

AERIAL SURVEYS OF BELUGAS IN COOK INLET, ALASKA, AUGUST 2009

Kim E.W. Shelden¹, Kimberly T. Goetz¹, Linda Vate Brattstrom¹, and Barbara A. Mahoney²

¹National Marine Mammal Laboratory
Alaska Fisheries Science Center
National Marine Fisheries Service, NOAA
7600 Sand Point Way NE
Seattle, Washington 98115-6349

²Alaska Regional Office
National Marine Fisheries Service, NOAA
222 W 7th Ave., Box 43
Anchorage, Alaska 99513

Abstract--The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in northern Cook Inlet, Alaska, 11-13 August 2009. 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 and to compare some of these results with boat-based photo-identification surveys conducted by LGL Alaska Research Associates, Inc. The survey (15 hours total) covered the coastal areas north of Point Possession and Beluga River. The 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) each day and crossed Cook Inlet from Point Possession to Beluga River. Two flights occurred each day on 11 and 12 August; a full survey of the upper inlet in the morning to locate groups and an afternoon survey of the upper inlet that coincided with the low tide, when belugas are typically found in consolidated groups. On 13 August, both flights coincided with the high tide as the low tides were too early and late in the day to permit adequate light levels for videotaping. We found beluga groups in the Susitna delta (from the Ivan to the Little Susitna River) and in Knik Arm every day. On the 11 August low tide survey (second flight of the day), we video-taped and counted belugas along the mudflats of the east tributary of the Susitna River (median count = 85 whales), in the Little Susitna River (median count = 89 whales), and in Eagle Bay in Knik Arm (median count = 22 whales) for a total median count of 196 whales. On the 12 August low tide, we video-taped and counted belugas in the Little Susitna River (median count = 161 whales), and in Knik Arm near Eagle Bay (median count = 51 whales) for a total median count of 212 belugas. On 13 August, we coordinated efforts with LGL's boat-based photo-identification project, 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. We found belugas in the same areas as the previous high tide surveys: in Knik Arm near Birchwood Airport (median count = 27 belugas), in the mouth of the Ivan River (median count = 61 belugas), in the eastern tributary of the Susitna River (median count = 15 belugas) and in the Little Susitna River (median count = 94 belugas) for a total median count of 197 whales. We did not find belugas in Turnagain Arm and Chickaloon Bay during the entire August survey. The median estimates of belugas seen each day in August 2009 (a quick index of relative abundance not corrected for missed whales) were greater than those documented in August 2006-2008, but less than those in August 2005.

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 is listed 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 (73 FR 60976, October 15, 2008, Mahoney and Shelden 2000).

The goals of the aerial survey in August 2009 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 fifth year for this project which began in August 2005 (Rugh et al. 2005a, 2006; Shelden et al. 2007, 2008). We also took this opportunity to coordinate with LGL Alaska Research Associates, Inc. to test our aerial counts and videotaped results of specific beluga groups against results from their boat-based photo-identification project.

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 left (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.

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.

In 2009, we coordinated efforts with LGL's boat-based photo-identification project on the last survey day, 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 (15 hours total) covered all coastal areas north of Point Possession and Beluga River (Figs. 1-3). All flights on 11, 12, and 13 August 2009 (6 take-offs and landings, flight time ranged from 1.75 to 2.83 hours) were based out of Anchorage International Airport. Of the 15 flight hours, 7.7 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 0.33 hours (4% of the effective search time). The four observers (authors of this report: KEWS, KTG, LVB, & BAM) have participated in this project on previous surveys.

