

## AERIAL SURVEYS OF BELUGAS IN COOK INLET, ALASKA, AUGUST 2010

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**Abstract**—The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in northern Cook Inlet, Alaska, 17-20 August 2010. The goal of the surveys was to obtain high-resolution video of each group of belugas to determine age structure (white relative to gray individuals and dark gray calves) and number of calves. The survey (16 hours total) covered the coastal areas north of Point Possession and Beluga River. Consistent with previous surveys by NMFS made each year since 1993, the August 2010 survey was flown in a high-wing, twin-engine aircraft (AeroCommander 680FL *N98UP*) 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 surveys occurred during the low tide when possible. We found beluga groups in the Susitna delta (from the Beluga River to the Little Susitna River) and in Knik Arm and Turnagain Arm every day. On the 17 August survey, we video-taped and/or counted 7 beluga groups: near Sunrise in Turnagain Arm (median count = 44), mid Knik River off Birchwood Airport (median count = 9), scattered across Goose Bay and Knik River (median count = 35), a lone whale on the shoreline near Windy Point, 3 whales lost in rain squalls at the Susitna River, a scattered group at the Ivan River (median count = 29), and in the mouth of the Beluga River (median count = 7). On the 18 August low tide, we video-taped and/or counted 5 beluga groups: in Eagle Bay (median count = 50), the Little Susitna River (median count = 7 whales), at Beluga River (3 large, white whales), and in Turnagain Arm (median count = 62 whales near Sunrise and 32 whales near Rainbow) for a total median count of 154 belugas. On 19 August low tide, we coordinated efforts with LGL's boat-based photo-identification project, counting and video-taping a beluga group then alerting the LGL team to the group to begin their photo-id effort after we departed the area to find another group. Belugas were again in Eagle Bay (median count = 73) and the Little Susitna River (median count = 95), along the east tributary of the Susitna River (median count = 17), and in Turnagain Arm ((median count = 48 whales near Gull Rock, 29 whales near Sunrise, and 4 whales near Bird Point) for a total median count of 266 whales. On 20 August, we again coordinated with LGL, videotaping and counting belugas in Eagle Bay (median count = 27) and the Little Susitna River (median count = 14). We saw no belugas in Chickaloon Bay during this survey. The median estimates of belugas seen each day when the entire upper inlet was surveyed in August 2010 (a quick index of relative abundance not corrected for missed whales) were similar to surveys in 2009 (196 on 11 August, 212 on 12 August, and 197 on 13 August), 2008 (109 belugas on 12 August, 177 on 13 August, 194 on 14 August), 2007 (181 belugas on 1 August, 141 belugas on 2 August) and in 2006 (126 belugas on 16 August, 143 belugas on 17 August), and 2005 (236 belugas on 11 August, 277 belugas on 12 August).

## Introduction

The National Marine Fisheries Service (NMFS) conducts aerial surveys of belugas (*Delphinapterus leucas*) in Cook Inlet, Alaska, each year to document their local distribution and abundance (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 (<400 whales; Hobbs et al. 2000a; Hobbs and Shelden 2008). The population in Cook Inlet has been designated as *depleted* under the Marine Mammal Protection Act (MMPA, 65 FR 34590) and as *endangered* under the Endangered Species Act (73 FR 62919, October 22, 2008). The subsistence hunt by Alaska Natives has been managed under MMPA Section 119 (Cooperative Agreements with NMFS) since 2000 (65 FR 59164, Mahoney and Shelden 2000).

The goals of the aerial survey in August 2010 were a) to document seasonal distribution relative to temporal habitat features (e.g. fish runs) and, b) to use paired high-definition (HD) video cameras to document the age structure of groups of belugas (white relative to gray individuals and dark gray calves) in Cook Inlet at a time when most calves have been born. This is the sixth year for this project which began in August 2005 (Rugh et al. 2005a, 2006; Shelden et al. 2007, 2008, 2009). We also took this opportunity to continue testing our aerial counts and videotaped results of specific beluga groups against results from LGL Alaska Research Associates, Inc., boat-based photo-identification project, an experiment first undertaken in August 2009 (Shelden et al. 2009).

