

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

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ABSTRACT--The National Marine Fisheries Service (NMFS) conducted surveys of the beluga population in Cook Inlet, Alaska, 29 May-7 June 2012. Using the same protocol since 1993, we flew aerial surveys (53 flight hours) of Cook Inlet in a twin-engine, high-wing Aero Commander aircraft at an altitude of 244 m (800 ft) and speed of 185 km/hr (100 kt). The study in June 2012 included surveys of coastal areas (flown 1.4 km offshore) around most of the inlet and 1300 km of transects across the inlet, effectively searching 30% of Cook Inlet's total area. Paired observers searched on the shore-ward (left) side of the plane where most beluga sightings occur, while a single observer and computer operator/data recorder were on the right side of the plane. After finding belugas, multiple aerial passes were made with paired observers completing four or more independent counts of each group. Daily median counts made on 6 different days ranged from 12 to 21 in Trading Bay (near McArthur River), 126 to 286 belugas in the Susitna delta (between the Beluga and Little Susitna rivers), and 0 to 32 belugas in Chickaloon Bay (including Fire Island and Turnagain Arm). Belugas were not found in Knik Arm. For the first time since 2001, belugas were observed south of the Forelands. Belugas have not been observed in the lower inlet in groups of this size (about 7 whales) since 1995. This lower inlet group moved into the upper inlet and was observed in Trading Bay for the remainder of the survey. We have not observed belugas in Trading Bay since our 1995 survey. In June 2012, the highest daily median estimate, used here as an index for relative abundance (not corrected for effort or for whales missed by the observer), was 319 belugas. This is within the range of index counts from previous survey years (305 belugas in 1993, 281 in 1994, 324 in 1995, 307 in 1996, and 264 in 1997, 193 in 1998, 217 in 1999, 184 in 2000, 211 in 2001, 192 in 2002, 174 in 2003, 187 in 2004, 192 in 2005, 153 in 2006, 224 in 2007, 126 in 2008, 303 in 2009, and 291 in 2010, and 208 in 2011).

Introduction

The National Marine Fisheries Service (NMFS) conducts annual aerial surveys to study beluga (*Delphinapterus leucas*) distribution and abundance in Cook Inlet, Alaska. These surveys typically occur in June and have been repeated each year since 1993 (Rugh et al. 2005, 2010). This project is conducted in cooperation with the Cook Inlet Marine Mammal Council (CIMMC) and the Alaska Beluga Whale Committee (ABWC). The objectives for the annual June surveys are to document beluga sightings for distributional analysis and to count and video belugas in Cook Inlet for abundance estimates. The intent of the 2012 survey, the results of which are reported here, was to maintain continuity with preceding NMFS surveys allowing for inter-year trend analyses.

Until 1999, Cook Inlet belugas were subject to an unregulated subsistence harvest (Mahoney and Sheldon 2000). Following abundance estimates that indicated this stock had declined nearly 50% between 1994 and 1998, NMFS designated the stock as depleted under the Marine Mammal Protection Act (65 FR 34590) on 31 May 2000. The small population size, approximately 300-400 whales (Hobbs et al. 2000a), its failure to increase (Hobbs et al. In prep), and isolation of the Cook Inlet beluga stock (O’Corry-Crowe et al. 1997; Laidre et al. 2000; Rugh et al. 2000) led to the listing of this distinct population segment as *endangered* under the U.S. Endangered Species Act in October 2008 (73 FR 62919).

Methods

Aircraft and data

The survey aircraft used in June 2012, an Aero Commander 690 (*N222ME*), has twin-engines, high-wings, and a more than 8-hour flying capability. Bubble windows were at the right and left forward observer positions, maximizing the search area. A large flat window behind the observer in the left forward position was used by another observer to assess detectability of beluga groups and to count during video passes. Video was collected during counting passes through a small opening window located between the observers on the left side of the aircraft. The data recorder used a laptop computer¹ connected to a handheld portable Global Positioning System (GPS) to record sighting and location data. Data entries included routine updates of time and location, as well as percent cloud cover, sea state (Beaufort scale), glare (on the left and right sides), and visibility (on the left and right sides). Visibility was documented in five subjective categories from excellent to useless; when conditions were rated poor or useless the trackline was considered unsurveyed. Each start and stop of a transect leg was recorded. Observers rotated between positions (left front, left rear, right front, recorder, and videographer) to minimize fatigue. Changes in seating positions were noted in the record.

Tracklines

Coastal surveys were conducted approximately 1.4 km offshore from the apparent waterline. The objective was to search all nearshore, shallow waters where belugas are typically seen in late spring/early summer (Rugh et al. 2000, 2010). The trackline distance from shore was monitored with an

¹ Starting in 2006, survey data were entered using a new software program specifically developed for the Cook Inlet beluga aerial survey by Niel and Kimberly Goetz.

inclinometer keeping the waterline about 10° below horizontal while the aircraft was at the standard altitude of 244 m (800 ft). Ground speed was approximately 185 km/hr (100 knots). This coastal survey included searches up rivers until the water appeared to be too shallow for belugas (as indicated by Alaska Native hunters who participated on surveys in the past). In addition to the coastal surveys, systematic transects were flown across the inlet in a sawtooth pattern and designed to minimize overlap with tracklines from previous years (Fig. 1).