The aerial surveys in August 2009 covered the coastline of northern Cook Inlet, searching most waters within 3 km of shore. We concentrated our efforts in Knik and Turnagain Arms, Chickaloon Bay (crossed the inlet between Point Possession and Beluga River), Susitna River delta and Little Susitna River. On 11 August, the survey began by following the coast along Chickaloon Bay into Turnagain Arm as far as Twentymile River, then surveying Chickaloon Bay, Chickaloon River, and continuing up the coast to Point Possession. At this point having not found belugas, the survey team began offshore transects in Chickaloon Bay one mile offshore from Point Possession heading east towards Burnt Island, and then two miles offshore, returning to Point Possession. After crossing the inlet to just south of Beluga River, we continued the coastal survey to Beluga River (surveying about 5 miles upriver), Susitna River, Little Susitna River (surveying about 7.5 miles upriver), and Knik Arm, before returning to Anchorage (Fig. 1a). One large group of

belugas was found widely dispersed across the Susitna River mouth, one large group was dispersed in the mouth of the Little Susitna River, and two groups were found in Knik Arm; a small group in was found in Goose Bay and a larger group was sighted north of Birchwood Airport. During the second flight of the day (Fig. 1b), which was conducted to coincide with low tide, we counted and video-taped each of the groups sighted on the previous flight: 7 passes on whales traveling westbound along the mudflats

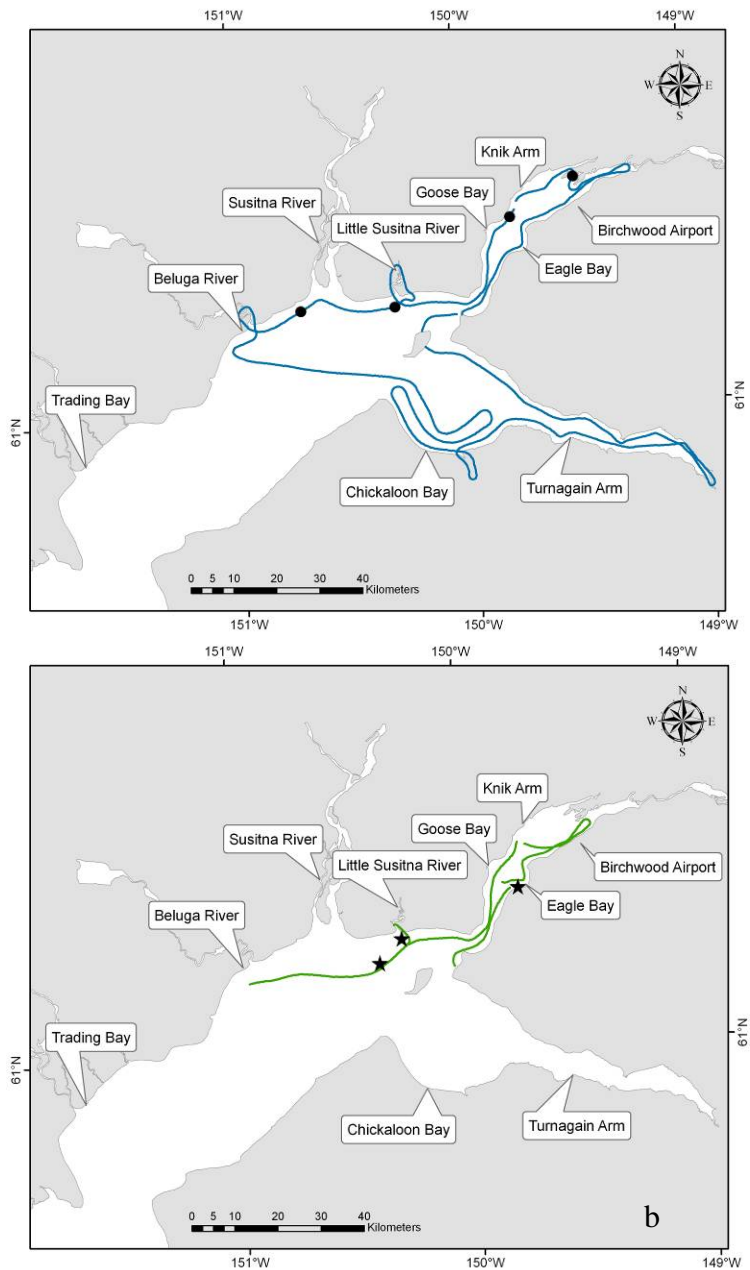


Figure 1. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 11 August 2009. The first flight (a) was conducted in the morning at high tide and the second flight (b) occurred during low tide later in the afternoon. Note that the black circles represent the locations where the beluga groups were originally sighted along the trackline and the black stars are the exact marks over the beluga groups during counting and video-taping passes.

of the Susitna River; 4 passes on whales in the Little Susitna River; 8 passes on whales in Eagle Bay (the groups in Knik Arm had moved into Eagle Bay as the tide ebbed) (Table 1).