## Methods

The survey aircraft (AeroCommander, *N98UP*), was equipped with large bubble windows at the left and right forward observer positions. Video camera footage was obtained through an open window on the left. An intercom system allowed communication among the observers, data recorder, and pilots. A computer program recorded sighting 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 using five subjective categories from *excellent* to *useless*. Survey segments that were rated as *poor* or *useless* on the coastal side of the aircraft were considered un-surveyed.

Most of the search effort was 1.4 km offshore along the coast of northern Cook Inlet (north of Point Possession and North Foreland). The goal 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 daily during low tide when possible.

The location of each whale group was established by recording a GPS position while flying directly over the group. The flight pattern used to count a whale group was an extended oval around the longitudinal axis of the group with turns made beyond the ends of the group. Whales were counted during each pass down the long axis of the oval with observers and cameras on the left 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 an accurate 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 sometimes seen at the surface 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 observer's median counts on multiple passes over each whale group (Table 1). The process of using medians instead of maxima 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 include repeated passes over whale groups. Medians are also more appropriate than maxima when counts are corrected for missed whales because correction factors should be applied to the most representative counts, not the most extreme.

We used paired HD video cameras used to film each group of belugas. One camera was set at wide angle to capture a view of the entire group, and the other camera was zoomed to magnify individual whales in the group. The zoomed 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 analyzed in the laboratory to obtain more accurate counts of belugas and the relative proportions of white versus gray versus dark gray (calf) whales.

As in August 2009, we coordinated efforts with LGL's boat-

**Table 1.** Estimates of beluga whale abundance made during aerial surveys of Cook Inlet in August 2010. Counts are medians from observers doing multiple counts of each whale group. Zeros indicate the area was surveyed, but no whales were seen, NS indicates area not surveyed. Sites are listed in a clockwise order around Cook Inlet starting with Turnagain Arm.

Location	8/17	8/18	8/19	8/20
Turnagain Arm	44	94	81	NS
Chickaloon Bay/ Point Possession	0	0	0	NS
Point Possession to Beluga River	0	0	0	NS
Beluga River	7	3	0	NS
Ivan River	29	0	0	NS
Susitna River	3	0	17	NS
Little Susitna River	0	7	95	14
Knik Arm	45	50	73	27
Fire Island	0	0	0	NS
<b>Totals</b>	<b>128</b>	<b>154</b>	<b>266</b>	<b>41</b>

based photo-identification project on the last survey days, counting and video-taping a beluga group then directing the LGL boat to the group to begin their photo-id effort after we departed the area to find additional beluga groups.

## Results

The surveys (16 hours total) covered all coastal areas north of Point Possession and Beluga River (Figs. 1-3). All flights on 17, 18, 19 and 20 August 2010 (5 take-offs and landings, flight time ranged from 1.6 to 4.6 hours) were based out of Anchorage International Airport. Of the 16 flight hours, 6.3 hours were spent on effort (i.e., 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). Viewing conditions were ideal during most of the surveys. *Poor or useless* visibility conditions (determined by the primary front observer) only interfered with the survey effort during 0.06 hours (1.0% of the effective search time). The three observers (authors of this report: KEWS, CLS, & LVB) have participated in this project on previous surveys.

The aerial surveys in August 2010 covered the entire coastline in northern Cook Inlet for most waters within 3 km of shore. On 17 August, the survey began by circling Fire Island then following the coast along Chickaloon Bay into Turnagain Arm as far as Twentymile River, back to Chickaloon Bay, entering Chickaloon River, continuing up the coast to Point Possession (Fig. 1). Belugas were found near Sunrise in Turnagain Arm (median count = 44, 8 video and counting passes).

