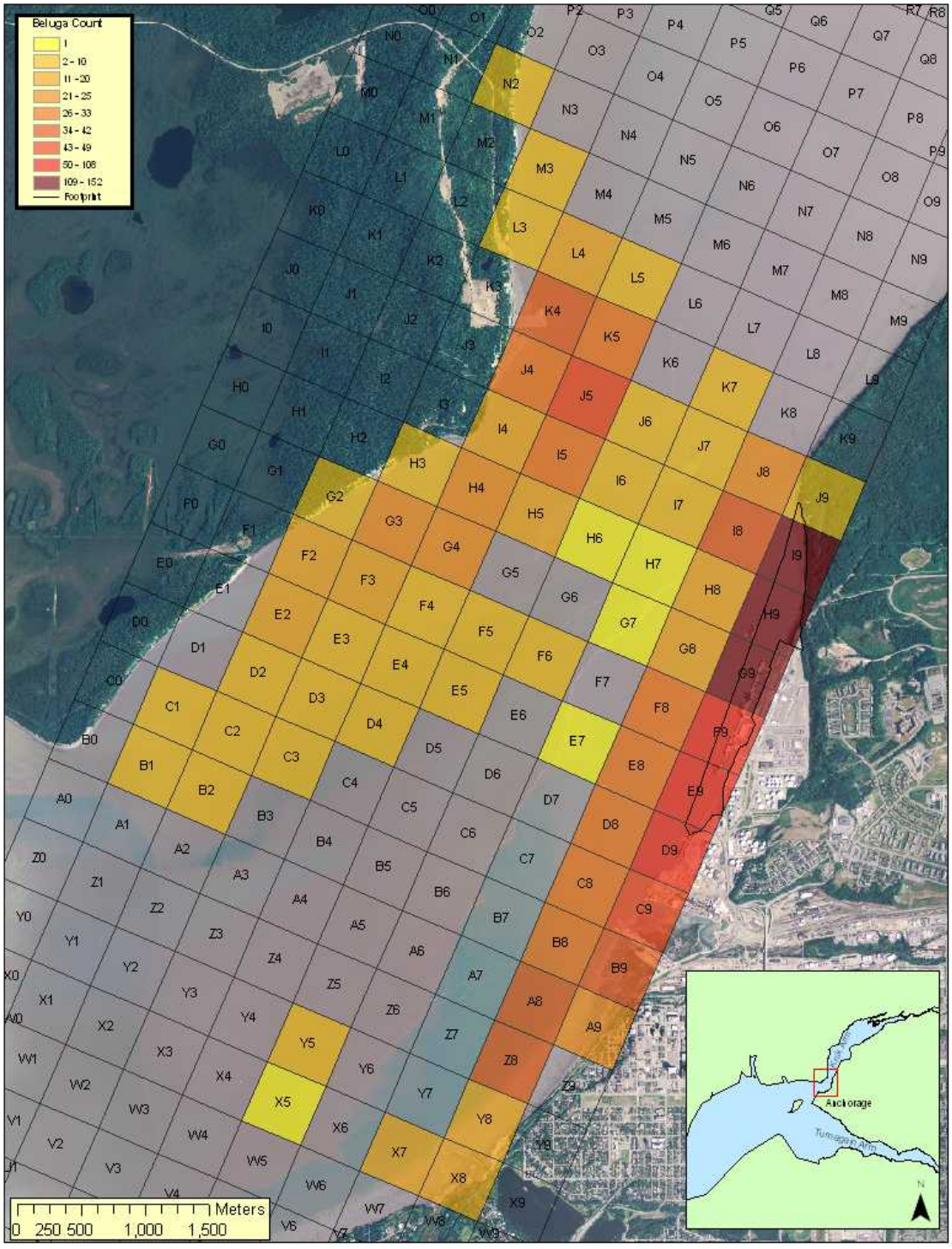


Figure 4.5. Spatial distribution of beluga whales. MTRP footprint is outlined in black within grid cells E9 – J9. Cells are color coded by the total number of whales observed during the entire study period Jun 24 – Nov 14, 2008.

4.3.2 Spatial distribution and movements by month

Overall track lines indicate beluga whales moved through the study area adjacent to the shorelines (Fig. 4.6). In August, beluga whales were observed near both shores of Knik Arm, but more frequently on the eastern shoreline, within or adjacent to the MTRP footprint. September track lines indicate whales traveled more frequently on the west side of Knik Arm near Port MacKenzie. In October and November beluga whales traveled on the east side of Knik Arm, within or adjacent to the MTRP footprint.