On 12 August, we flew the same pattern excluding the offshore transects in Chickaloon Bay. On the morning flight, three beluga groups were found in the same areas as the morning survey on 11 August (excluding the beluga group found in Goose Bay) (Fig. 2a). Once again, during a second flight that coincided with low tide (Fig. 2b), we counted and video-taped each of the groups sighted during the morning survey: 7 passes on whales in the Little Susitna River; and 7 passes on whales in Eagle Bay, Knik Arm (Table 1).

Table 1. Estimates of beluga whale abundance made during aerial surveys of Cook Inlet in August 2009. Counts are medians from observers doing multiple counts of each whale group. 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	8/11	8/12	8/13
Turnagain Arm	0	0	-
Chickaloon Bay/ Point Possession	0	0	0
Point Possession to Beluga River	0	0	0
Beluga River	0	0	0
Ivan River	0	0	61
Susitna River	85	0	15
Little Susitna River	89	161	94
Knik Arm	22	51	27
Fire Island	0	0	0
Totals	196	212	197

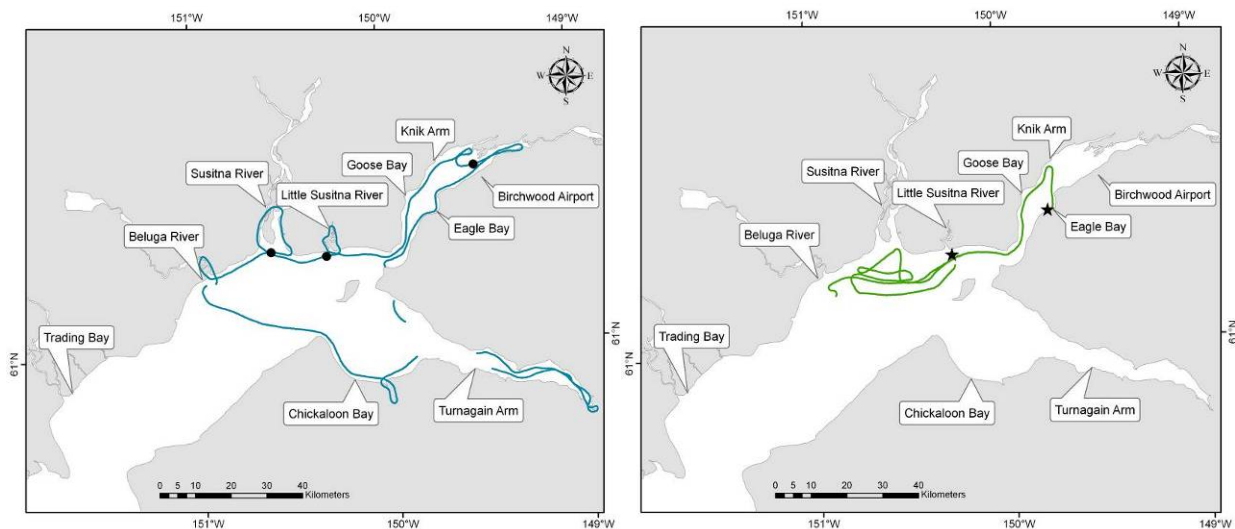


Figure 2. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 12 August 2009. The first flight (a) was conducted in the morning at high tide and the second flight (b) occurred during low tide later in the afternoon. Note that the black circles represent the locations where the beluga groups were originally sighted along the trackline and the black stars are the exact marks over the beluga groups during counting and video-taping passes.

Similar to the previous day, the group in Knik Arm moved into Eagle Bay during the afternoon low tide. The two groups observed earlier in the day, one at the east tributary of the Susitna River and one in the Little Susitna River appeared to have combined into one large group in the Little Susitna River by low tide.