Survey effort terminated just east of Point Possession when the computer battery and inverter power from the aircraft failed. We returned to Anchorage to fix the problem. The afternoon flight began in Knik Arm, covering the

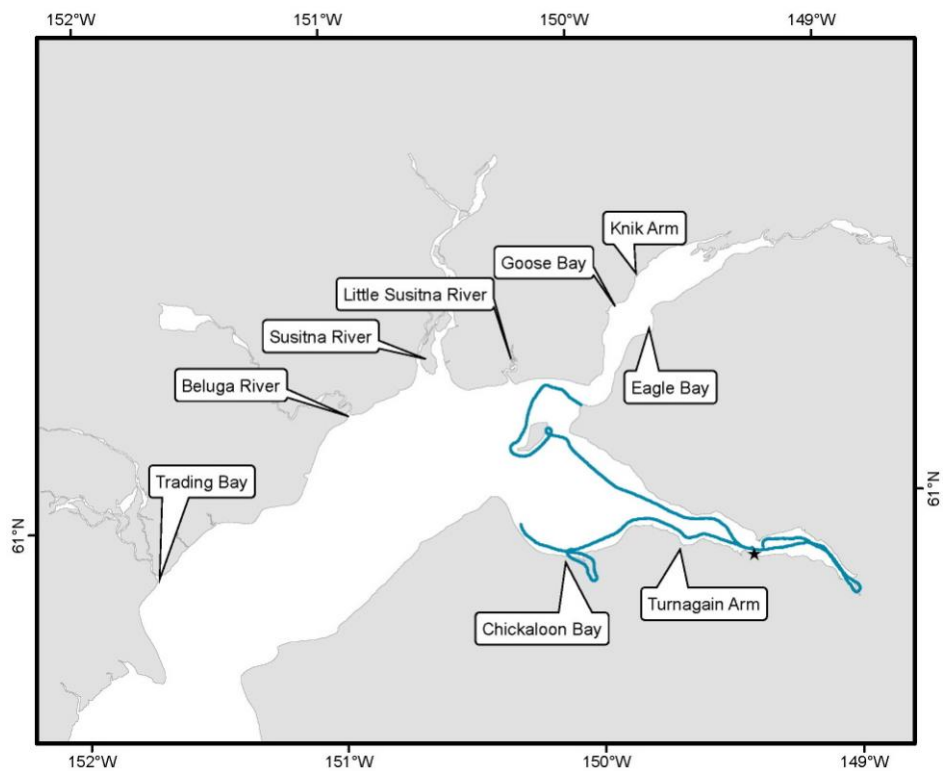


Figure 1. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 17 August 2010 morning flight. Note that the black star represents the exact mark over the beluga group during counting and video-taping passes.

shoreline north to the bridge (Fig. 2). Belugas groups were found mid-river near Birchwood Airport (median count = 9, 4 video and counting passes), scattered from Goose Bay to the mudflats (median count = 35, 3 video and counting passes), and a single whale near the shoreline south of Birchwood. Air traffic and restricted airspace precluded completion of the coastal trackline from Elmendorf to Anchorage and around Point Mackenzie. The survey track resumed midway between Point Mackenzie and the Little Susitna River. We surveyed up the Little Susitna to the power lines, across the mouth of the Susitna River, where three belugas were observed but lost in rain squalls. We continued the coastal survey to Beluga River, detecting belugas at the Ivan River (median count = 29, 6 video and counting passes) and in the mouth of the Beluga River (median count = 7, 5 video and counting passes). The total median count for the day was 128 beluga whales. Conditions were good to poor with rain squalls and low cloud cover.

On 18 August, we flew the reverse pattern completing Knik Arm during the low tide then the Susitna region (surveying up the Little Susitna, Susitna, and Beluga Rivers to the power lines), crossing to Point Possession then Fire Island and the circuit around Chickaloon Bay and Turnagain Arm (Fig. 3). On the low tide, the large group in Knik Arm was in Eagle Bay (median count = 50, 9 video and counting passes).

We found a small group in the Little Susitna River mouth (median count = 7, 5 video and counting passes) and 3 large, white belugas in the Beluga River mouth (no video). Two large groups of belugas were in Turnagain Arm, one moving into the Arm along the shore between Rainbow and Indian Creek (median count = 32, 7 video and counting passes) and the other moving out of the Arm along the shore near Sunrise (median count = 62, 5 video and counting passes). The total median count for the day was 154 beluga whales. Conditions were fair to excellent with clear skies, calm winds and some glare.