4.3.3 Spatial distribution by tidal stage

Spatial distribution by tidal cycle was primarily along the shore (Fig. 4.7). During low ebb and slack tides, beluga whales were fairly evenly distributed across the mouth of Knik Arm, with increased presence on the eastern shoreline during low ebb tides, and on the western shoreline during low slack tides. They were heavily concentrated on the western shoreline during low flood tides. Very few observations occurred during high flood tides, and were concentrated on the western shoreline near Port MacKenzie. High slack tide observations were also few and were split between both eastern and western shores. The majority of sightings during high ebb tides occurred in November, when substantial numbers of whales (n = 72) were observed traveling south along the eastern shoreline within and adjacent to the MTRP footprint.

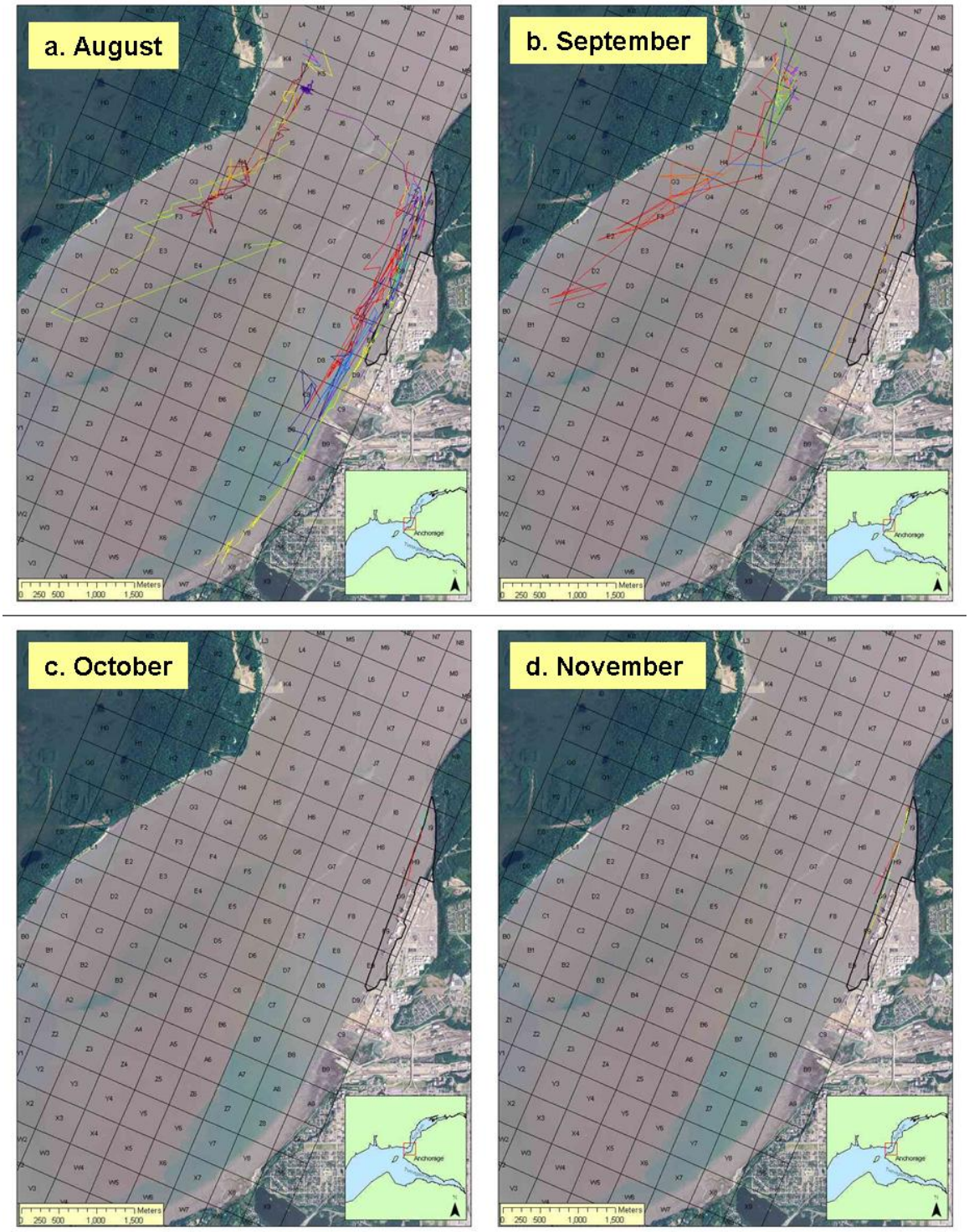


Figure 4.6. Movement of beluga whale groups by month. Each colored track line represents one beluga whale group, and does not reflect group size or composition. MTRP footprint is outlined in black.

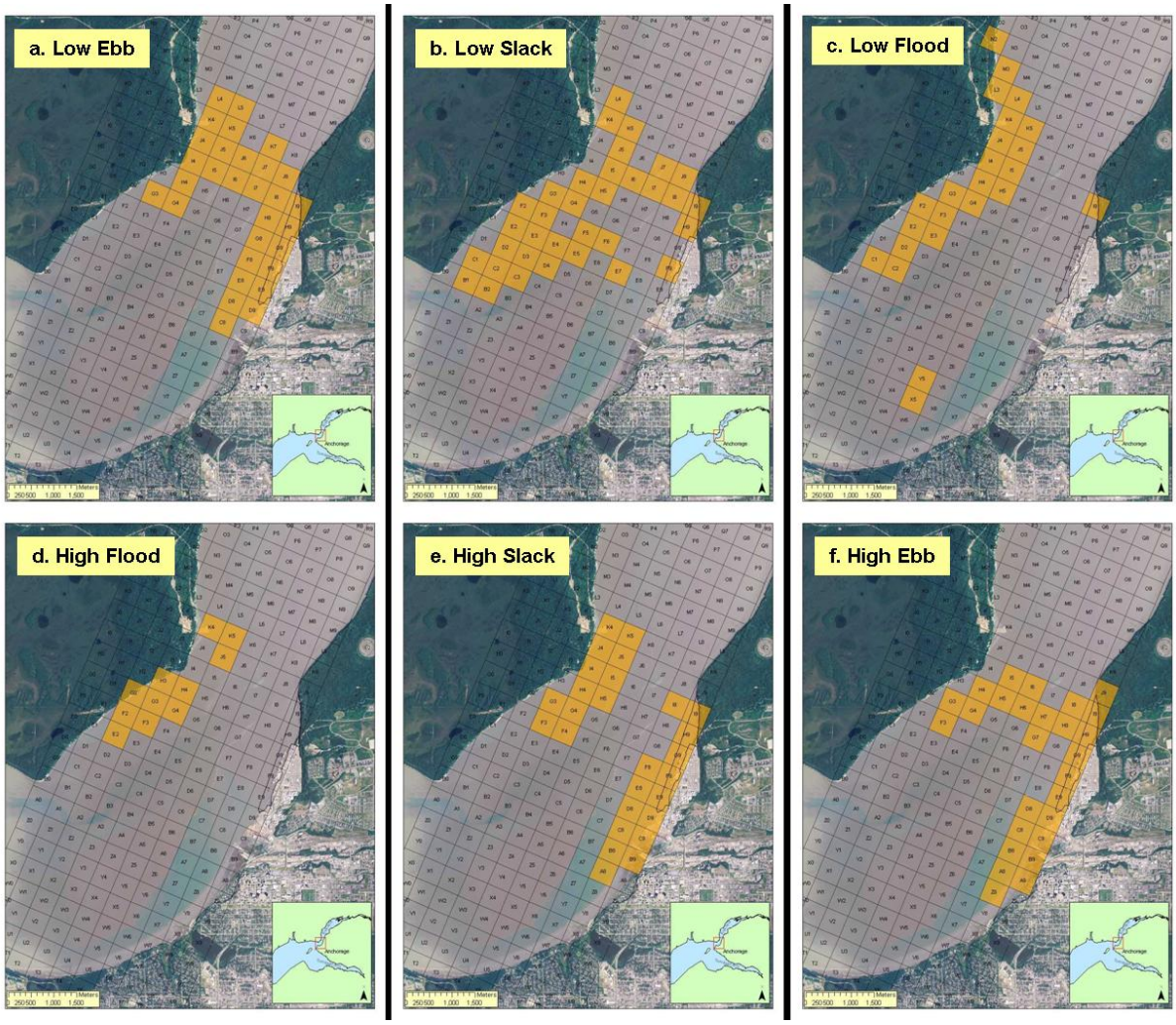


Figure 4.7. Spatial distribution of beluga whales across tidal stages. MTRP footprint is outlined in black.