On 13 August, we were only able to survey during the high tide as the low tides occurred too early and late to allow adequate conditions for videotaping. 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. During the first flight we surveyed Knik Arm (Fig. 3a) and after a brief break in Anchorage, we surveyed the rest of the upper inlet from Beluga River to Little Susitna River and across to Chickaloon Bay and Chickaloon River (Fig. 3b). Most beluga groups were in the same areas as the previous high tide surveys: in Knik Arm near Birchwood Airport (9 passes), in the mouth of the Ivan River (6 passes), in the eastern tributary of the Susitna River (8 passes) and in the Little Susitna River (8 passes,) for a total median count of 197 whales (Table 1).

The LGL survey team was able to photograph the beluga group in Knik Arm, beginning about 50 minutes after we departed the area. Their group size estimates were very similar to those obtained from the aircraft and video footage from the aerial cameras and photographs from the boat will be analyzed in the

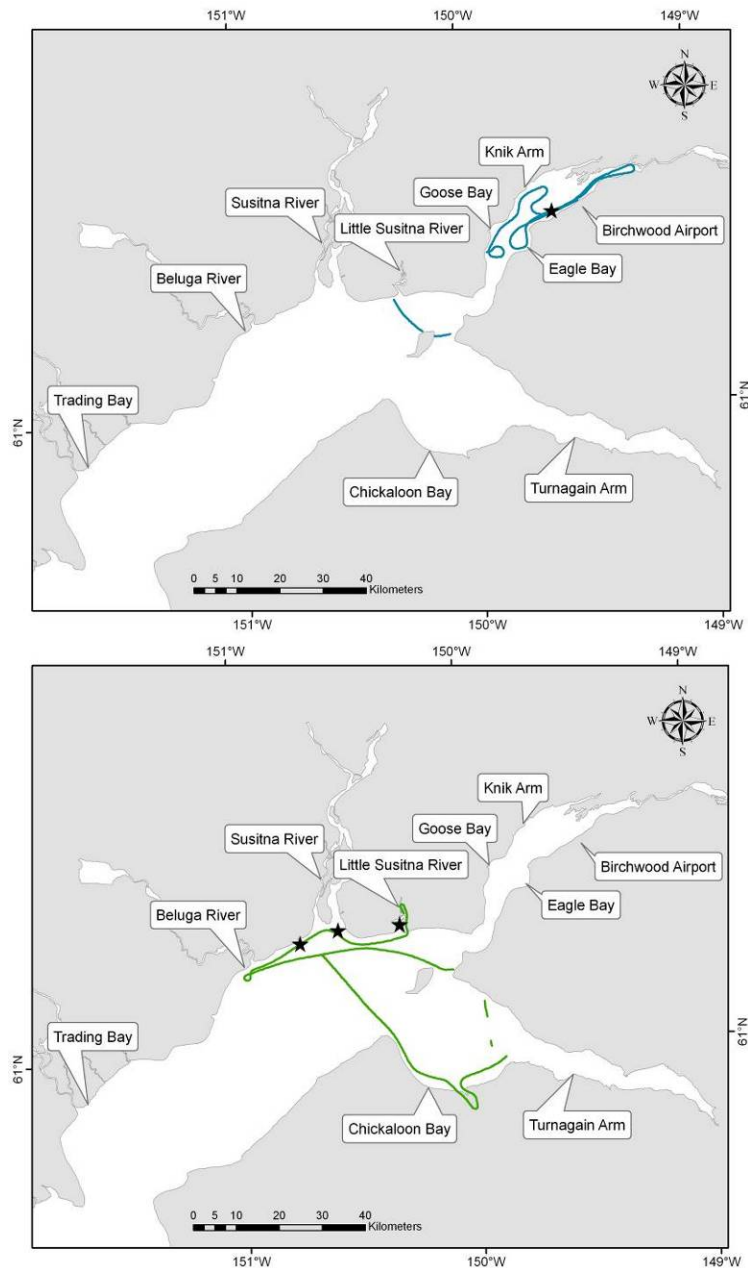


Figure 3. On-effort tracklines and beluga sightings for upper Cook Inlet survey on 13 August 2009. Both flights were conducted at high tide. Note that black stars are the exact marks over the beluga groups during counting and video-taping passes.

laboratory to obtain more accurate counts of belugas and the relative proportions of white versus gray versus dark gray (calf) whales. Unfortunately, the boat could not enter the Little Susitna River until 2 hours after our departure because of tides and the LGL team reported a much smaller group than had been observed during the aerial passes.