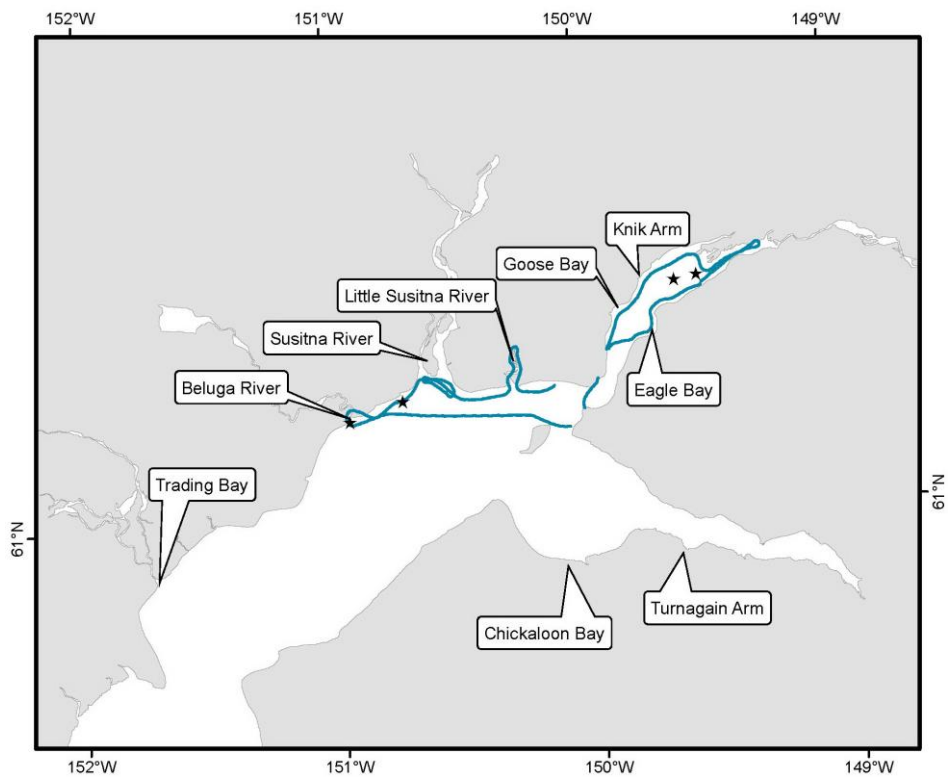


Figure 2. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 17 August 2010 afternoon flight. Note that the black stars represent the exact marks over the beluga groups during counting and video-taping passes.