4.4 Group Size and Structure of Beluga Whales

A total of 196 adults, 51 sub-adults, 26 calves and 10 animals of unknown age class were observed during the period June 24 – November 14, 2008 (Figure 4.8). Mean group size was 3.82 ± .60 individuals. Only nine groups contained identified calves, and groups with calves were larger on average (12.89 ± 3.43 individuals) than those without. All but one group containing calves were sighted within or adjacent to the MTRP footprint.

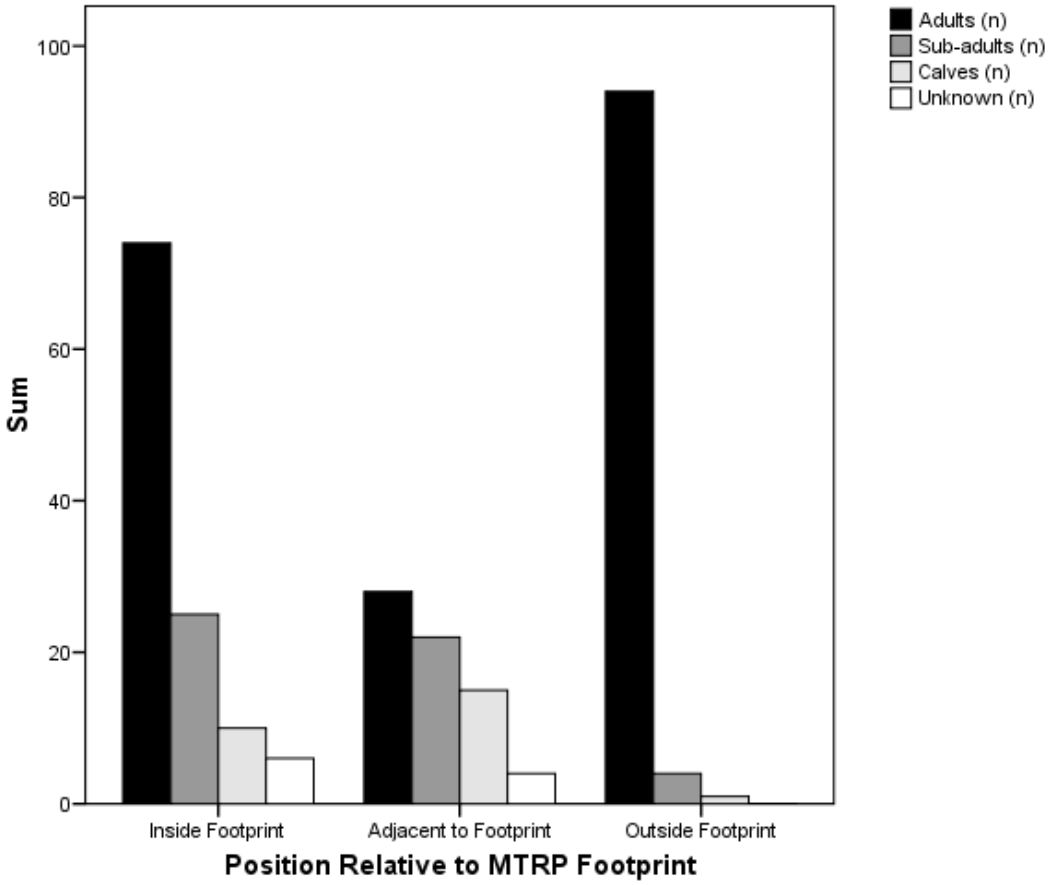


Figure 4.8. Number of beluga whales in each age class relative to appearance within the MTRP footprint.

4.5 Movements and Behavior of Beluga Whales

Whales were primarily observed moving north through the study area during the late summer and early fall, and traveling south during the late fall. Two large groups (n = 57) were observed moving south through the study area in mid-November. Confirmed diving was observed periodically (n = 18), and feeding was suspected on three occasions but never confirmed. No unusual behavioral events (e.g., abrupt directional

changes, rapid descents) were observed during the study period. Milling was the only other observed behavior (n = 10).