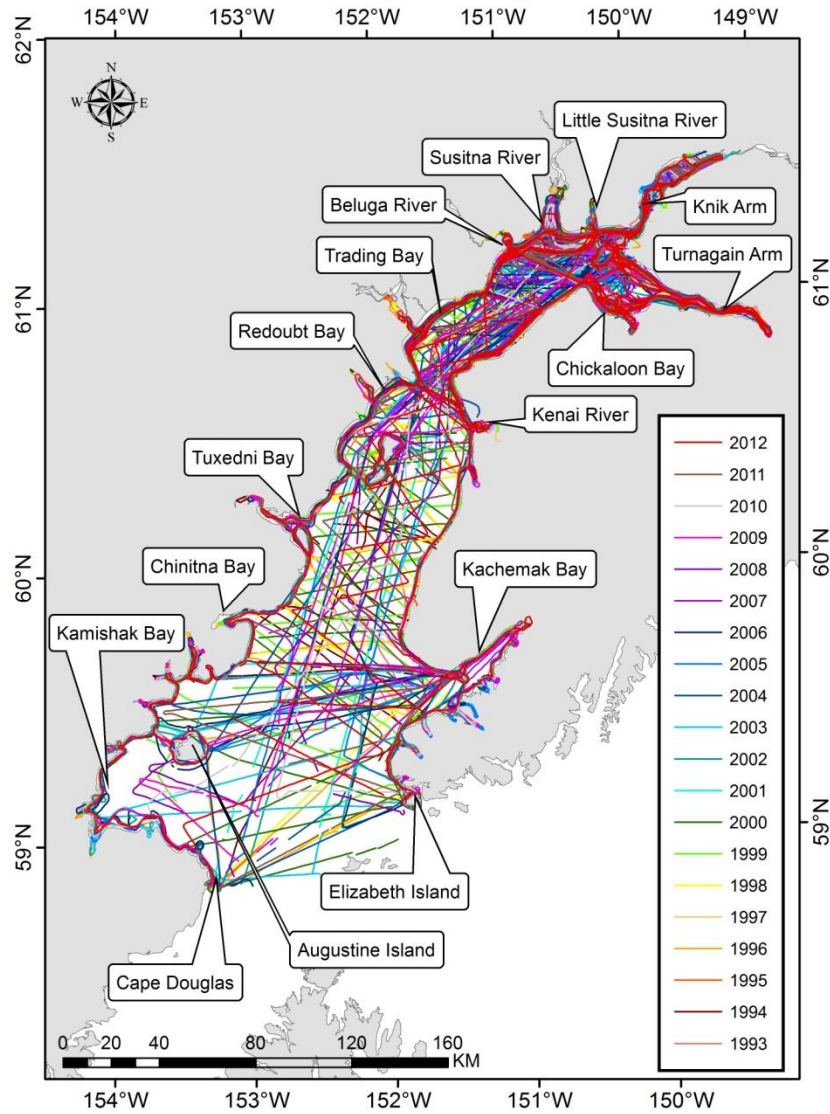


Figure 1. On-effort tracklines for June aerial surveys of belugas in Cook Inlet, 1993-2012.

Tides and Wind

There was a general attempt to synchronize flights with low tides in the Susitna delta and Knik Arm because: 1) the effective survey area was minimized at low tide when large areas of mudflats were exposed; and 2) beluga groups tend to concentrate along the edges of the mudflats at low tide, making them easier to locate and count. Turnagain Arm was usually surveyed in the morning when wind speeds tended to be lower. Aerial surveys south of East and West Foreland were scheduled as a function of weather, not tides.

Although there are many daylight hours in June, light levels in Anchorage were low enough to prevent surveying before 07:30 or after 19:30, local time. The flight schedule for every survey day was designed to take advantage of tidal patterns, as described above, relative to workable daylight hours.

Counting protocol

Immediately upon seeing a beluga group, each observer reported the sighting to the data recorder. As the aircraft passed abeam of the whale group, the observer(s) informed the recorder of the inclinometer angle and notable group behaviors but not group size. After a beluga group was reported, the trackline was maintained until the group was well behind the aircraft. The pilot and data recorder were instructed not to call out beluga sightings until the whales were past the wing and likely missed by observers on that side of the aircraft. After the initial sighting of belugas and passing the whale group, the systematic search effort was stopped and counting passes began.

Whale group locations were established at the onset of the counting passes by flying directly over the group and marking the group perimeters with GPS positions. 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 belugas. Whale counts were made on each pass down the long axis of the oval, with the observers and cameras on the left side of the aircraft. Counts began and ended on cue from the front counter, starting when the leading edge of the beluga group was close enough to be counted and ending when the trailing edge went behind the wing line. This provided a precise record for the duration of each counting effort. The paired observers made independent counts and recorded their results along with date, time, pass number, and quality of the counting pass. The pass quality was a function of how well the observers saw the group location; it was not a function of how many whales were at the surface on the respective pass. Ratings were A (the counting effort was uncompromised by glare, whitecaps, distance, etc.) through F (when it was not practical to count whales). Only passes given quality codes of A and B were used in the abundance analysis. Although whale tracks can be seen in muddy water, only whales at the surface during a pass were included in the counts. Daily count records were not shared within the aerial team until the survey effort was completed to maximize the independence of each observer's counts.

The daily aerial counts are represented by medians of each observer's median counts on multiple passes (typically 4 to 8 passes) over each whale group (Table 1). Using median counts instead of maximum or mean counts reduces the effect of outliers (extreme high or low counts) and makes the NMFS surveys more comparable to other surveys that lack multiple counting passes over whale groups. Median counts are also more appropriate than maximums when these counts are corrected for missed whales because correction factors should be applied to representative counts, not extremes. However, when establishing the annual index, the procedure has been to use the highest of the daily medians instead of a median of all daily medians; this avoids including counts from days with only partial surveys.

Table 1. Beluga counts made during aerial surveys of Cook Inlet in June 2012. Counts are medians from multiple counts of each whale group. Dashes indicate no survey effort and zeros indicate that the area was surveyed, but no whales were seen. Sites are listed in a clockwise order around Cook Inlet starting with Turnagain Arm.

Location	5/29	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7
Turnagain Arm	---	---	---	0	2	0	0	0	---	0
Chickaloon Bay/ Point Possession	---	---	---	2	30	0	17	4	12	9
Point Possession to Moose Point/East Foreland	---	0	---	0	0	0	0	0	0	0
Mid-inlet east of Trading Bay	0	0	7 ^d	0	---	---	---	---	0	---
East Foreland to Homer	0 ^b	0	---	0 ^e	0 ^f	0 ^f	0 ^f	0 ^f	---	---
Kachemak Bay to Elizabeth Island	0 ^b	0	---	---	---	---	---	---	---	---
West side of lower Cook Inlet	0 ^b	0 ^c	---	---	---	---	---	---	---	---
Redoubt Bay	---	---	---	0 ^e	---	---	---	---	---	---
Trading Bay	---	---	---	14	21	14	16	17	12	14
Susitna delta^a	---	---	---	126	219	178	286	256	^g	232
Knik Arm	---	---	---	0	0	0	---	0	---	0
Fire Island	---	---	---	0	0	0	---	0	---	0
Totals	0	0	7	142	272	192	319	277	24^g	255

^aThe coast between North Foreland and Point Mackenzie is defined as the Susitna delta.

^bSurveyed offshore sawtooth tracklines from Anchorage to Cape Douglas, aborted coastal survey at Chinitna Bay due to high winds.

^cSurveyed offshore sawtooth from Elizabeth Island north to Moose Point.

^dwhales were just southeast of West Foreland headed toward land from offshore.