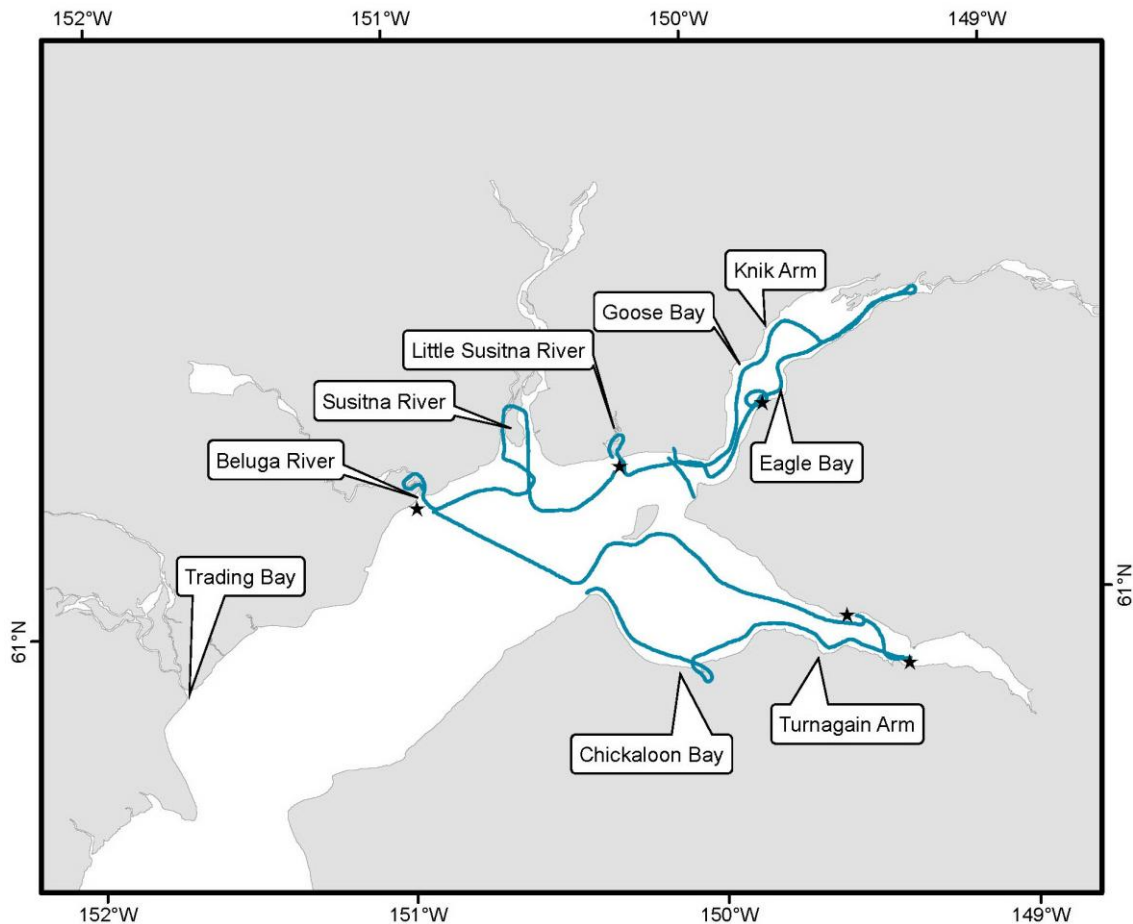


Figure 3. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 18 August 2010 flight. Note that the black stars represent the exact marks over the beluga groups during counting and video-taping passes.

On 19 August, we followed a similar pattern to the day before surveying the upper inlet in a counter-clockwise direction. We completed Knik Arm and the Susitna delta on the morning low tide, crossed the inlet to Point Possession and flew the coastline to Chickaloon River and then into Turnagain Arm, finishing the survey crisscrossing Chickaloon Bay (Fig. 4). We coordinated our efforts with LGL, counting and video-taping a beluga group then directing the LGL boat to the group to begin their photo-id effort after we departed the area to find another group. Beluga groups were in Eagle Bay (median count = 73, 10 video and counting passes), the Little Susitna River (median count = 95, 12 video and counting passes), along the mudflats of the east tributary of the Susitna River (median count = 17, 7 video and counting passes), and in three groups in Turnagain Arm, one near Gull Rock (median count = 48, 8 video and counting passes), one east of Sunrise in Turnagain Arm (median count = 29, 7 video and counting passes), and a group of 4 whales near Bird Point (no video passes). The total median count for the day was 266 beluga whales. The LGL team (T. McGuire and C. Kaplan) was able to photograph

belugas at Eagle River and the Little Susitna River. Sighting conditions were fair to excellent with calm winds, clear skies and some glare.

