

# AERIAL SURVEYS OF BELUGAS IN COOK INLET, ALASKA, AUGUST 2007

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## Abstract

The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in northern Cook Inlet, Alaska, 1-2 August 2007. The 13.1 hour survey covered the coastal areas north of Moose Point and the Native Village of Tyonek. Consistent with NMFS surveys conducted since 1993, the August 2007 survey was flown in a high-wing, twin-engine aircraft (NOAA Twin Otter *N56RF*) at an altitude of 244 m (800 ft) and a speed of 185 km/hr (100 kt). The survey track paralleled the coast (1.4 km offshore) and crossed the Inlet the first day from just north of Moose Point to Tyonek, and the second day from Point Possession to Beluga River. Two flights were flown each day coinciding with the morning high tide and afternoon low tide. The intent of the survey was to obtain high-resolution video of each beluga group to determine age structure (white relative to gray individuals and dark gray calves) and number of calves. Video cameras used during past surveys (1999-2001 and 2002-2005) were paired with the high-definition video camera used in 2006-2007 to test for differences in video quality across years.

Despite extensive surveys of the northern Inlet, belugas were found only in the Susitna delta. During the morning high tide on 1 August, belugas were dispersed and swimming in random directions across the delta from the Ivan River to the eastern tributary of the Susitna River, precluding us from acquiring any useable video or counts. A smaller group in tight formation traveling up river near the oxbow in the Little Susitna River was video-taped and counted (median count = 27 whales). By the afternoon low tide, whales were found in three compact groups traveling along the edge of the mudflats near the mouth of the Ivan River (median count = 53 whales), the eastern tributary of the Susitna River (median count = 96 whales), and mouth of the Little Susitna River (median count = 32 whales) for a total median count of 181 whales during the afternoon tide. Similar results occurred on 2 August, with belugas found dispersed across the Susitna delta and from the mouth to approximately 5 miles up the Little Susitna River during the morning high tide. The afternoon low tide yielded two compact groups, one near the mouth of the Ivan River (median count = 88 whales) and the other near the Little Susitna River (median count = 53 whales) for a total median count of 141 whales. Belugas were not seen in Chickaloon Bay and Knik Arm. The daily median estimates (a quick index of relative abundance not corrected for missed whales) were on par with August 2006 counts (126 belugas on 16 August, 143 on 17 August) but were below counts made in August 2005 (236 belugas on 11 August, 277 on 12 August).

## Introduction

The National Marine Fisheries Service (NMFS) conducts aerial surveys to study the distribution and abundance of belugas (*Delphinapterus leucas*) in Cook Inlet, Alaska. These surveys typically occur in June and have been repeated each year since 1993 (Rugh et al. 2000, 2005a). This project is in cooperation with the Cook Inlet Marine Mammal Council (CIMMC) and the Alaska Beluga Whale Committee (ABWC). Management concerns have focused on the population of belugas in Cook Inlet because of its isolation from other beluga populations (O’Corry-Crowe et al. 1997; Laidre et al. 2000; Rugh et al. 2000) and its small size of less than 300 whales (Hobbs et al. 2000a; NMFS unpublished data). The Cook Inlet population has been designated as depleted under the Marine Mammal Protection Act (65 FR 34590) and is proposed for listing as endangered under the Endangered Species Act (72 FR 19854). The Alaska Native subsistence hunt has been managed under a Cooperative Agreements with NMFS since 2000 (65 FR 59164, Mahoney and Shelden 2000).

The objectives for the aerial survey in August 2007 were to study seasonal distribution relative to temporal habitat features (e.g. fish runs) and to use paired high-definition (HD) video cameras to document beluga groups for continued analysis of age structure (white relative to gray individuals and dark gray calves), especially at a time (August) when most calves are born.

## Methods

The survey aircraft, a Twin Otter (*N56RF*), was equipped with large bubble windows at the left and right forward observer positions. Video camera footage was obtained through an open window at the right aft position. An intercom system allowed communication among the observers, data recorder, and pilots. A computer program recorded sighting data and location data from a portable Global Positioning System (GPS). Data entries included routine updates of time, location, percent cloud cover, sea state (Beaufort scale), glare (on the left and right), visibility (on the left and right), and start and stop of survey effort. Visibility was documented in five subjective categories from excellent to useless; survey segments rated poor or useless were considered unsurveyed.