Forty-two of the 54 groups with more than one individual were tightly packed and moving in a unified pattern. The remainder were either traveling in a loosely packed group (n = 5) or were milling in dense (n = 2) or dispersed (n = 4) groups. All but one group with calves were traveling, and of those all but one were densely packed. The remaining group with calves was milling in a dispersed group.

4.5.1 Responses to pile driving

There were no observed behavioral changes (e.g., abrupt behavioral changes, rapid descents) or other indicators of response to pile driving or other in-water construction.

4.6 Discussion and Summary – Beluga Whales

4.6.1 Temporal Distribution

Peaks in beluga whale sightings in August and September are consistent with previous observations (Hobbs et al. 2005, Markowitz and McGuire 2007), indicating that beluga whales continue to move through Knik Arm in response to movements of their primary prey. The peak in November is consistent with an increase in late fall observations in 2007 (Cornick and Saxon-Kendall 2008). This second year of consistent November observations suggests that ice-free conditions in Knik Arm continue to persist beyond those of previous years, and beluga whales appear to be remaining in the study area until forced to move into the lower Cook Inlet by the intrusion of ice. Ice-free conditions could provide increased foraging opportunity before winter, increased protection for calves from predation or both.

4.6.2 Spatial Distribution

Spatial use patterns are consistent with those reported by Markowitz and McGuire (2007), specifically a high degree of use of the area within and adjacent to the MTRP footprint. However, Markowitz and McGuire's (2007) observational effort was focused primarily around the Port and the construction zone, so their observations did not capture the whales' substantial habitat use along the western shoreline of Knik Arm. This section of the study area would include known foraging areas around the Little Susitna River and other potential foraging areas on the side of Knik Arm opposite the MTRP footprint.

4.6.3 Group Size, Structure and Behavior

Mean group size during 2008 (~4 whales) was comparable to 2007 (~ 4 whales) and 2006 (~ 3 whales; Markowitz and McGuire 2007). However, the mean size of groups with calves was larger in 2008 than in 2006 (12 and 10 whales, respectively). Group dispersion during 2008 was comparable to 2006 and 2007, with the majority of groups of greater than one individual being tightly spaced.

Observed beluga whale behavior was also consistent with previous observations, with whales primarily traveling through the study area to and from likely foraging areas further up Knik Arm (e.g., Fish Creek, Eagle River, Eklutna). As in previous years, whales were observed following tidal cycles through the study area, moving into Knik Arm on the rising tide and back out on the falling tide, putting them primarily in the study area during low slack and ebb tides.

4.6.4 Responses to pile driving

No unusual behavioral changes or abrupt changes of direction or pattern of movements was observed during the study period, during pile driving or any other in-water construction activities. However, shore-based observations are not able to capture any responses that may occur beneath the surface, particularly vocal responses, and so we cannot definitively state that there were no responses.

4.7 Other Marine Mammals

Two harbor seals (*Phoca vitulina*) were observed during the entire period from June 24 – November 14, 2008; one on July 8 at 16:30 near the dredging activity (Grid Cell I8), the other on September 2 at 16:25 in Grid Cell J9. In both cases, the seals surfaced briefly and were not observed again. No other marine mammals (except beluga whales) were sighted by APU observers during the study period.

5.0 Summary

Overall, beluga whale habitat use, movement and behavior during the June 24 – November 14, 2008 study period were all consistent with observations by LGL in 2006 (Markowitz and McGuire 2007) and APU in 2007 (Cornick and Saxon-Kendall 2008). Beluga whales move into Knik Arm during the late summer and early fall, following their primary prey and providing increased predation protection for calves. Beluga whales appear to be responding to later ice-free conditions in the area, remaining well into November for the second year. Thus far, no obvious behavioral, habitat use or

movement changes have been observed that can be attributed to in-water construction activities at the Port.

6.0 Acknowledgements

We would like to acknowledge the contributions of several people to the successful completion of APU's second year performing marine mammal monitoring for the MTR Project. Laurie Butler, Sam Cunard and everyone at ICRC provided APU with excellent logistical support. Eight APU students worked as observers during 2008 and also assisted with data entry. The opportunity provided by ICRC and MARAD is a significant enhancement to their training in the APU Marine Biology Program.