^e Surveyed to Kenai River and Kustatan River in lower inlet

^f Surveyed to Kenai River in lower inlet

^g Whales too dispersed in the Susitna River delta to get accurate counts or video.

Cameras

Paired High Definition (HD) video cameras (Sony HXR-NX5U) were used to document beluga groups; one camera had a lens set at wide angle to view the entire beluga group, and the second camera lens was zoomed to magnify individual whales in the group. The zoomed video is used to determine correction factors for missed animals (see Hobbs et al. 2000b) and to examine color ratios of white adults relative to dark juveniles (Litzky 2001; Hobbs et al. 2012). For many years, Cook Inlet beluga abundance surveys relied on a “standard” mini digital video camera with resolution of 720 x 480 pixels (a Sony DVCAM, DSR-PDX10 Model L10A), but from 2006 through 2010 paired JVC GR-HD1 High

Definition cameras (1290 x 720) were used to provide better resolution video. In 2011, the purchase of two new Sony HXR-NX5U High Definition video cameras with 1920 x 1080 pixel resolution replaced the older video cameras to further increase the quality of video and streamline post-processing of digital video files. The paired Sony cameras were operated on all counting passes when group size appeared to be more than 10 belugas. Video clips from the two cameras will be studied in the laboratory to obtain precise beluga counts. These video beluga counts are also assessed for the amount of time the counting area was in view, which is used to derive a correction factor that accounts for whales not at the surface during the counting pass (Hobbs et al. 2000b). The beluga counts from the video images will be used to help determine the 2012 Cook Inlet beluga abundance estimate (e.g., Hobbs et al. 2000a).

Results

Survey effort

A total of 53 hours were flown around Cook Inlet 29 May-7 June 2012. All flights (18 take-offs and landings ranging from 1 to 5 hours) were based out of Anchorage, sometimes with refueling stops in Homer and Kenai. Of the 53 flight hours, 30.5 hours were spent on survey effort (i.e., not including time on the runway, deadheading without a search effort, circling whale groups to conduct counts, or periods with poor or useless visibility). Due to poor or useless visibility as determined by the left-front observer, 1.2 hours of search effort (~4% of the possible search time) was lost.

One observer (KWS) has participated in the Cook Inlet beluga surveys in most seasons since the project began in 1993. One observer (JAM) participated in 2007. Another (CLS) participated in 2003, 2004, 2006, and 2009-2012. The remaining observer (LWB) has participated since 2008.

Coverage

The June 2012 aerial surveys provided a thorough coverage (100%) of the Cook Inlet coastline (1,810 km) for waters within approximately 3 km of shore (Figs. 2 and 3). In addition, 1,300 km of systematic transects were flown across the Inlet. Assuming a 2.0 km transect swath (1.4 km on the left side plus 1.4 km on the right side, less the 0.8 km blind zone beneath the aircraft), the cumulative survey tracklines covered 6,219 km², which is 30% of the Cook Inlet surface area (20,943 km²). This coverage was similar to past beluga surveys in Cook Inlet (Rugh et al. 2000, 2005, 2010). Upper Cook Inlet was surveyed on seven days in June 2012, concentrating in areas where beluga groups have consistently been found in the past, such as the Susitna delta, Knik Arm, Turnagain Arm, and Chickaloon Bay. Excluding repetitions of the upper inlet, 46% of upper Cook Inlet's total area was covered by all offshore transects (656 km²) and coastline surveys (1,100 km²). In lower Cook Inlet, surveys covered 26% of the area (1,906 km² of coastline plus 1,944 km² of offshore transects relative to a surface area of 17,131 km²).

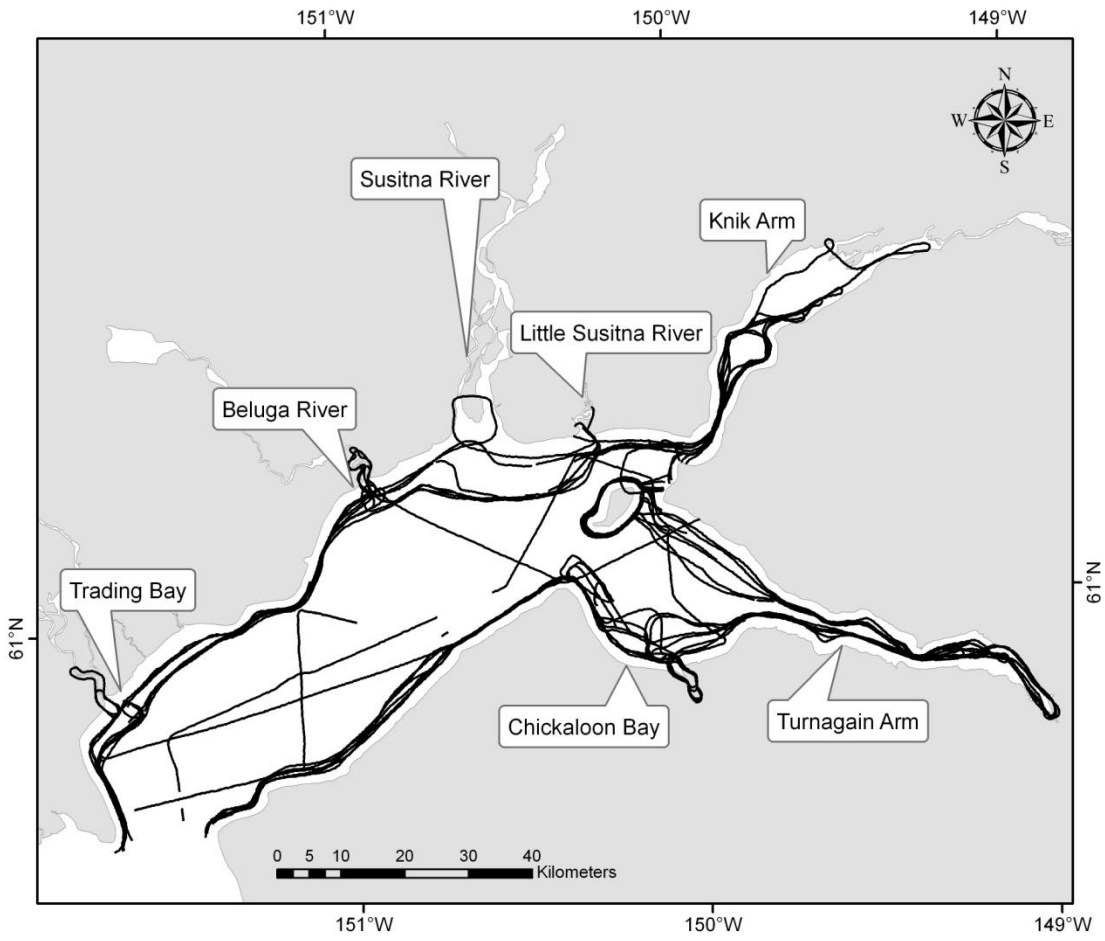


Figure 2. On-effort tracklines for aerial surveys of belugas, upper Cook Inlet, June 2012.