Most of the search effort was 1.4 km offshore along the coast of northern Cook Inlet (north of Moose Point and the Native Village of Tyonek). The objective was to search all nearshore, shallow waters where belugas are typically seen in summer (Rugh et al. 2000). The trackline distance from shore was monitored with an inclinometer, keeping the waterline 10° below horizontal when the aircraft was at the standard altitude of 244 m (800 ft). Ground speed was approximately 185 km/hr (100 knots). The survey included searches up rivers until the water seemed to be very shallow or a distance recommended by Alaska Native beluga hunters who surveyed with us in the past (Rugh et al. 2000). Surveys were conducted twice daily during extreme high tide in the morning and low tide in the afternoon.

Location of each whale group was established by flying directly over the group and marking a GPS position. The flight pattern used to count a whale group involved an extended oval around the longitudinal axis of the group with turns made well beyond the ends of the

group. Whale counts were made on each pass down the long axis of the oval with observers and cameras on the right side of the aircraft. Counts began and ended on a cue from the front observer, starting when the leading edge of the group was close enough to be counted and ending when the trailing edge went behind the aircraft wing. This method gives a precise record of the duration of each counting pass. Quality of each counting pass was a function of how well the observers saw the location of a group, not how many whales were at the surface. Ratings were A (if no glare, whitecaps, or distance compromised the counting effort) through F (if it was not practical to count whales on that pass). Only quality A and B ratings were used in the analysis. Although whale tracks were often seen in muddy water, only whales at the surface during a counting pass were included in the counts. The daily aerial counts are represented by medians of each of the observers' median counts on multiple passes over each whale group (Table 1). The process of using medians instead of maximums or means reduces the effect of outliers (extremes in high or low counts) and makes the results more comparable to aerial surveys that do not fly multiple passes over whale groups. Medians are also more appropriate than maximums when counts are corrected for missed whales because correction factors should be applied to the most representative counts, not the most extreme.

Paired HD video cameras were used to document beluga groups; one camera had a lens set at wide angle to capture a view of the entire beluga group, and the second camera lens was zoomed in to magnify individual whales in the group. The zoomed in video is used to determine correction factors for missed whales (see Hobbs et al. 2000b) and to examine color ratios of white relative to gray belugas (Litzky 2001; Sims et al. 2003). The paired cameras were operated on all counting passes. Video footage from the cameras will be studied in the laboratory to obtain precise counts of belugas and the relative proportions of white versus gray versus dark gray (calf) whales.

To compare the zoomed in video quality of the HD cameras used in 2006-2007 to the zoomed in video quality of cameras used in the past, an HD camera was paired with a digital Hi-8 (DHi-8) video camera (1999-2001 surveys) and a digital video (DV) camera (2002-2005 surveys). Comparisons between Hi-8 video cameras (1996-1998 surveys) and DHi-8 were conducted during the June 1999 survey (Rugh et al. 1999).

## **Results**

The 13.1 hour survey covered all coastal areas north of Moose Point and the Native Village of Tyonek (Figs. 1-2). All flights on 1-2 August 2007 (4 take-offs and landings ranging from 2.5 to 3.9 hours) were based out of Anchorage. Of the 13.1 flight hours, 7.75 hours were spent on effort (not including time spent taxiing on the runway, deadheading without a search effort, circling whale groups to conduct counts, or periods with poor or useless visibility). With the exception of high winds and whitecaps in portions of Turnagain Arm, viewing conditions were ideal during most of the two-day survey. Poor or useless visibility conditions (determined by the primary front observer) only interfered with the survey effort during 0.33 hours (4% of the effective search time). All three observers (authors of this report) have participated in this project on previous surveys.

