

AERIAL SURVEYS OF BELUGAS IN COOK INLET, ALASKA, JUNE 2005

David J. Rugh¹, Kimberly T. Goetz¹,
Barbara A. Mahoney², Brad K. Smith², and Thomas A. Ruzzkowski³

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

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

³ 724 Postal Service Loop #6500
Fort Richardson, Alaska 99505

Abstract

The National Marine Fisheries Service (NMFS) conducted an aerial survey of the beluga population in Cook Inlet, Alaska, 31 May to 9 June 2005. The survey (54.5 flight hrs) was flown in a twin-engine, high-wing aircraft at an altitude of 244 m (800 ft) and speed of 185 km/hr (100 kt), consistent with NMFS' surveys conducted each year since 1993. The flights in June 2005 included one or more surveys of coastal areas (flown 1.4 km offshore) around the entire inlet and 1,363 km of transects across the inlet, effectively searching 28% of Cook Inlet but nearly 100% of the coastal areas. Paired, independent observers searched on the coastal (left) side of the plane, where virtually all beluga sightings occur, while a single observer was on the right. A computer operator/data recorder was also on the left side. After finding beluga groups, a series of aerial passes was made with two pairs of primary observers each making four or more independent counts of each group. Daily median counts made in optimal viewing conditions on six different days were 23-155 belugas in the Susitna delta (between the Beluga and Little Susitna Rivers), 0-43 in Knik Arm, 0-21 in Turnagain Arm, 24-66 in Chickaloon Bay, and 0-29 at Fire Island. No belugas were seen elsewhere, such as in the central or lower Inlet. On these annual surveys, belugas have often been seen in the Susitna area, Knik Arm, Turnagain Arm, and Chickaloon Bay, but never before have significant numbers been seen near Fire Island. The highest of the daily median estimates (a very rough but quick index of relative abundance, not corrected for effort nor for estimates of whales missed) for June 2005 is 192 belugas. This is below index counts for years prior to 1998 (305 in 1993, 281 in 1994, 324 in 1995, 307 in 1996, and 264 in 1997), but it is similar to other counts made during the past seven years (193 in 1998, 217 in 1999, 184 in 2000, 211 in 2001, 192 in 2002, 174 in 2003, and 187 in 2004).

Introduction

The National Marine Fisheries Service (NMFS) has conducted annual aerial surveys to study the distribution and abundance of belugas (*Delphinapterus leucas*) in Cook Inlet each June/July since 1993 (Rugh *et al.* 2005). This project has been in cooperation with the Cook Inlet Marine Mammal Council (CIMMC) and the Alaska Beluga Whale Committee (ABWC). The primary objectives for the current study are to document the location of sightings and count belugas in Cook Inlet while maintaining a continuity with preceding studies to allow for inter-year trend analyses.

Much of the motivation for this research has been driven by the small size (approximately 400 whales; Hobbs *et al.* 2000a) and isolation of the beluga stock in Cook Inlet (O=Corry-Crowe *et al.* 1997; Laidre *et al.* 2000; Rugh *et al.* 2000), which, until 1999, was subjected to an unregulated harvest (Mahoney and Sheldon 2000). On 31 May 2000, this stock was designated as depleted under the Marine Mammal Protection Act (65 FR 34590) and is now managed with a small, regulated subsistence harvest.

Methods

Aircraft and data

The survey aircraft, an Aero Commander 680 FL (*N7UP*), has twin-engines, high-wings, and 10-hr flying capability. There are bubble windows at each of three primary observer positions, maximizing the search area. An intercom system provided communication among the observers, data recorder, and pilots, but a selective listening device was used to aurally isolate each observer position. A laptop computer used to record sighting data as well as location data from a portable Global Positioning System (GPS). Data entries included routine updates of time, locations (every two seconds), percent cloud cover, sea state (Beaufort scale), glare (on the left and right), and visibility (on the left and right). Visibility was documented in five subjective categories from excellent to useless; conditions rated poor or worse were considered unsurveyed. Each start and stop of a transect leg was recorded. Observer seating positions were noted each time they were changed, generally every 1-2 hrs to minimize fatigue.