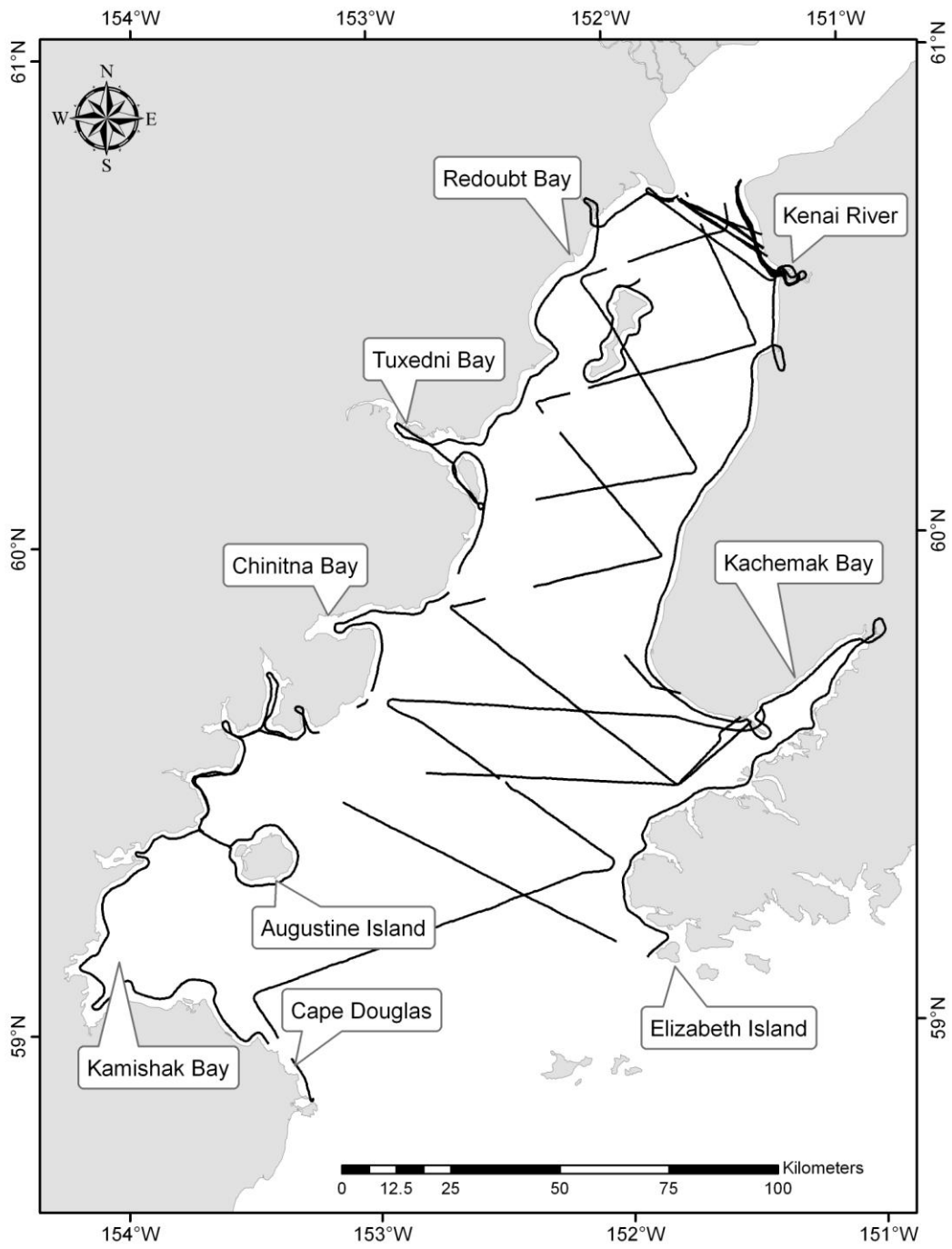


Figure 3. On-effort tracklines for aerial surveys of belugas, lower Cook Inlet, June 2012.