The aerial surveys in August 2007 covered (100%) of the northern Cook Inlet coastline for most waters within 3 km of shore during high and low tide (Fig. 1). On 1 August, the morning high tide survey began at Burnt Island following the coast along Chickaloon Bay (entering Chickaloon River), rounding Point Possession then crossing the Inlet to Tyonek where the coastal survey continued to Beluga River (surveying about 5 miles up river), the Susitna delta, Little Susitna River (surveying about 7.5 miles up river), Knik Arm, back to Chickaloon with a survey of Turnagain Arm, and circling Fire Island before returning to Anchorage (Fig. 1). Two groups of belugas were found in the Susitna delta; one large group was dispersed across the mouths of both tributaries of the Susitna River and another group was in the first bend of the Little Susitna River. Counts and video passes were obtained on the smaller, more compact group in the Little Susitna River (8 passes, median count = 27 whales). On the afternoon low tide, we flew directly to the Little Susitna River and followed the coast to the Ivan River (Fig. 1). Belugas were initially in four compact groups along the edge of the mudflats but seemed to merge into three groups during counting and video-taping (Table 1). Counting and video passes were obtained starting with the group near the Ivan River (9 HD passes and 5 HD/DV zoomed passes, median count = 53 whales). A group in the eastern tributary of the Susitna River (6 HD passes and 5 HD/DV zoomed passes, median count = 96 whales) and a group near the mouth of the Little Susitna River (5 HD passes and 4 HD/DV zoomed passes, median count = 32 whales) were also counted and video-taped for a total median count of 181 whales for the afternoon tide (Table 1). We re-surveyed Knik Arm and Chickaloon Bay to ensure all belugas were accounted for (Fig. 1). Boats were not seen in coastal areas during either flight; however, multiple set nets were visible along the coast from Point Possession to just north of Moose Point on the morning flight.

The first flight on 2 August coincided with the morning high tide. We flew from Anchorage, around Turnagain Arm and Chickaloon Bay to Point Possession, across the Inlet to Beluga River (surveying about 5 miles up the river), then north around the Susitna delta (surveying 10 miles up the Susitna River), Little Susitna River (surveying 7.5 miles up the river), Knik Arm, and circled Fire Island before landing (Fig. 2). Much like the previous day, belugas were dispersed across the Susitna delta and scattered from the mouth to roughly 5 miles up the Little Susitna River. For the afternoon low tide flight, we surveyed from the Little Susitna River to the Ivan River where we found two compact beluga groups along the edge of the mudflats (Fig. 2). Counts and video passes were obtained near the mouth of the Ivan River (8 HD/DHi-8 zoomed in passes and 9 HD passes, median count = 88 whales) and the Little Susitna River (7 HD/DHi-8 zoomed in passes and 8 HD passes, median count = 53 whales) for a total median count of 141 whales (Table 1). After completing the counting and video passes, we again surveyed Knik Arm, Fire Island, Chickaloon Bay to Point Possession, crossed the Inlet to the Beluga River, and followed the coast to Point MacKenzie, finding only the two groups of belugas in the Susitna delta (Fig. 2). Belugas were absent from Chickaloon Bay and Knik Arm during the entire survey.

The daily median estimates (an index of relative abundance not corrected for missed whales) of 181 and 141 belugas were on par with August 2006 counts (126 belugas on 16 August, 143 on 17 August) but were below counts made in August 2005 (236 belugas on 11

August, 277 on 12 August). In June 2007, the daily median estimates ranged from 132 to 224 belugas (Rugh et al. 2007).

Other marine mammal sightings included one harbor seal (*Phoca vitulina*) swimming near the mouth of the Chickaloon River (1 August) and three harbor seals swimming near the Ivan River (2 August).

## Discussion

The primary objective in August 2007 was to use paired HD video cameras to document beluga groups for analysis of age structure (white relative to gray individuals and dark gray calves) at a time when it is likely belugas of the year are born. This is the same objective applied to the survey conducted in August 2005 and 2006 (Rugh et al. 2005b, Rugh et al. 2006). Lab analysis will determine if the ratio of calves (small, dark whales) to adults (large, white whales) significantly changes between June and August. This ratio will be important in assessing the reproductive potential of this depleted stock of belugas. The quality of video cameras used during surveys in the past will also be assessed against the HD cameras used in 2006-2007.