Tracklines

Coastal surveys were conducted approximately 1.4 km offshore. The objective was to search all nearshore, shallow waters where belugas are typically seen in summer (Rugh *et al.* 2000). The trackline distance from shore was monitored with an inclinometer such that the waterline was generally 10E 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 less than 1 m deep, based on the appearance of rapids or riffles or as recommended by Native hunters who have flown with us in the past.

In addition to the coastal surveys, systematic transects were flown across the inlet (Fig. 1). Offshore tracklines were designed to run the length of Cook Inlet or cross it, minimizing overlap (Fig. 2).

Tides

The broad geographical range of these surveys in conjunction with rapidly changing tide heights made it impractical to survey at specific tidal conditions throughout Cook Inlet. There was an attempt to synchronize flight timings with low tides in the Susitna delta and Knik Arm, primarily to minimize the effective survey area at low tide, large areas of mudflats were exposed that would otherwise have to be surveyed. In the past, it has proved best to survey Knik Arm during a rising tide because whale groups were relatively more concentrated as they moved up flooding channels. Also, when the whales followed the current north, they moved away from the intense air traffic experienced near Anchorage with Elmendorf Air Base, Merrill Field, Lake Hood, and the Anchorage International Airport where observed whales could not be circled for the standard counting protocol. Because the change of tides in Turnagain Arm can be so rapid that tide rips compromise visibility, we attempted to survey there on a slack tide. At high tide, belugas in Chickaloon Bay sometimes grouped close to shore or in Chickaloon River where they were relatively easy to count. The timing of aerial surveys of areas south of Point Possession and North Foreland were a function of weather, not tides.

Although there are many hours of daylight in this area during early June (just prior to the summer solstice), light levels were low enough at night to limit our survey to hours between 07:30 and 19:00, 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 independently reported the sighting to the recorder. As the aircraft passed abeam of the whales, the observer informed the recorder of the inclinometer angle and notable behaviors but not group size. With each sighting, the observer's position (left front, left center, etc.) was recorded. An important component of the survey protocol was the independence of the paired observers (i.e., that they not cue each other to their sightings). Visual barriers were between them, and their headsets did not allow them to hear each other. After a group of whales was reported, the trackline was maintained until the group was well behind the aircraft; then the aircraft returned to the group and began a circling routine. This allowed each observer full opportunity to independently sight and report whale groups and made it clear when a group was missed. The pilot and data recorder did not cue the observers to the presence of a whale group until it was out of sight.

The whale group location was established at the onset of the aerial counting passes by flying directly over the group, marking the perimeters of the group. The flight pattern used to count a whale group involved an extended oval around the longitudinal axis of the group with turns made well beyond the ends of the group. Whale counts were made on each pass down the long axis of the oval. Because there were four passes for each of the two pairs of observers on the right side of the aircraft, there were typically eight or more separate counting opportunities per whale group. 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 wing line. This provided a precise record of the duration of each counting effort. The paired observers made independent counts and wrote down their

results along with date, time, pass number, and quality of the count. The quality of a count was a function of how well the observers saw the location of a group, not how many whales were at the surface on the respective pass. 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). Quality A and B estimates were used in the analysis; quality C and D were not used in analysis. Only whales that were at the surface during a counting pass were included; whale tracks in the muddy water or ripples were not counted. Count records were not shared on the aerial team until after all surveys were completed. This was done to maximize the independence of each observer's counts.

Because most whale groups were counted on eight different aerial passes, and because two observers were counting on each pass, there were usually 16 counts made per group per day, not including counts made later on video tapes. The daily aerial counts are represented by medians of each of the four observers= median counts on multiple passes over a group (Table 1). The process of using medians instead of maximums or means reduces the effect of outliers (extremes in high or low counts) and makes the results more comparable to others= surveys which lack multiple passes over whale groups. Medians are also more appropriate than maximums when counts are corrected for missed whales. However, when establishing the standard annual index, the procedure has been to use the highest of the daily medians instead of a median of the daily medians to avoid problems with days when significant whale groups were missed or important areas were unsampled due to weather.