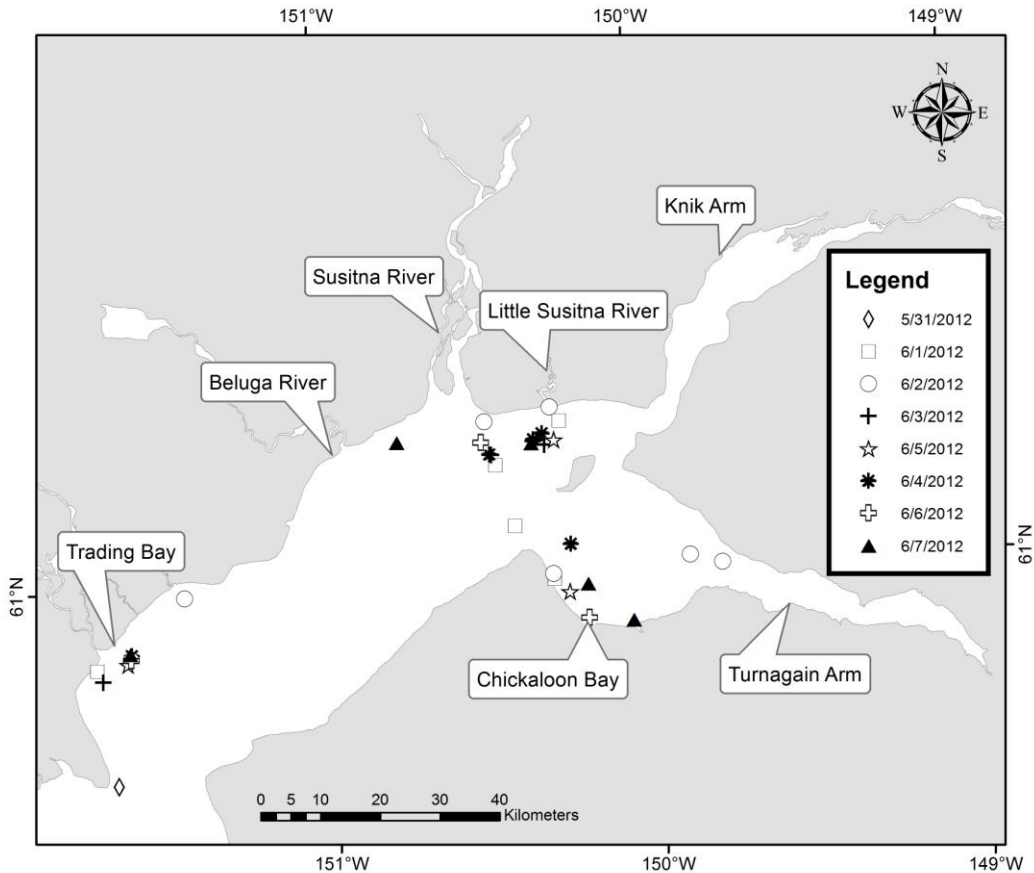


Figure 4. Beluga sightings in Cook Inlet, June 2012.

2012 Daily Reports

May 29

Lower inlet surveys were planned for the beginning of the project given tides were more favorable (negative tides later in the day) beginning in June. The survey began off Anchorage and followed offshore sawtooth transects that ended northwest of Anchor Point, where we flew to Homer to refuel. We continued the sawtooth pattern ending at the waypoint north of Cape Douglas. At Cape Douglas, we began the coastal survey heading north with a brief transit offshore to circle Augustine Island. Conditions deteriorated near Ursus Cove and the coastal survey was aborted at Chinitna Bay due to high winds. Marine mammals sighted included harbor porpoise (*Phocoena phocoena vomerina*), sea otters (*Enhydra lutris kenyoni*), Steller sea lions (*Eumetopias jubatus*), harbor seals (*Phoca vitulina*), an unidentified marine mammal (possible sea otter) and unidentified whales (possibly *Orcinus orca*) (Fig. 5). Harbor porpoise (5 sightings for a total of 7 animals) were seen along the offshore tracklines between Kalgin Island and Anchor Point despite fairly poor sighting conditions. Sea otters were seen on offshore tracklines, in Kachemak and Kamishak bays, and near Augustine Island (14 sightings of 77

animals). Two groups of Steller sea lions (65 animals) were hauled out close to Cape Douglas. Two unidentified cetaceans (possibly killer whales) were seen mid-inlet between Elizabeth Island and Kamishak Bay. Finally, a total of 450 harbor seals (10 sightings) were hauled out or in the water from Shaw Island to Bruin Bay. Viewing conditions were good to poor with high winds (Beaufort sea state 4-5) throughout much of the survey area (Fig. 3).

May 30

Lower inlet surveys continued for a second day, covering the eastern coastline from Point Possession to just north of Elizabeth Island where offshore tracklines were flown in a sawtooth pattern north to Anchorage. Low ceilings, high sea states, and rain forced us to abort part of the offshore trackline from Elizabeth Island to Kamishak Bay and part of the trackline from Kamishak Bay to the west side of the Inlet (Fig. 3). High sea states forced us to end the survey after reaching the end of the trackline near Moose Point (Fig. 2). Marine mammal sightings included: sea otters in Kachemak Bay, Kamishak Bay, and on the offshore transect (48 sightings of 960 animals); 4 groups of harbor seals hauled out (n = 55, 100, 20 and 10 animals) and 2 groups of seals (n = 5 and 3 animals) swimming at Bradley River and off Point Bede, 1 humpback whale (*Megaptera novaeangliae*) enroute from Homer to offshore transect Waypoint 3; 3 groups of killer whales including a pair of males between offshore waypoints, and a pod of 7 (juveniles and females) enroute to Homer from Waypoint 3; 2 harbor porpoise (1 sighting) on the offshore trackline north of Anchor Point; and 1 harbor porpoise on the offshore trackline north of Tuxedni Bay and south of Kalgin Island (Fig. 5).

May 31

Lower inlet surveys continued for a third day, including a circuit around Kalgin Island and covering the western coastline from Ursus Cove to North Foreland (Figs 2 and 3). Marine mammal sightings included: 8 sea otters between Iniskin and Oil bays; harbor seals in the water near Kalgin Island (n=1), 12 harbor seals in the water in Iniskin Bay and hauled out at Tuxedni Bay (2 groups, 85 and 10 animals) and on the shoreline from Big River to Kustatan River (4 groups, 125 animals); 1 harbor porpoise between Chinitna and Tuxedni bays; and 7 beluga whales just southeast of West Foreland headed toward Trading Bay (Fig. 5).

June 1

The first survey of upper Cook Inlet also extended south into the lower inlet to Kenai River and Kustatan River. Surveys were timed to coincide with the falling/low tide (11:29, +0.91 ft) at Susitna River and Knik Arm. We departed Anchorage and circled the west shore of Fire Island before crossing Chickaloon Bay and entering Turnagain Arm. We surveyed the entire Arm and continued the survey into Chickaloon Bay, surveying up Chickaloon River and along the bluffs where a lone beluga was encountered (Fig. 4). We resumed the coastal survey around Point Possession where another lone beluga (Group 2) was seen headed offshore. We crossed the inlet to the Beluga River where we surveyed up the river before resuming the coastal survey, crossing the mouth of the Susitna River where another lone whale was observed. After circling, at least 8 whales were observed in Group 3 but were too scattered for counting/video passes. We continued the coastal survey to the Little Susitna River where a large group of belugas (Group 4: 9 video and counting passes) was found along the shore near the river mouth with part of the group entering the Little Susitna River (Fig.4). Whales were not seen in Knik Arm. Other marine mammal sightings included harbor seals hauled out on the Chickaloon River

mudflats (17 animals) and hauled out on the Susitna mudflats ($n=60+3+120$) (Fig. 5). After a short break in Anchorage, we conducted a second flight crossing Chickaloon Bay to Point Possession and following the coast to Kenai River, surveying up the river then crossing the inlet to Kustatan River. Here we resumed the coastal survey headed north into Trading Bay where we encountered a northbound group of belugas approaching the mouth of the McArthur River (Group 5: 6 video and counting passes). The coastal survey was terminated at Beluga River. A single harbor seal was seen in the water near Tyonek. Sighting conditions were fair to excellent with Beaufort sea states ranging from 0 to 3.