The August 2007 aerial survey of Cook Inlet continued the time series documenting beluga distribution in months other than June, and supplemented information gathered in 2000/01 (Rugh et al. 2005a). Although the survey area in August 2007 was limited to northern Cook Inlet, this coverage is considered sufficient for examining beluga distribution because there have been consistently low sighting rates south of the Forelands (lower Cook Inlet) for over a decade (Rugh et al. 2000; 2005a). Similar to the past 15 years of June surveys, groups of belugas were seen near the Susitna and Little Susitna Rivers on 1-2 August 2007. No belugas were found in Chickaloon Bay though viewing conditions were good; this absence of belugas was also noted in the survey conducted in August 2005 (Rugh et al. 2005b) and August 2006 (Rugh et al. 2006). Median counts of whales in August 2007 were similar to median counts in June 2007 (132-224 and 141-181, respectively), providing further evidence that a major change in beluga distribution did not occur from June to August.

## **Acknowledgments**

Rod Hobbs, Task Leader for the Cook Inlet beluga studies, helped coordinate funding for this project. Our pilots in August 2007 were Doug MacIntyre and Jason Mansour of NOAA; they filled a critical role in keeping the aircraft at the preferred altitude and distance from shore when flying intricate patterns over moving whales and watching for aircraft in an exceptionally busy airspace. Two HD video cameras were loaned to our project by Chris Rooper of the Alaska Fisheries Science Center, NOAA. Data entries were made on a program developed specifically for this project by Niel and Kimberly Goetz. This study was conducted under MMPA Scientific Research Permit No. 782-1719.

## Citations

- Hobbs, R.C., D.J. Rugh, and D.P. DeMaster. 2000a. Abundance of beluga whales, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994-2000. *Marine Fisheries Review*. 62(3):37-45.
- Hobbs, R.C., J.M. Waite, and D.J. Rugh. 2000b. Beluga, *Delphinapterus leucas*, group sizes in Cook Inlet, Alaska, based on observer counts and aerial video. *Marine Fisheries Review*. 62(3):46-59.
- Laidre, K. L., K. E. W. Shelden, D. J. Rugh, and B. A. Mahoney. 2000. Beluga, *Delphinapterus leucas*, distribution and survey effort in the Gulf of Alaska. *Mar. Fish. Rev.* 62(3):27-36.
- Litzky, L.K. 2001. Monitoring recovery status and age structure of Cook Inlet, Alaska belugas by skin color determination. Thesis (M.S.) Univ. Wash. 76 p.
- Mahoney, B.A. and K.E.W. Shelden. 2000. Harvest history of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. *Mar. Fish. Rev.* 62(3):124-133.
- O'Corry-Crowe, G.M., R.S. Suydam, A. Rosenberg, K.J. Frost, and A.E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. *Mol. Ecol.* 6:955-970.
- Rugh, D.J., K.E.W. Shelden, B.A. Mahoney, L.K. Litzky, R.C. Hobbs, and K.L. Laidre. 1999. Aerial surveys of beluga whales in Cook Inlet, Alaska, June 1999. Unpubl. NMFS report. 10 pp.
- Rugh, D.J., K.E.W. Shelden, and B.A. Mahoney. 2000. Distribution of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, during June/July 1993-2000. *Mar. Fish. Rev.* 63(3):6-21.
- Rugh, D.J., K.E.W. Shelden, C.L. Sims, B.A. Mahoney, B.K. Smith, L.K. Litzky, and R.C. Hobbs. 2005a. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Tech Memo. NMFS-AFSC-149. 71p.
- Rugh, D.J., K.T. Goetz, and B.A. Mahoney. 2005b. Aerial survey of belugas in Cook Inlet, Alaska, August 2005. Unpubl. NMFS report. 8 pp.
- Rugh, D.J., K.T. Goetz, C.L. Sims, and B.K. Smith. 2006. Aerial surveys of belugas in Cook Inlet, Alaska, August 2006. Unpubl. NMFS report. 9 pp.
- Rugh, D.J., K.T. Goetz, J.A. Mocklin, B.A. Mahoney, and B.K. Smith. 2007. Aerial surveys of belugas in Cook Inlet, Alaska, June 2007. Unpubl. NMFS report. 16 pp.
- Sims, C.L, R.C. Hobbs, and D.J. Rugh. 2003. Developing a calving rate index for beluga in Cook Inlet, Alaska using aerial videography and photography. Abstract (poster) in the Fifteenth Biennial Conference on the Biology of Marine Mammals. Greensboro, North Carolina. 14-19 Dec. 2003.