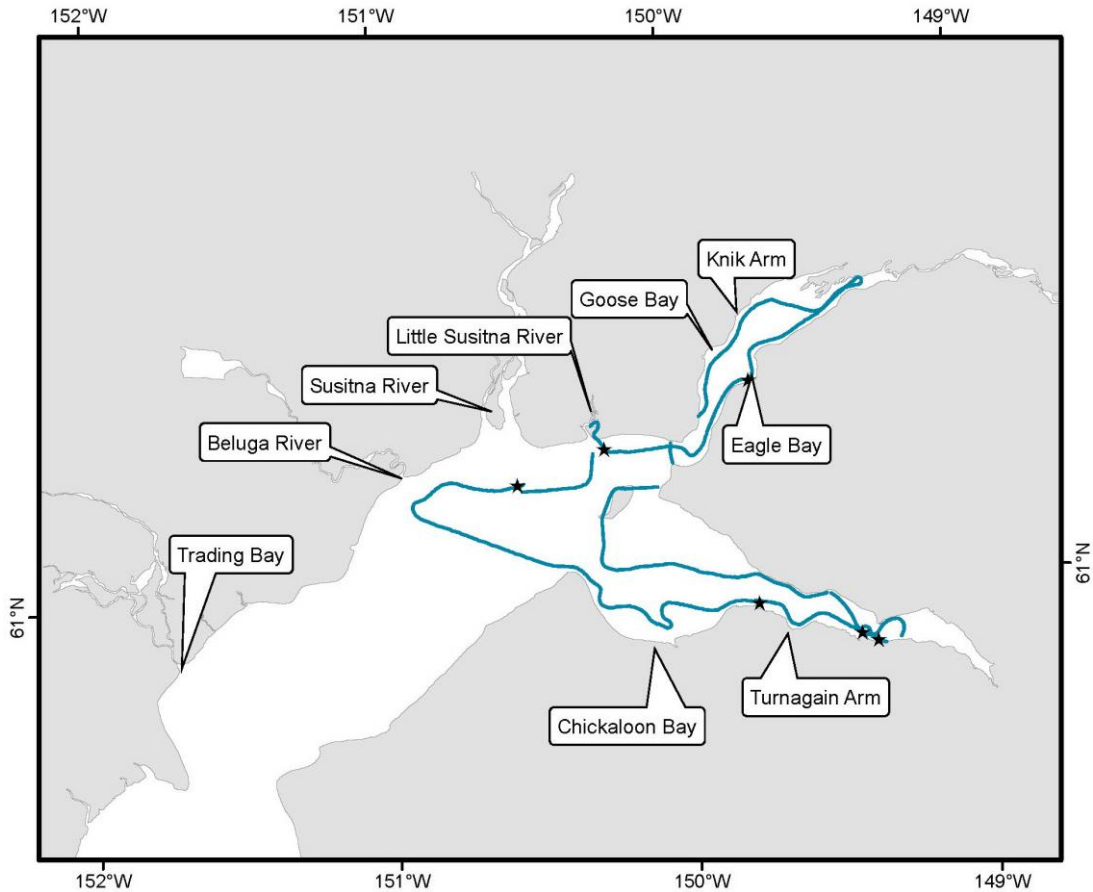


Figure 4. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 19 August 2010 flight. Note that the black stars represent the exact marks over the beluga groups during counting and video-taping passes.

On 20 August, we again coordinated efforts with LGL conducting an experiment-only flight. Belugas were videotaped and counted in Eagle Bay (7 passes, median count = 27) and the Little Susitna River (5 passes, median count = 14).

Harbor seals (*Phoca vitulina*) were the only other marine mammals sighted during the August 2010 survey (Fig. 5). Seals were at the mouth of the Chickaloon River (n = 19 on 17 August, 45+ on 18 August, and 20 on 19 August), near Sunrise in Turnagain Arm (n = 15 on 17 August, 50+ on 18 August, and 20+ on 19 August), at the mouth of the Beluga River (2-3 in the water on 18 August), on the Susitna River mudflats (100 on 18 August, and 85 on 19 August), at the Little Susitna River (n = 1 on 17 August, 14 on 18 August, 11 on 19 August, and 9 on 20 August), and near Birchwood in Knik Arm (n = 5 on 18 August).