June 2

We completed a full survey of the upper inlet north of Kenai River and West Foreland. The survey began by circling Fire Island, following the mudflats into Turnagain Arm, Chickaloon Bay (including the river and bluffs), and the east coast to Kenai River (up river to the bridge) before landing to refuel. We departed Kenai for West Foreland and completed a survey of the west coast to Anchorage including transit up the McArthur River, Beluga River, Susitna River, and Little Susitna River. The flights coincided with the falling tide in Turnagain Arm and rising tide in the Susitna delta (low tide at 12:21, -1.39 ft). Belugas were in six groups: Group 1 was a lone white whale headed west along the Potter Marsh mudflats, Group 2 was a lone white whale seen west of Beluga Point (on which we were unable to get an accurate location), Group 3 was scattered along the bluffs of Chickaloon Bay (8 video and counting passes), Group 4 was near Shirleyville/Granite Point (10 video and counting passes), Group 5 was initially two groups that combined into one large compact group and continued traveling west toward the east tributary of the Susitna River (9 video and counting passes) and Group 6, a large group in the Little Susitna River (11 video and counting passes) (Fig. 4). Other marine mammal sightings included: 47 harbor seals hauled out in five groups ($n = 6, 17 (2+15), 14,$ and 9) at Chickaloon River, 1 hauled out on a rock near Point Possession, 1 swimming north near Moose Point, and 8 (5 sightings) in the water near McArthur River (Fig. 5). Sightings conditions were much improved from the previous day with calm sea states and good to excellent visibility.

June 3

We completed a full survey of the upper inlet north of Kenai River and West Foreland, this time on the falling tide in Turnagain Arm and low tide in the Susitna delta (13:12, -3.24 ft). Belugas were in three groups: Group 1 was south of McArthur River (5 video and counting passes); Group 2 included two adults with a small calf (no video, circled to count) near the eastern tributary of the Susitna River; and Group 3, a large group west of the Little Susitna River (11 video and counting passes) (Fig. 4). Other marine mammal sightings included: 2 harbor seals in the water at Chickaloon River, 8 harbor seals hauled out at McArthur River, and 2 groups ($35+7$) hauled out at the Susitna delta (Fig. 5). Sighting conditions deteriorated slightly from the previous day with mostly calm sea states with patches of poor visibility due to higher Beaufort and rain near Fire Island.

June 4

We continued to follow the same pattern as the two previous days, completing a full survey of the upper inlet north of Kenai River and West Foreland, this time on the high tide in Turnagain Arm and low tide in the Susitna delta (14:02, -4.39 ft). Belugas were in 5 groups: Group 1 was in mid-Chickaloon Bay (8 counting passes, but no video as the group was scattered in deep water); Group 2 just north of McArthur River (9 video and counting passes), Group 3 traveling east from the Susitna River (6

video and counting passes), Group 4 and 5 just west of the Little Susitna River (7 and 4 counting and video passes, respectively), that converged together into one group (Group 6: 5 video and counting passes) (Fig. 4). Other marine mammal sightings included: 2 harbor seals hauled out at Chickaloon River and 1 seal swimming off Chickaloon Bluffs, 2 harbor seals swimming by West Foreland, 2 groups (5 + 6) harbor seals in the water near McArthur River, and 3 groups (4+60+80) hauled out at the Susitna delta (Fig. 5). Sightings conditions were much improved from the previous day with calm sea states and fair to excellent visibility.

June 5

We continued to follow the same pattern completing a full survey of the upper inlet north of Kenai River and West Foreland, on the high tide in Turnagain Arm and low tide in the Susitna delta (14:50, -4.70 ft). Belugas were in 3 groups: Group 1 was perpendicular to the Chickaloon Bay bluffs (7 counting passes, but no video as the group was small and scattered); Group 2 just north of McArthur River (5 video and counting passes); and Group 3 just west of the Little Susitna River (11 counting and video passes) (Fig. 4). Other marine mammal sightings included: 2 harbor seals hauled out at Chickaloon River, and 33 in the water near McArthur River (Fig. 5). Sightings conditions continued to improve with calm sea states and fair to excellent visibility.

June 6

The weather forecast for the day was not promising: winds gusting up to 30 kts at Bird Point in Turnagain Arm and rain predicted for the afternoon. We circled Fire Island then cut across Chickaloon Bay to escape the high winds, unable to safely survey Turnagain Arm. Conditions were calm along the south shore and bluffs where Group 1 was encountered (6 video and counting passes). We continued to survey the coastline from Point Possession to Moose Point then completed an offshore trackline to the mudflats in Trading Bay between West Foreland and McArthur River where the coastal survey resumed. Group 2 was just north of the mouth of the McArthur River (5 video and counting passes). Sighting conditions began to deteriorate as we approached the Susitna River delta. Belugas were scattered offshore along the unexposed edge of the mudflats as the tide was starting to fall (Group 3). Video and counting passes were aborted as winds continued to rise and rains began. Wind gusts up to 35 kts prevented us from surveying Knik Arm. Other marine mammal sightings included: 3 harbor seals hauled out at Chickaloon River, 125 hauled out near McArthur River, 17 hauled out by Beluga River, and 2 groups hauled out (100 +100) at the Theodore and Lewis rivers, respectively (Fig. 5).

June 7

We completed a full survey of the upper inlet north of Moose Point and the mudflats between West Foreland and McArthur River. The flight coincided with the high tide in Turnagain Arm and falling tide in the Susitna delta (low at 16:27, -2.8 ft.). Winds were calm with excellent to fair (due to glare) sighting conditions throughout the upper inlet. Beluga groups were observed in Chickaloon Bay at the river mouth (Group 1: 3 counting passes, no video) and a mile off the mudflats swimming rapidly toward the bluffs (Group 2: 4 counting passes, no video); at McArthur River (Group 3: 5 video and counting passes); offshore along the submerged mudflats off Lewis River (Group 4: 6 video and counting passes); and west of the Little Susitna River (Group 5: 10 video and counting passes). Other marine mammal sightings included: 16 harbor seals hauled out at Chickaloon River, 50 in shallow water at McArthur River, 1 swimming at Beluga River, and 2 groups; 20 hauled out and 1 swimming at the

Lewis River (Fig. 5).

Summary counts of belugas

The daily medians ranged from 142 to 319 whales (Table 1). Following the protocol from previous surveys, the highest daily median is used as the annual index count; therefore, in June 2012 the index count was 319 belugas. This annual index does not reflect any correction for missed whales. Calculations for whales missed during these aerial counts and abundance estimates are described in Hobbs et al. (2000a, b). The median count in 2012 is within the range of counts from 1993-2011 (Table 2).