Table 1. August 2007 beluga counts made during aerial surveys of Cook Inlet. Counts are medians from observers doing multiple counts of each whale group. Dashes indicate no survey effort, and zeros indicate the area was surveyed, but no whales were seen. Sites are listed in a clockwise order around Cook Inlet starting with Turnagain Arm.

Location	8/1	8/2
Turnagain Arm	0	0
Chickaloon Bay/ Point Possession	0	0
Point Possession to Beluga River	0	0
Beluga River	0	0
Ivan River	53	88
Susitna River	96	0
Little Susitna River	32	53
Knik Arm	0	0
Fire Island	0	0
<b>Totals</b>	<b>181</b>	<b>141</b>



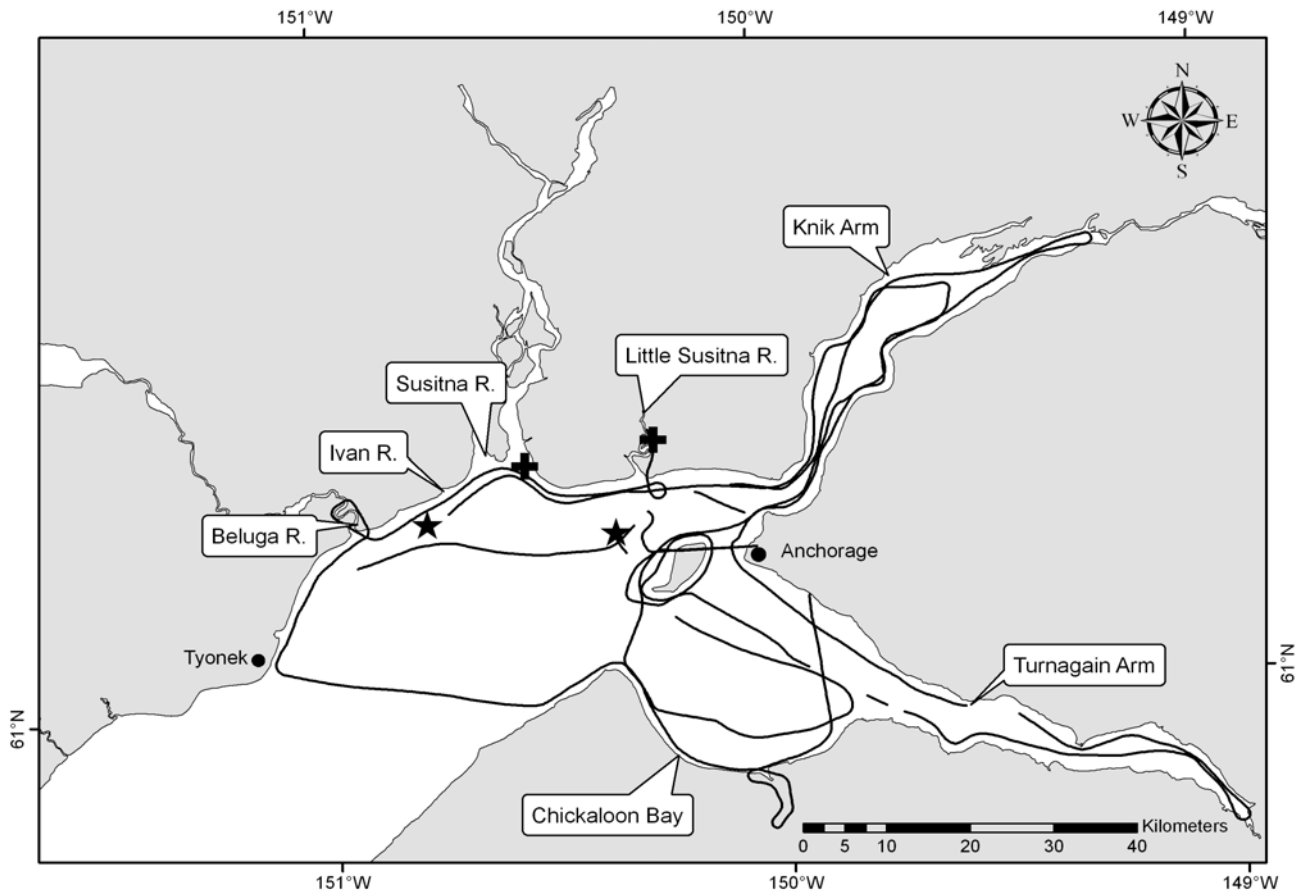


Figure 1. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 1 August 2007. Crosses represent morning high tide sightings and stars afternoon high tide sightings.