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Appendix I

POA Land-Based Surveys of Marine Mammals: Beluga whales (*Delphinapterus leucas*)

Alaska Pacific University

Station:	Date (dd/mm/yy):	Observer(s):	Pg __ of ___
Shift Start Time (hh:mm):	Shift End Time (hh:mm):	Optic:	

Verified_________
Entered by_______
Sheet #______________

Sampling Round	Best Sample ☐	Time (hh:mm)	Count				Harbor Seal	Harbor Porpoise	Steller Sea Lion	Killer Whale	Other	Magnetic Compass Bearing 001-360°	Grid Cell	Group #	Group Code	Activity		Direction	Previously Counted Y/N/U		In-water Construction Activity		Start/End/Arrive/Leave (S/E/A/L)		Comments	Comments on the Reverse ☐
			Adults	Sub-Adults	Calves	Unk										1	2		You	Other	1	2	CON 1	CON 2	Write additional comments on the reverse side of this sheet. Be sure to identify which record additional comments are associated with.	
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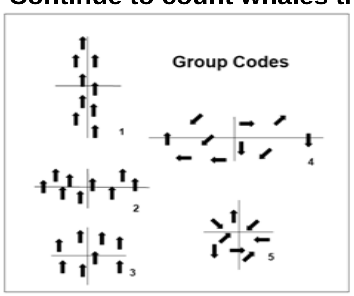
Note the time at the <u>first</u> and <u>last</u> sighting of each whale/group. Identify EACH grid cell the whales move through and note the time they enter each cell!!

Continue to count whales throughout the time the whales are in the area, until you get an accurate count (Best Sample)



Activity Code	
1	Traveling/Moving
2	Diving
3	Motionless on surface
4	Spyhopping
5	Breaching
6	Feeding Observed
7	Feeding Suspected
8	Milling

Activity Code	
9	Startled effect
10	Approaches then leaves
11	Change in swimming speed
12	Abrupt change in direction
13	Abrupt dives
14	Disperse
99	Other

In-water Construction Activities	
0	No construction
1	Soft-start
2	Impact sheet pile driving (PD)
3	Vibratory sheet PD
4	Impact pipe PD
5	Vibratory pipe PD
6	Dredging
7	In-water fill
99	Other

POA Land-Based Surveys of Marine Mammals: Environmental Conditions **Alaska Pacific University**

Station:	Date (dd/mm/yy):	Observer(s):	Pg___of___

Verified____________
Entered by__________
Sheet #_________________

Time (hh:mm)	Air Temp. (°C)	Precip Code 00-none 01-fog 02- rain 03-snow	Wind Dir. (99 if null)	Wind Speed (km/hr, nearest whole number)	Cloud Cover (%)	Vis. Dis. (km)	See Far Shore	Glare	Central Glare Bearing 001-360°	Swell (ht in m)	Sea State (Beaufort)	White Caps	Sea Ice Concentration (tenths 00-10)	Overall Conditions	# of vessels (hourly)	Comments	Comments on Reverse
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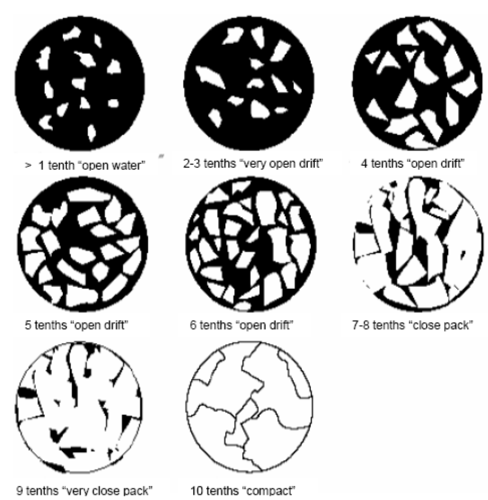
Sea State	Description
0	Sea like mirror
1	Ripples but without foam crests
2	Small wavelets
3	Large wavelets, perhaps scattered white horses
4	Small wavelets, fairly frequent white horses

Sea Ice Concentration (tenths 00-10)



Types of Vessels	
Ship	Skiff
Tug boat	Dredge
Barge	Coast Guard
Tug & barge	Other
Dredge	

Overall Conditions	
1	Poor
2	Moderate
3	Excellent