Table 2. Cook Inlet beluga index counts (i.e., highest daily median count) made during aerial surveys in June or July 1993-2012 showing abundance estimates with respective CVs (Hobbs et al. 2000a; NMFS unpublished data).

Year	Dates	Index counts	Abundance estimates	CV	Nmin	Upper CL	Lower CL
1993	June 2-5	305	---	---			
1994	June 1-5	281	653	0.24	535	1038	411
1995	July 18-24	324	491	0.21	412	738	327
1996	June 11-17	307	594	0.20	503	876	403
1997	June 8-10	264	440	0.13	395	567	341
1998	June 9-15	193	347	0.17	301	483	249
1999	June 8-14	217	367	0.09	340	438	308
2000	June 6-13	184	435	0.14	387	572	331
2001	June 5-12	211	386	0.10	355	469	317
2002	June 4-11	192	313	0.10	288	381	257
2003	June 3-12	174	357	0.08	334	418	305
2004	June 2-9	187	366	0.13	328	472	284
2005	May 31-June 9	192	278	0.10	256	338	229
2006	June 5-15	153	305	0.10	280	371	251
2007	June 7-15	224	375	0.08	350	438	320
2008	June 3-12	126	375	0.11	342	465	302
2009	June 2-9	303	321	0.11	293	398	259
2010	June 1-10	291	340	0.08	318	398	291
2011	May 31-June 9	208	284	0.09	263	339	238
2012	May 28-June 7	319	312	0.13	280	402	242

Note: there were revisions to the abundance estimate CVs after reanalysis of the data for the time series (Hobbs et al. In prep). The CVs presented in earlier field reports were estimated using the method of Hobbs et al. (2000b). The revised CVs (resulting in revised CL and Nmin estimates) are based on the standard error of the daily abundance estimates and an estimate of the variance based on diving behavior of a tagged whale.

Other marine mammals

Although belugas were not seen in lower Cook Inlet (south of 60°43'N), many other marine mammals were recorded (Fig. 5). Harbor seals were seen on every survey day in lower and upper Cook Inlet. There were 64 harbor seal sightings ranging from 1 to 125 seals per group (1,812 harbor seals total; mean group size of 28). Sea otters were seen in or near Kachemak Bay, on offshore tracklines and along the west side of the inlet from Cape Douglas to Harriet Point (a total of 1,045 otters; mean group size of 17). One unidentified marine mammal sighting (1 individual – probably a sea otter) was sighted near Homer. Two groups of Steller sea lions were seen hauled out close to Cape Douglas (65 animals total). Cetacean sightings in lower Cook Inlet included 1 humpback whale sighting (1 whale total) in Kachemak Bay, 3 killer whales sightings (9 individuals total) in Kachemak Bay and on offshore transect, and 8 sightings of harbor porpoise (11 individuals total) seen on offshore transects. There was one unidentified cetacean sighting (2 individuals - possibly killer whales) seen 4 miles from the location of 2 killer whales that were seen the next day.

a

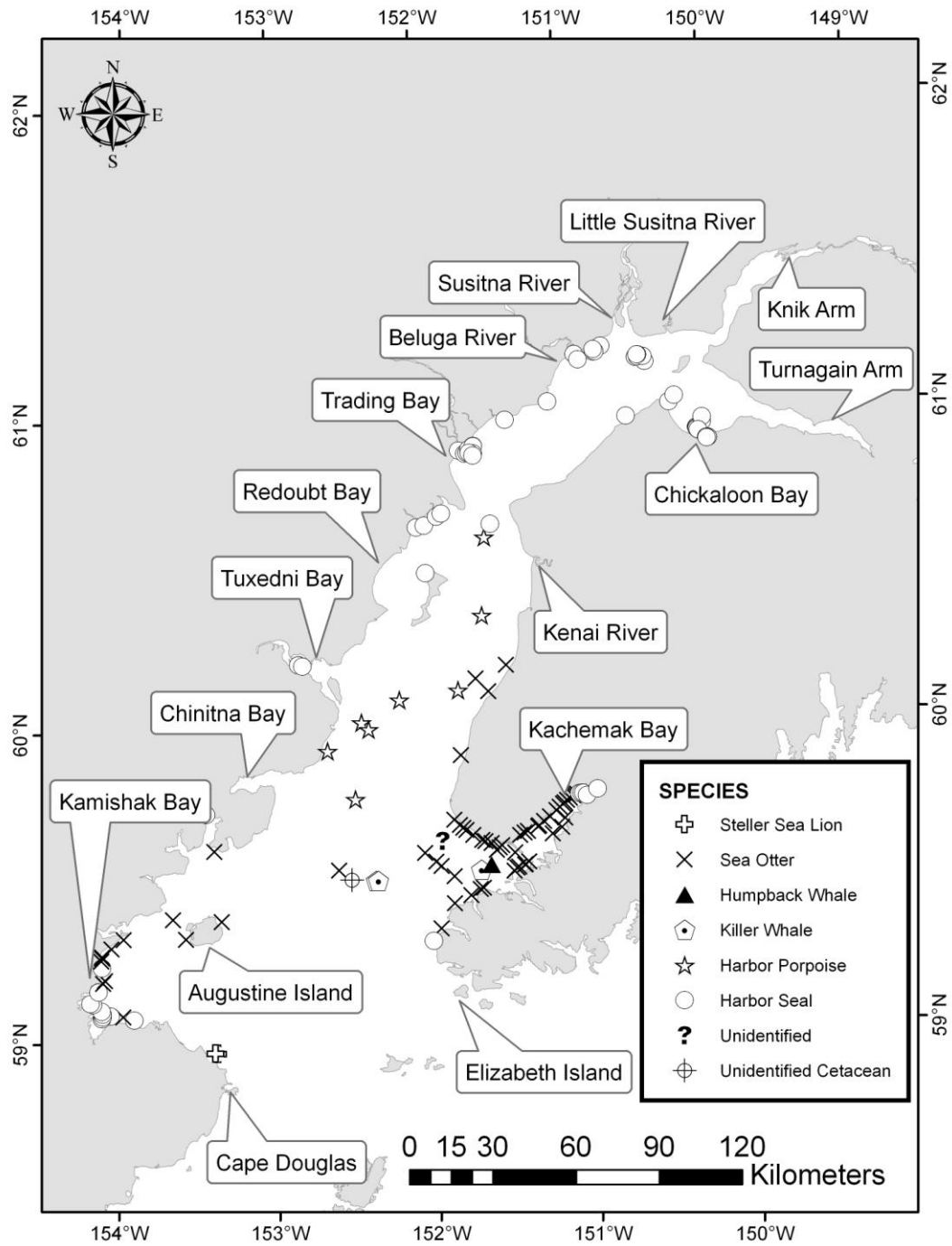


Figure 5. Marine mammal sightings other than belugas, in Cook Inlet, June 2012.

