

AERIAL SURVEYS OF BELUGAS IN COOK INLET, ALASKA, AUGUST 2012

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Abstract—The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in northern Cook Inlet, Alaska, 7-9 August 2012. The goal of the survey was to obtain high-resolution video of beluga groups in order to determine age structure (white relative to gray individuals and dark gray calves) and number of calves. The survey (15.4 hours total) covered the coastal areas down to Kenai River and north of West Forelands. Following protocol used by NMFS since 1993, the August 2012 beluga survey was flown in a high-wing, twin-engine aircraft (AeroCommander 690A *N222ME*) 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 daily surveys occurred during the falling tide when possible. Beluga groups were found in the Susitna delta (from the Beluga River to the Little Susitna River) and in Knik Arm every day, while only one beluga group was found in Turnagain arm on one of the three survey days. On 7 August, we videoed and/or counted 3 beluga groups: one large group spread out from the mouth of the Theodore river to outside the Ivan River (median count = 219), a group in the Northeast channel of the Susitna River (median count = 76), and a group in Eagle Bay, exiting Eagle River (median count = 27), for a total median count of 322. On 8 August, belugas were seen in Turnagain Arm, moving from Bird Point to Rainbow Creek and continuing toward Indian Creek along the Seward Highway (median count = 33). Two groups were seen at the Susitna River, one group spread across the river mouth, and the second group slightly north (median counts = 176 and 55, respectively). A fourth group was found in Eagle Bay moving north along the cliffs on the incoming tide (median count = 11), making 275 the total median count for 8 August. We observed five groups on 9 August. A single whale was seen near the mouth of Chickaloon River. A large group was found spanning the mouths of the Theodore and Susitna rivers (median count = 268) and a medium-sized group in the Little Susitna River (median count = 18). Two groups of whales were found in Knik Arm, a small group of 2 whales at the dock at Point MacKenzie and a group of whales in Goose Bay (median count = 12), making 301 the total median count on 9 August. The range of median estimates (275-322) of belugas seen in August 2012 (a quick index of relative abundance not corrected for missed whales) was within or above medians observed over the last 7 years (2005 (236-277), 2006 (126-143), 2007 (141-181), 2008 (109-194), 2009 (196-212), 2010 (128-266) and 2011 (204)).

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, 2010). This project has been conducted 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, 2002; Laidre 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 2012 were a) to document seasonal distribution 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 eighth year for this project, which began in August 2005 (Shelden et al. 2011, Hobbs et al. 2012).

Methods

Aircraft and data

The survey aircraft (AeroCommander 690A N222ME), was equipped with large bubble windows at the left and right forward observer positions. Video was collected through a small opening window positioned between the left front observer bubble window and a large flat window. 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 ranging from *excellent* to *useless*. Survey segments that were rated as *poor* or *useless* on the coastal side of the aircraft were considered unsurveyed.

Tracklines

Most of the search effort was 1.4 km offshore along the coast of northern Cook Inlet (north of Kenai River and West Foreland). The goal was to search all nearshore, shallow waters where belugas are typically seen in summer (Rugh et al. 2000; 2010). 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 appeared very shallow or to 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.

Counting Protocol

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 along 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 above 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 Sony HXR-NX5U HD video cameras 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; Hobbs et al. 2012). The paired cameras were operated on all counting passes when group sizes were estimated to be greater than 10 whales. Video 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.

Table 1. Beluga whale counts made during aerial surveys of Cook Inlet in August 2012. Counts are medians of each observer's median counts on multiple passes over each whale group. NS indicates area not surveyed, * indicates see text for details. Sites are listed clockwise around Cook Inlet starting with Turnagain Arm.

Location	8/7	8/8	8/9
Turnagain Arm	0	33	0
Chickaloon Bay/ Point Possession	0	0	1
Point Possession to Beluga River	0	0	0
Beluga –Ivan Rivers	219	0	0
Susitna River	76	231	268
Little Susitna River	0	0	18
Knik Arm	27	11	14
Fire Island	0	0	0
Totals	322	275	301

Results

The surveys (15.4 hours total) covered all coastal areas in upper Cook Inlet north of Kenai River and West Foreland (Figs. 1-3). Surveys were carried out on 7, 8 and 9 August 2012, 5 take-offs and landings and flight time ranged from 2 to 5 hours. Of the 15.4 flight hours, 6.97 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, and 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 0.04 hours (0.5% of the effective search time). The three observers (authors of this report: CLS, LVB and KTG) have participated in this project on previous surveys.