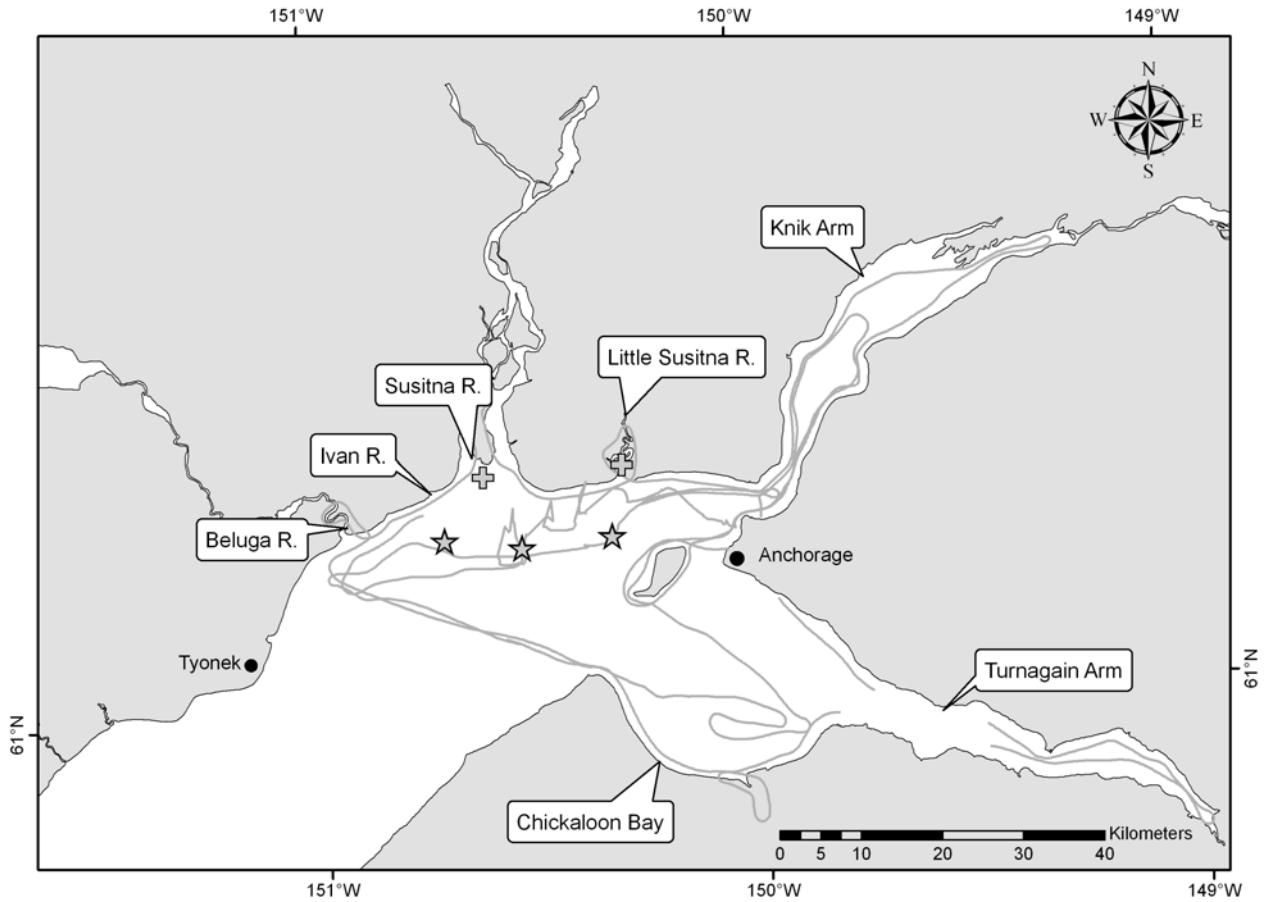


Figure 2. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 2 August 2007. Crosses represent morning high tide sightings and stars afternoon low tide sightings

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