Discussion

The June 2012 Cook Inlet survey was similar to previous surveys in terms of research protocol and survey area. In addition to the many years this project has been underway (since 1993), each of these beluga surveys has involved several replicate flights around upper Cook Inlet. The large number of flights and consistency in effort has helped detect whale distribution patterns. In 2012, belugas were again found in the Susitna delta and Chickaloon Bay. Two belugas were found in Turnagain Arm, none were seen in Knik Arm, and a group of 7 belugas was observed south of the Forelands. Before 1996, it was not uncommon to see beluga groups south of North Foreland (Rugh et al. 2000, 2010), but since the mid-1990s, only one or two beluga groups have been found in lower Cook Inlet (Rugh et al. 2010). Belugas have not been observed in the lower inlet during our surveys since 2001, and not in numbers of this size since 1995. This lower inlet group moved into the upper inlet and was observed in Trading Bay for the remainder of the survey. We have not observed belugas in Trading Bay since our 1995 surveys. In spite of good sighting conditions during most of these June annual surveys, belugas were regularly observed only in upper Cook Inlet north of Beluga River. Given the number of other marine mammals seen in the lower Inlet, the lack of beluga sightings was not due to compromised visibility.

The 2012 index count (median count from the best survey day) was 319 belugas, which is within the range of index counts made annually since 1993 (Table 2). These median counts are uncorrected for missing whales, but they do provide a crude assessment of the aerial survey effort. The annual calculated abundance includes corrections for whales missed within the viewing range of observers, whales missed because they were beneath the surface or missed due to the density of groups. These corrected abundance estimates are shown in Table 2 and Figure 6 (estimates from 1994-2000 are from Hobbs et al. (2000a); estimates from 2001 to 2012 are from Rugh et al. (2005) and NMFS unpublished data). The abundance estimates, with their associated coefficients of variance, are the appropriate values to be used in interyear trend analyses (Fig. 6).

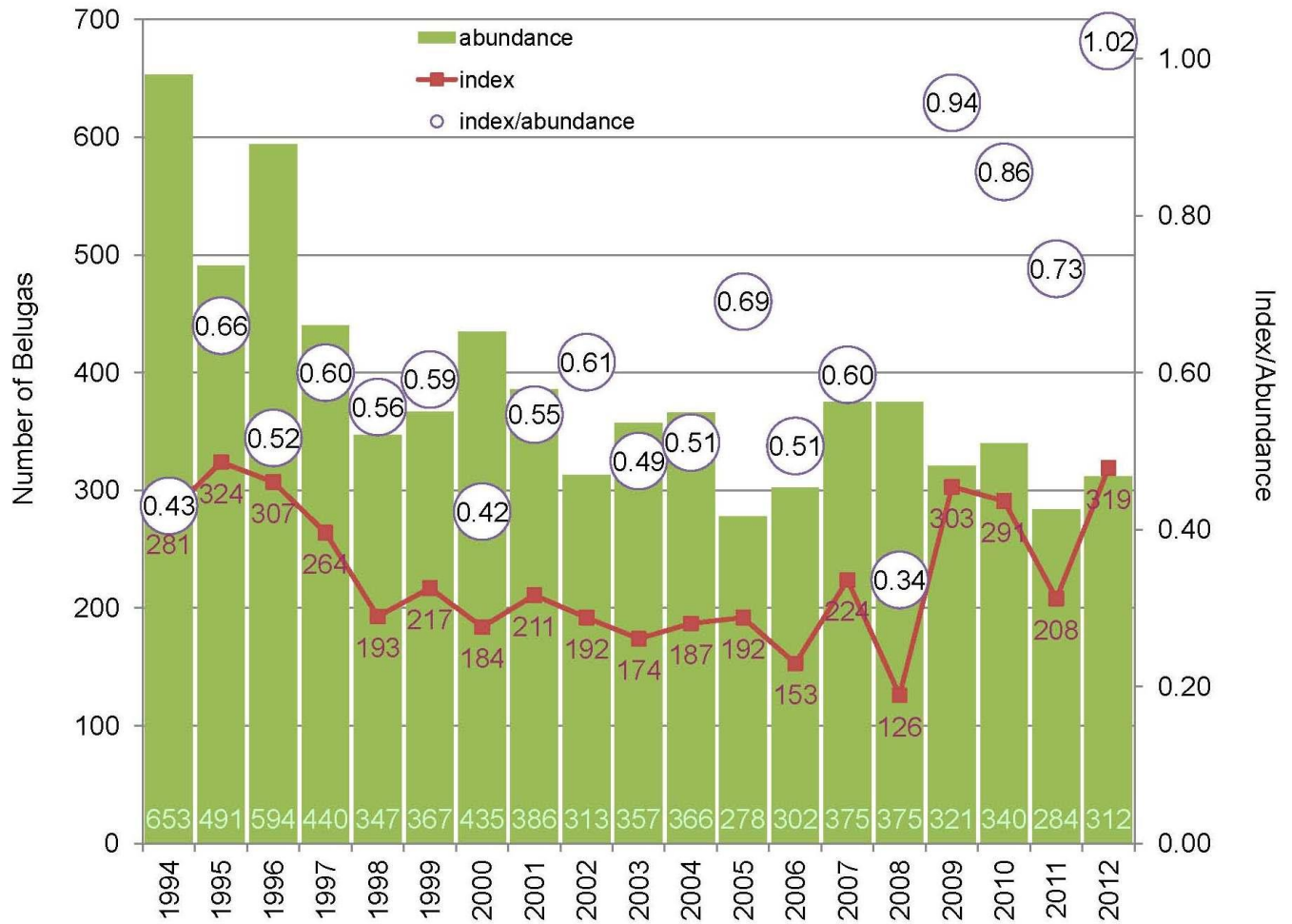


Figure 6. Annual abundance estimates (green bars) and median index counts (red line) for beluga aerial surveys, Cook Inlet, Alaska, 1994-2012. Circles show index counts divided by abundance estimates (note: in most years the index count is between 50% - 70% of the total abundance estimate).

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