The August 2012 aerial surveys covered 100% of waters within 3 km of shore in northern Cook Inlet. On 7 August, we surveyed Turnagain Arm and Chickaloon Bay, before crossing the inlet from Point Possession to Beluga River. Heavy fog precluded surveying further south. An attempt was made to survey north from Beluga River, but due to patches of fog, the survey was aborted. We resumed effort approximately four hours later when weather conditions improved. On the second flight of the day, we resumed coastal effort and surveyed south of the Beluga River and continued north through the Susitna delta and into Knik Arm (Fig. 1).

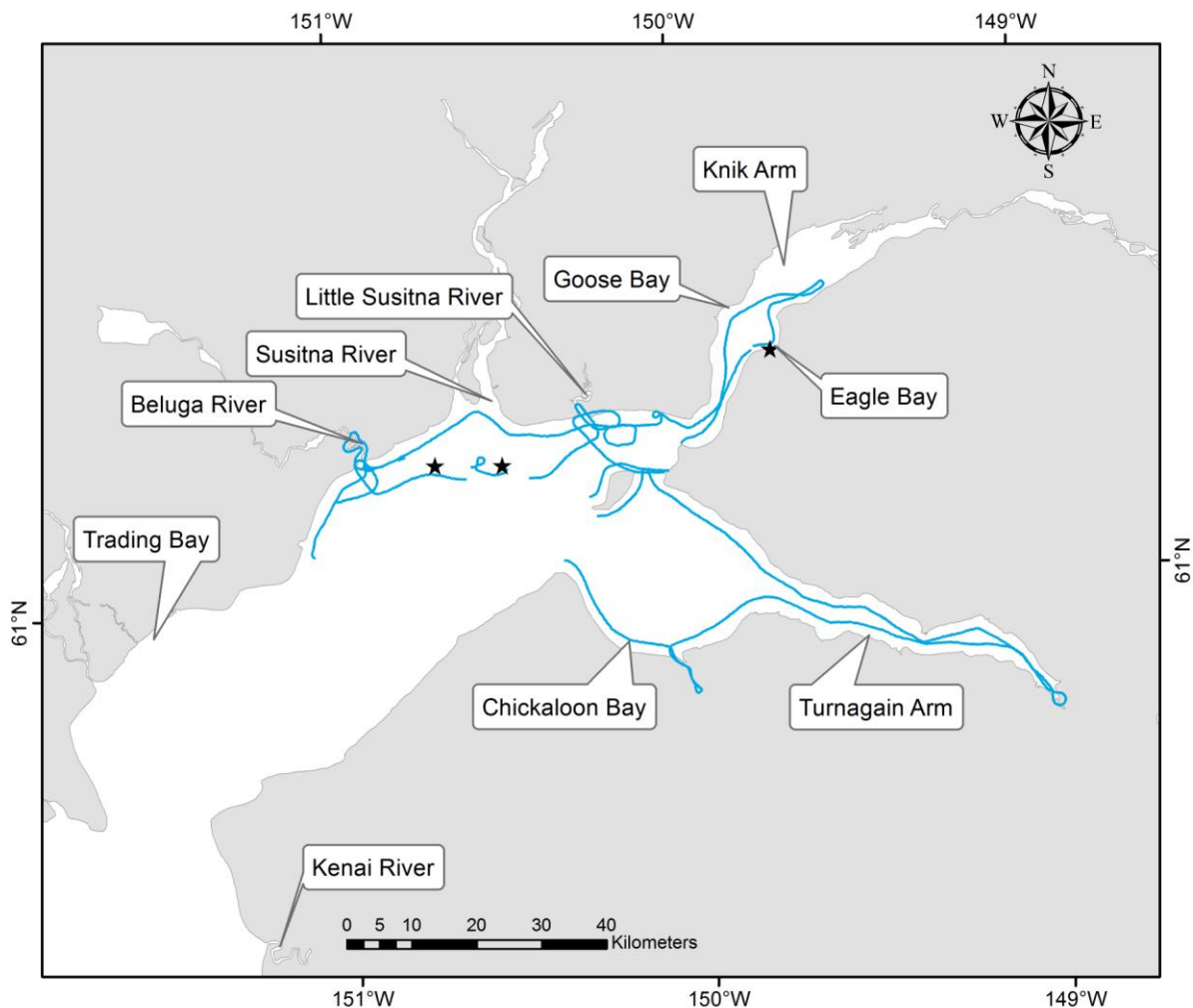


Figure 1. On-effort tracklines and beluga sightings for upper Cook Inlet survey on the 7 August 2012 flight. Note that the black stars represent the exact marks over a beluga group during counting and video passes.