Harbor seals (*Phoca vitulina*) were the only other marine mammals sighted during the August 2009 survey (Fig. 4). Seals were hauled out on mudflats offshore of the mouth of the Chickaloon River (1 group, n=50 on 11 and 12 August, and 2 groups of n=30 on 13 August). On 12 August, seals were also seen in Turnagain Arm (1 group, n=1) on the mudflats at the mouth of the Beluga River (1 group, n=1), the mouth of the Susitna River (4 groups, n=66) and along the shore of the Little Susitna River (1 group, n=9).

The median counts (an index of relative abundance not corrected for missed whales) for each day of 196, 212, and 197 belugas were similar to those documented during the 2005-2008 August surveys (Fig. 5). The August 2009 counts also fell within the range of daily median counts obtained in June 2009 (136 to 303 belugas, Sheldon et al. 2009).

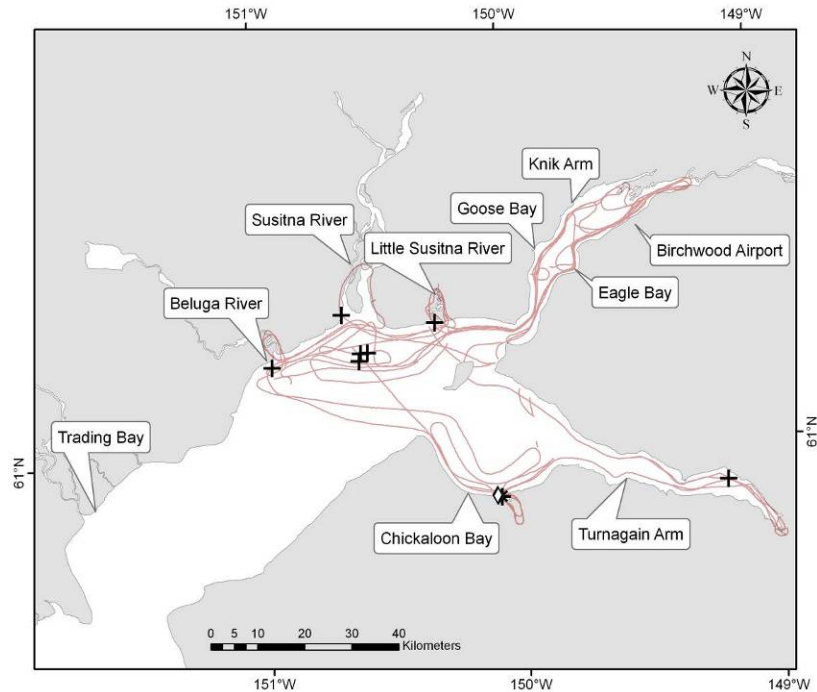


Figure 4. All on-effort tracklines flown during the August 2009 survey (faint red lines) with daily harbor seal sightings (black asterisks = 11 Aug, black crosses = 12 Aug, and white diamonds = 13 Aug).