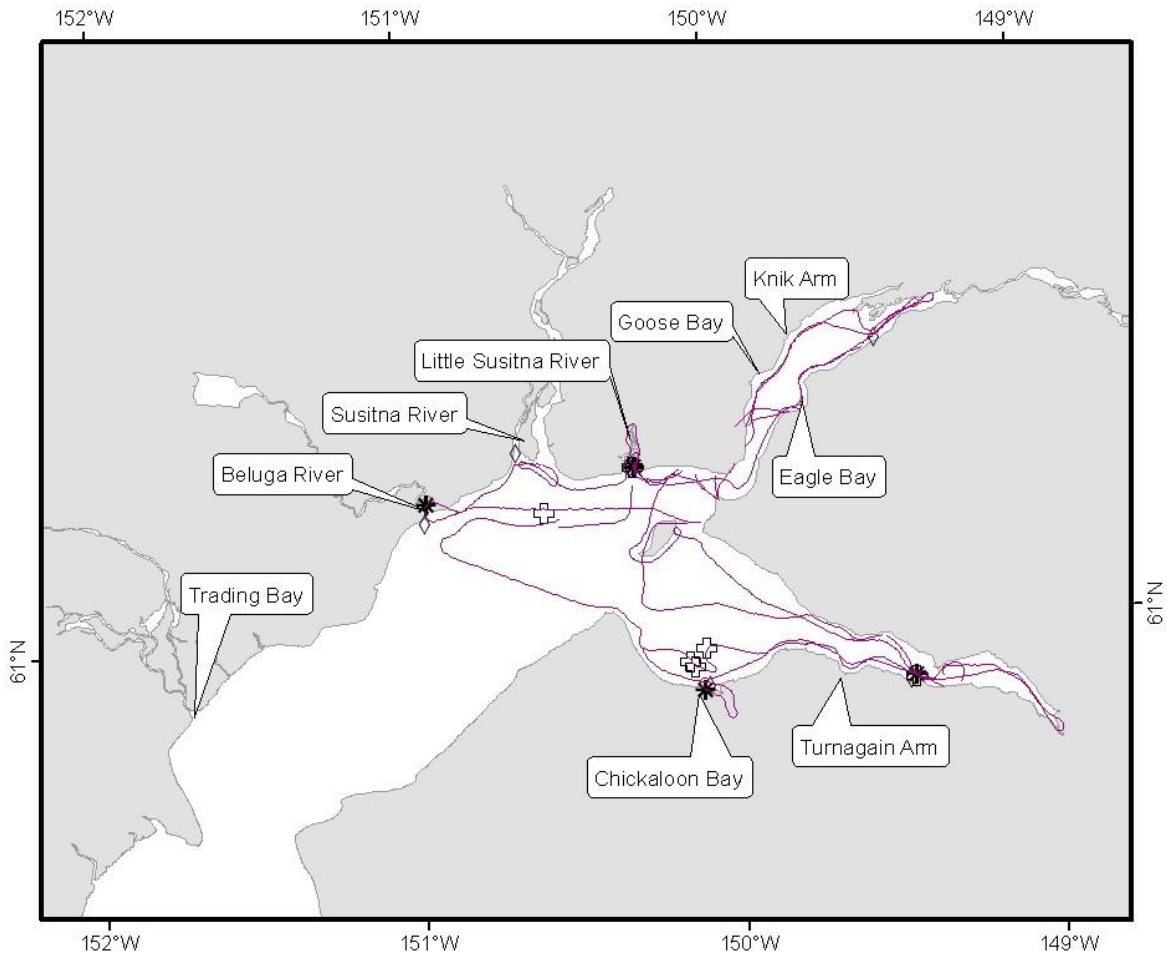


Figure 5. All on-effort tracklines flown during the August 2009 survey (faint red lines) with daily harbor seal sightings (black asterisks = 17 Aug., white diamonds = 18 Aug., white crosses = 19 Aug., and black crosses = 20 Aug.).

The median counts (an index of relative abundance not corrected for missed whales) of 128, 154, and 266 belugas for each day when a full circuit of the upper inlet was completed were similar to those documented during the 2005-2009 August surveys (Fig. 6). The August 2010 counts also fell within the range of daily median counts obtained in June 2010 (82 to 291 belugas, Sheldon et al. 2010).