Belugas were found between the Theodore and Lewis rivers (Group 1: median count = 219, 8 video and counting passes), in the Northeast channel of the Susitna River (Group 2: median count = 76, 7 video and counting passes), and in Eagle Bay (Group 3: median count = 27, 8 video and counting passes). The total median count for the day was 322 beluga whales. After the morning flight with fog, the afternoon survey conditions had good visibility with low winds.

On 8 August, we surveyed Turnagain Arm and found Group 1 moving from Bird Point to Rainbow Creek, and as we counted the group it continued to move toward Indian Creek (median count = 33, with 4 video and counting passes). The survey continued down the east side of the inlet to Kenai River before landing in Kenai for refueling. We then surveyed across the inlet to West Foreland and along the west inlet, breaking off the coastal survey to survey up the Beluga and Little Susitna rivers. Finally, we flew up Knik Arm before landing in

Anchorage (Fig. 2).

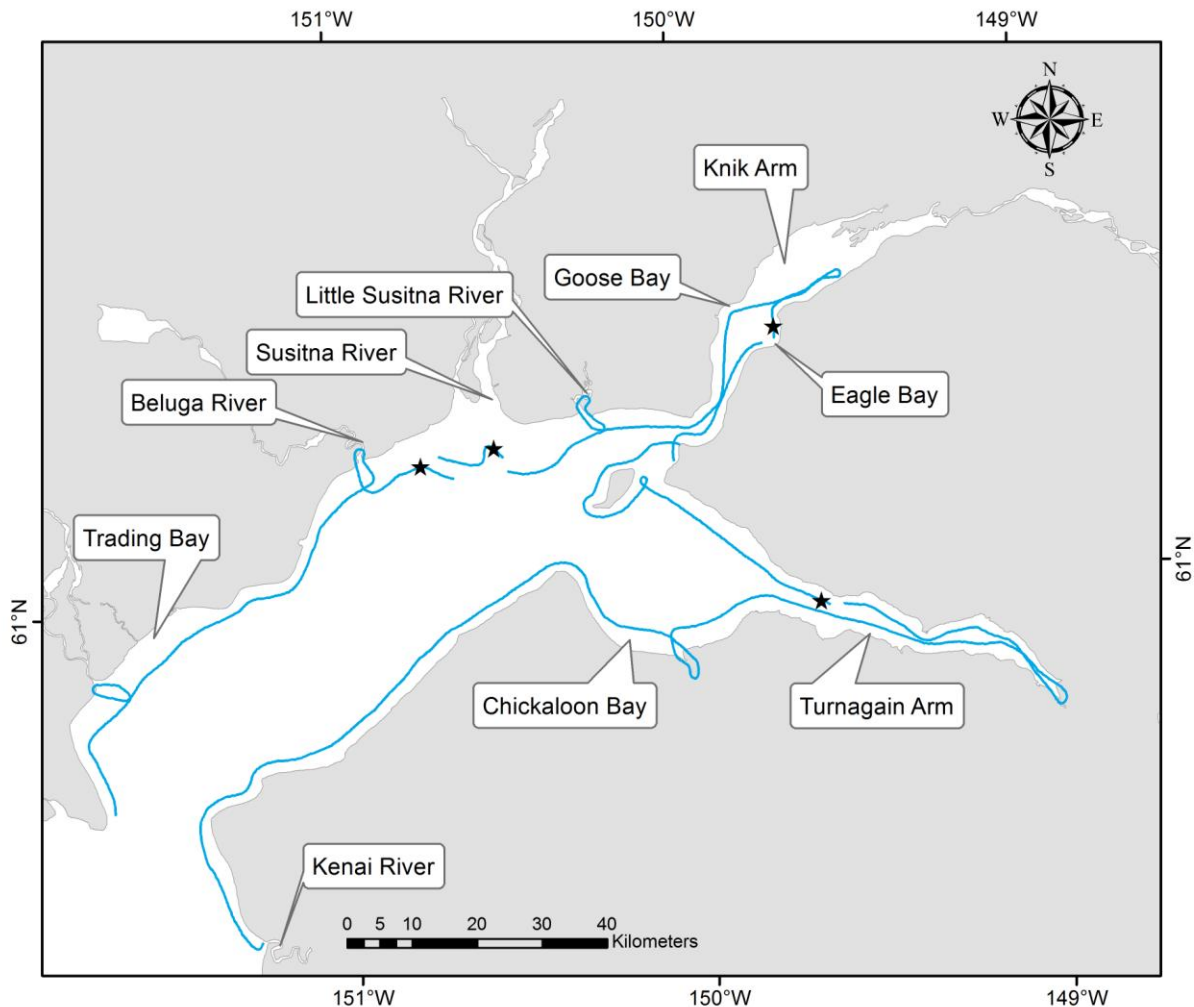


Figure 2. On-effort tracklines and beluga sightings for Cook Inlet survey on the 8 August 2012 flight. Note that the black stars represent the exact marks over the beluga groups during counting and video passes.

A large group of belugas (Group 2) was found along the mouth of the Susitna River (median count = 176, 8 video and counting passes). Group 3 was found in the East channel of the Susitna River (median = 55, 6 video and counting passes). The final group of the day, (Group 4) was found in Eagle Bay on the flooding tide. Due to military air traffic, we were limited in our ability to circle on Group 4 (median = 11, 2 counting passes). The total median count for 8 August was 275 belugas. Survey conditions were fair to good with some glare and low winds.

On 9 August, we surveyed around Fire Island and then followed the shoreline into Turnagain Arm up to 22-mile River. Next, we surveyed Chickaloon Bay, headed towards Point Possession and then crossed the inlet to Beluga River. We resumed the coastal survey crossing the Susitna delta and headed north into Knik Arm (Fig. 3).