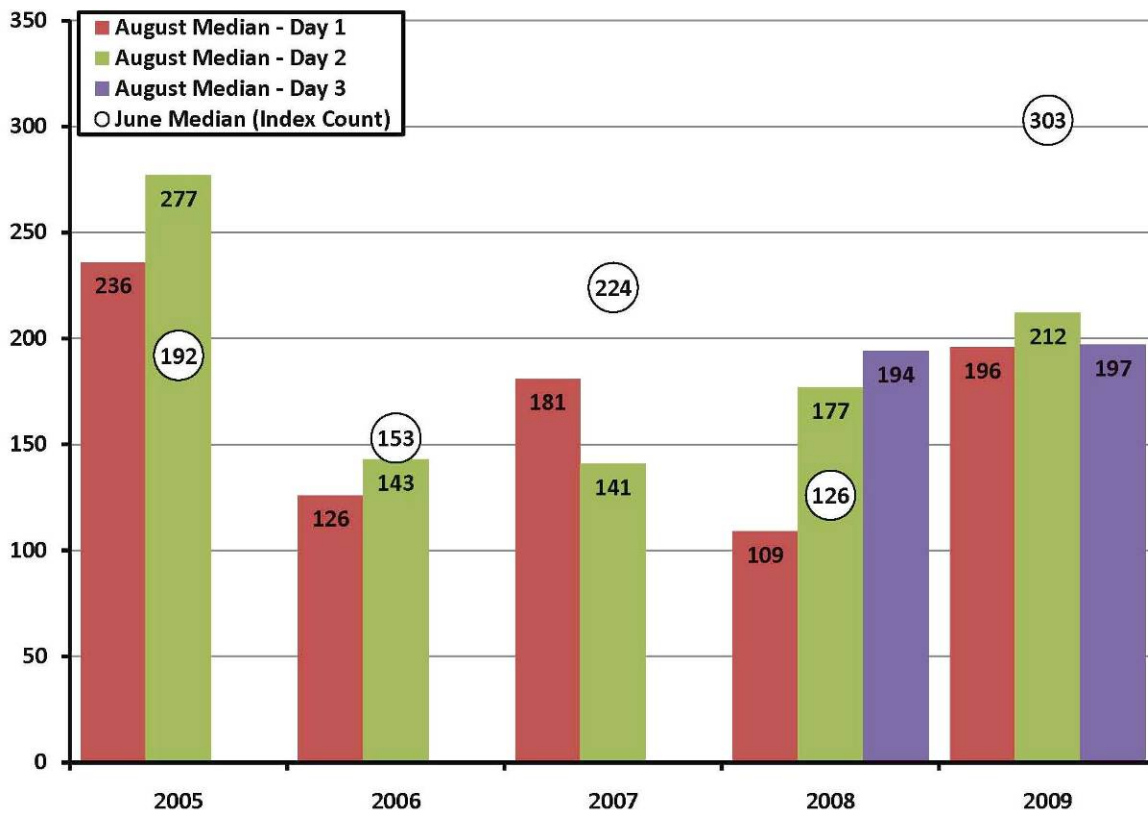


Figure 5. Daily median counts obtained during August aerial surveys of Cook Inlet belugas compared to the June index count (highest daily median count), 2005-2009.

Discussion

The primary goal of the surveys in August 2009 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 2005-2008 (Rugh et al. 2005b, 2006, Sheldon et al. 2007, 2008). 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 2009 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 2009 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). Groups of belugas were seen near the Susitna and Little Susitna Rivers, and in Knik Arm. No belugas were found in Turnagain

Arm or Chickaloon Bay though survey conditions were mostly good. The absence from Chickaloon Bay was consistent with results from surveys in August 2005, 2006, 2007, and 2008 (Rugh et al. 2005b, 2006, Sheldon et al. 2007, 2008). Median counts of whales in August 2009 were less than index count (highest daily median count) in June 2009 (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.

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.
- Shelden, K., K. Goetz and J. Mocklin. 2007. Aerial surveys of belugas in Cook Inlet, Alaska, August 2007. Unpublished NMFS report. 11p.
- Shelden, K.E.W., D.J. Rugh, K.T. Goetz, L. Vate Brattstrom and B.A. Mahoney. 2008. Aerial surveys of belugas in Cook Inlet, Alaska, June 2008. Unpublished NMFS report. 18p.

Cite as:

Shelden, K.E.W., K.T. Goetz, L. Vate Brattstrom, and B.A. Mahoney. 2009. Aerial surveys of belugas in Cook Inlet, Alaska, August 2009. NMFS, NMML Unpublished Field Report. 10p.