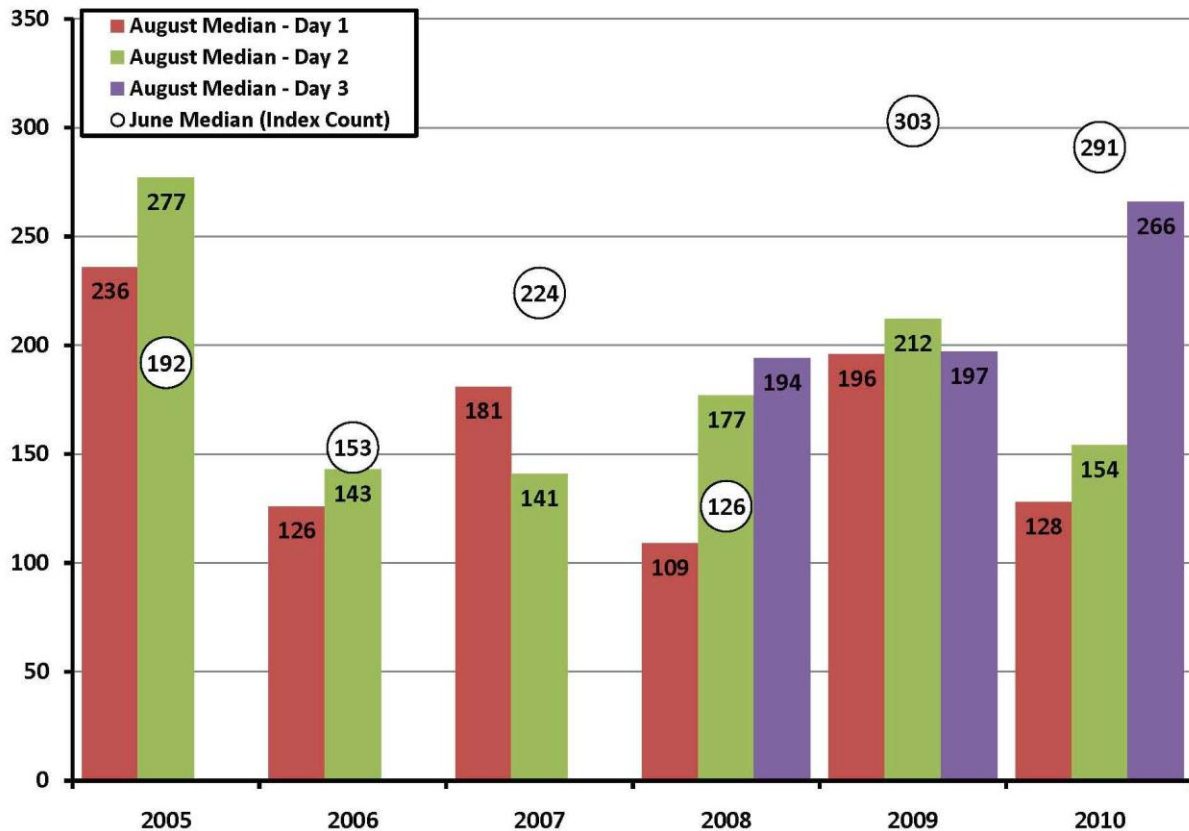


Figure 6. Daily median counts obtained during August aerial surveys of Cook Inlet belugas compared to the June index count (highest daily median count), 2005-2010.

## Discussion

The primary goal of the surveys in August 2010 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 most calves have been born. This was consistent with the goals of surveys made in August of 2005-2009 (Rugh et al. 2005b, 2006, Sheldon et al. 2007, 2008, 2009). Further analyses of the data will determine if there are any differences between the ratios of calves (small, dark whales) to adults (large, white whales) in June versus August. This ratio will be important in assessing the reproductive potential of this *endangered* beluga stock. Results from this study and the joint aerial and LGL boat-based surveys will be presented in a separate document after analyses of video and photographs are completed.

The August 2010 aerial survey of Cook Inlet continued the time series documenting the distribution of belugas in months other than June, and supplemented information gathered in 2000 and 2001 (Rugh et al. 2005a). Although the survey area in August 2010 was limited to northern Cook Inlet, this coverage is considered sufficient for examining beluga distribution for calf ratios because there have been

consistently low sighting rates south of the Forelands (lower Cook Inlet) for more than a decade (Rugh et al. 2000; 2005a, 2010). Groups of belugas were seen from the Beluga River to Little Susitna River, and in Knik Arm and Turnagain Arm. No belugas were found in Chickaloon Bay though survey conditions were mostly good. The absence from Chickaloon Bay was consistent with results from past August surveys (Rugh et al. 2005b, 2006, Sheldon et al. 2007, 2008, 2009). Median counts of whales in August 2010 were less than index count (highest daily median count) in June 2010 (Fig. 5), which is also similar to August 2006 and August 2007. Though, the opposite occurred in August 2005 and August 2008 (Fig. 5). There was no substantial difference in the distribution of belugas in upper Cook Inlet between June and August.

### **Acknowledgments**

Rod Hobbs, Task Leader for the Cook Inlet beluga studies, helped coordinate funding for this project. Our pilots in August 2009 were Roger Weber and Jon Hall of Northern Commanders LLC; 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 Goetz and Kimberly Goetz. This study was conducted under MMPA Scientific Research Permit No. 782-1719.

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