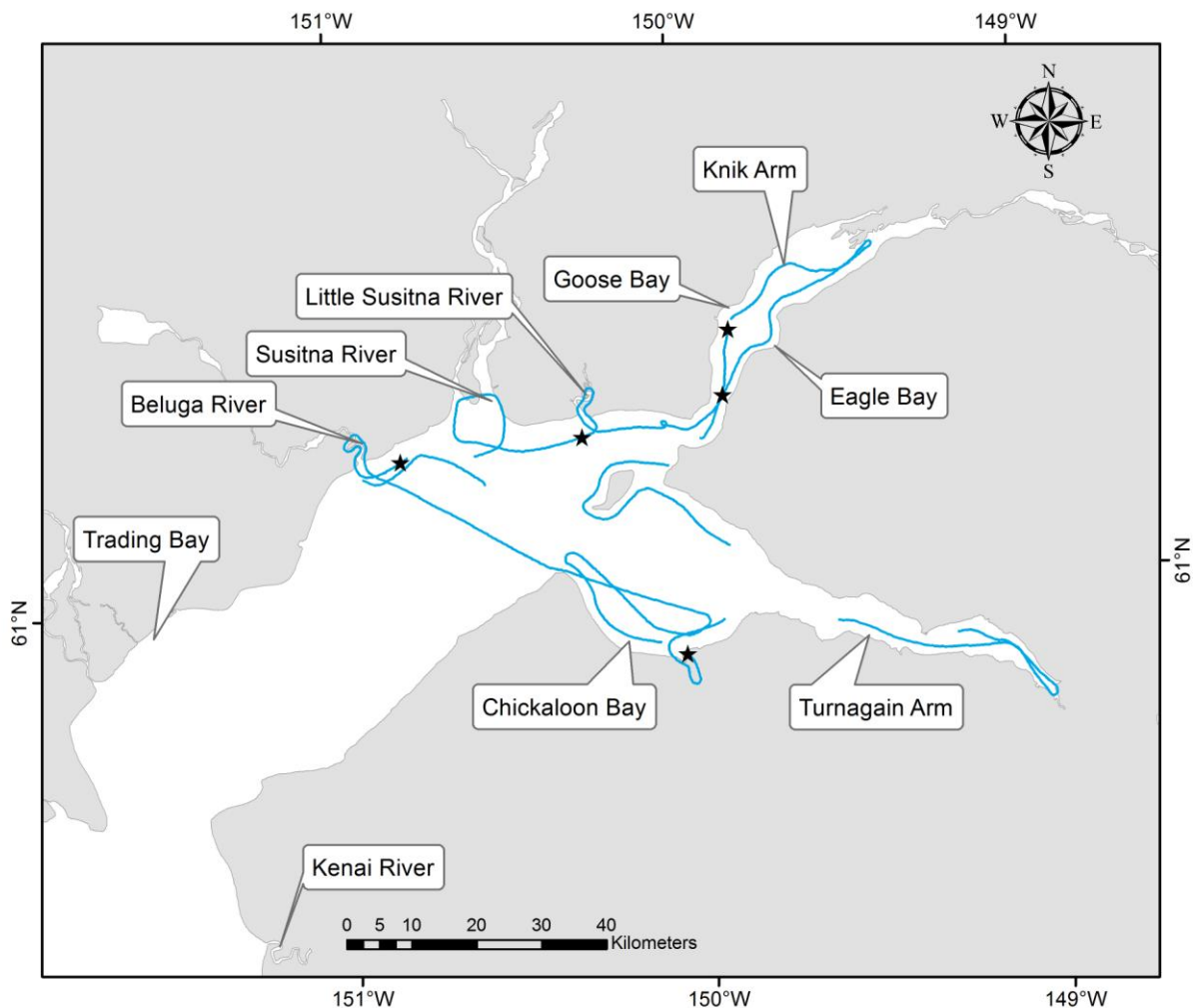


Figure 3. On-effort tracklines and beluga sightings for upper Cook Inlet survey on the 9 August 2012 flight. Note that the black stars represent the exact marks over the beluga groups during counting and video passes.

A single whale, Group 1, was found near the mouth of Chickaloon River (no video). A large group of belugas, Group 2, spanned from Theodore River across the mouth of the Susitna River (median count = 268, 8 video and counting passes). Group 3 was found in the Little Susitna River (median count = 18, 5 video and counting passes). Group 4 (2 belugas) was seen at the dock at Point MacKenzie. Due to heavy air traffic, extended counting and video recording was not possible. Group 5 was travelling along the coastline near Goose Bay (median count = 12, 8 video and counting passes). The total median for the day was 301 beluga whales. The survey conditions were variable with visibility ranging from *poor* to *excellent*, with glare and high Beaufort in some areas.

Harbor seals (*Phoca vitulina*) were the only other marine mammal observed during the August 2012 survey (Fig. 4). Seals were hauled out on the mudflats of Chickaloon River (n = 45) and by Theodore River (n = 80) on 7 August. On 8 August, 1 harbor seal was seen swimming between the Theodore and Susitna rivers and a medium-sized group (n = 16) was hauled out by the Little Susitna River. On 9 August, seals were hauled out at Beluga River (n = 30), Theodore River (n = unknown), the west tributary of Susitna River (n = 6), and two groups on mudflats off the mouth of the Susitna River (n = 18 and 10).

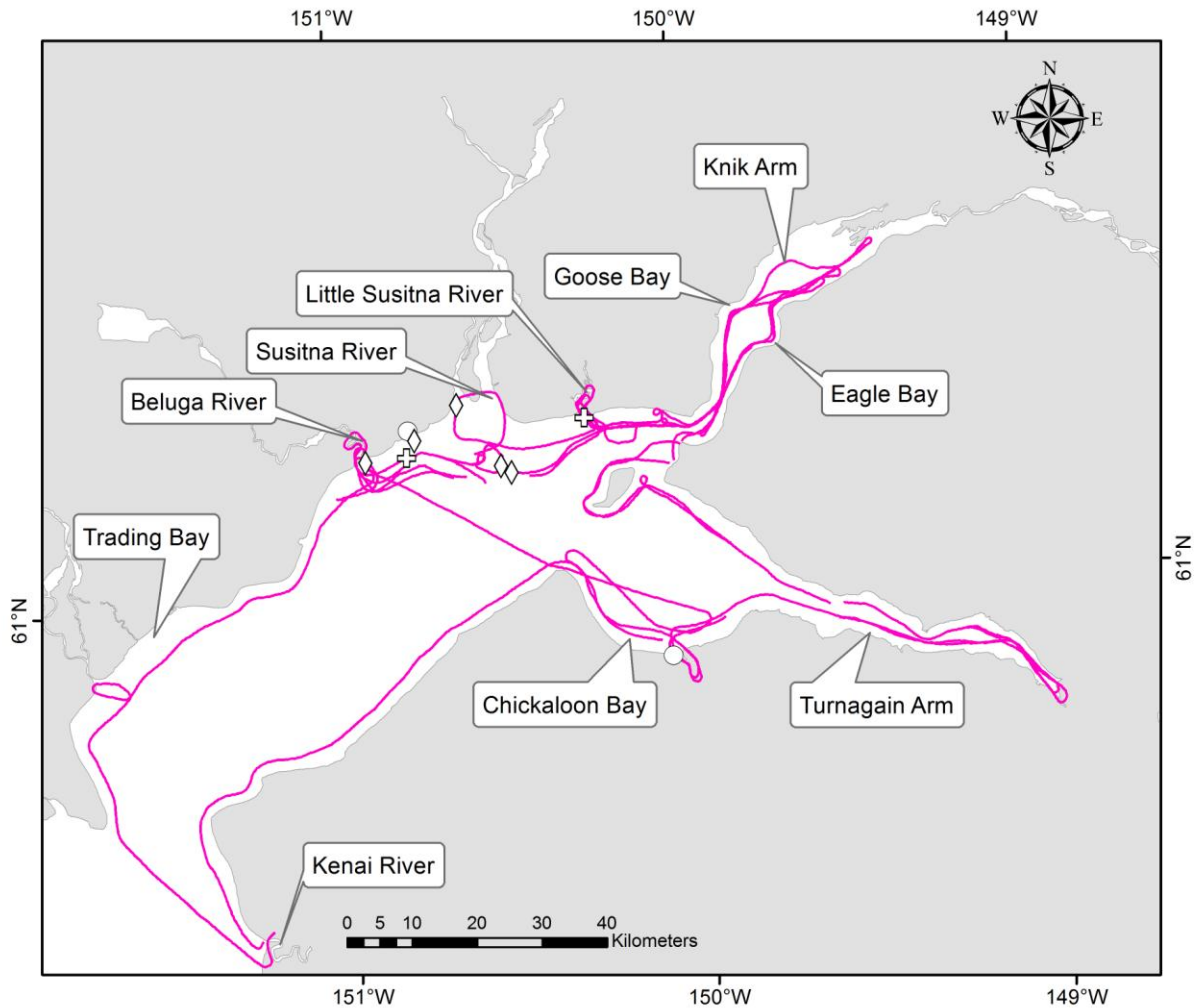


Figure 4. All on-effort tracklines flown during the August 2012 survey (magenta lines) with daily harbor seal sightings (white circles = 7 August, white crosses = 8 August, and white diamonds = 9 August).

The median count (an index of relative abundance not corrected for missed whales) of 322 was higher than counts documented during the 2005-2011 August surveys (Fig. 5). The August 2012 median of 322 was close to the range of daily median counts obtained in June 2012 (142 to 319 belugas, Shelden et al. 2012).



Figure 5. Daily median counts obtained during August aerial surveys of Cook Inlet belugas compared to the June index count (highest daily median count), 2005-2012.

Discussion

The primary goal of the August 2012 survey 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 2005-2011 (Rugh et al. 2005b, 2006, Shelden et al. 2007, 2008, 2009, 2010, 2011, Hobbs et al. 2012). Further analyses will determine if there are differences between the ratios of calves (small, dark whales) to adults (large, white whales) in June and August. This ratio will allow us to assess the reproductive potential of this *endangered* beluga stock.

The August 2012 aerial survey of Cook Inlet is a continuation of a 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 2012 was limited mostly to upper 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 Susitna River to Point MacKenzie and in Knik Arm. The presence of beluga in Turnagain Arm and in Chickaloon Bay was unusual compared to past August surveys when no belugas were found in these areas (Rugh et al. 2005b, 2006, Sheldon et al. 2007, 2008, 2009, 2010, 2011). The median count of 322 whales in August 2012 was only slightly higher than the index count of 319 (highest daily median count) in June 2012 (Fig. 5), with the August daily medians being similar to the daily medians from the June survey. Similar August counts have occurred in 2005 and 2008 (Fig. 5). There was no substantial difference in the distribution of belugas in upper Cook Inlet between June and August.

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