Cameras

A digital video camera was operated on most counting passes. This "standard camera" (a Sony DVCAM, DSR-PDX10 Model L10A) was used at its widest angle to keep the entire group of belugas in view. Images from the "standard camera" will be studied in the laboratory for whale counts relative to the precise length of time that images were available to be counted. These are the beluga counts that will be used to determine the abundance estimates (Hobbs *et al.* 2000a).

During half of the aerial passes, a second camera (a Sony DSR PD100a), kept at maximal optical zoom (12x), was mounted on a common board beside the "standard camera." Images from the camera kept at maximal zoom will be examined for subtle surfacings that did not show up in the standard video and for color ratios (white adults vs dark juveniles) within the respective groups (as described in Litzky 2001). Analysis of both the aerial counts and counts from the video tapes are detailed in Hobbs *et al.* (2000b) for 1994-2000 data.

On the other half of the aerial passes, a digital still camera (Nikon D1X with a 80-200mm Nikkor AF lens) was mounted alongside the "standard camera." The still camera was fired when there were whales in view, unlike the video cameras which videotaped well before and after a whale group passed through the field of view. The digital still images provide greater detail to help detect calves, which are darker than the adults and do not rise above the surface as much as the white adults do (Sims *et al.* 2003).

Results

Survey effort

A total of 54.5 hrs were flown around Cook Inlet from 31 May to 9 June 2005. All flights (16 take-offs and landings ranging from 1.1 to 6.0 hrs) were based out of Anchorage, sometimes with refueling stops in Homer or Kenai. Of the 54.5 flight hours, 31.2 hrs were spent in the standard search, not including time spent taxiing on the runway, deadheading without a search effort, circling whale groups to conduct counts, or periods with poor visibility. Visibility conditions interfered with the survey effort during 1.2 hrs (3.9% of the effective search time) when the left-front observer considered the visibility poor or useless. Two of the primary observers (DJR and BAM) have participated in this project every season or almost every season since it began in 1993, one observer (BKS) participated in 5 previous surveys, and two observers (KTG and TAR) had not participated in this project previously.

Coverage

The composite of the aerial surveys in June 2005 provided a thorough coverage of the coast of Cook Inlet (1,388 km) for most of the area within approximately 3 km of shore (Figs. 1 and 2). In addition, there were 1,363 km of systematic transects 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 roughly 5,500 km², which is 28% of the 19,863 km² surface area of Cook Inlet; however, these surveys covered virtually 100% of the coastal areas. This coverage was typical of these beluga surveys during the past decade (Rugh *et al.* 2000). Most of upper Cook Inlet was surveyed six times, especially areas where groups of belugas have consistently been found in the past B such as the Susitna delta, Knik Arm, and Chickaloon Bay.

Daily reports

May 31:

The survey began in Knik Arm just after a rising tide (low at 9:03 at Anchorage). Prior to entering Knik Arm, we went west as far as the Little Susitna River to make a thorough check of the area around the Arm. A group of belugas was found at the Little Su, but no counts were made in order to keep good timing with the tide in Knik. No belugas were seen in Knik although conditions were ideal. From Knik Arm, the survey continued around Fire Island to Turnagain Arm. Conditions were only fair in the lower (western) part of Turnagain Arm. After getting past the entrance to the fjord, conditions improved, and we had a good view of most of the Arm. No whales were seen. Chickaloon Bay also had winds and glare compromising visibility, but the coastal area was good, and a group of beluga was found near the boulder field. From Chickaloon Bay, we flew a coastal route south to Kenai and took a break.

From Kenai we flew to West Foreland and made a coastal survey around the Susitna delta, including surveys up the Big and Little Susitna Rivers. Conditions were good throughout. A big group of belugas was found at the Ivan River, and two small groups were near the Little Su that appeared to have merged at some point. There was a research boat doing counts of belugas in the area. About the time we had completed four counting passes, two tagging boats arrived. The whales dispersed and became so hard to find that we abandoned effort and

ended the day's survey. The tagging team put a tag on one of these whales about the time we left the area, and we heard several beeps on the receiver.

June 1:

We surveyed Turnagain Arm in good to excellent conditions: tide was low, there were few rips, and it was calm throughout. However, no belugas were seen. Chickaloon Bay was flat calm. Large mud flats were exposed in the middle of the bay. One group of belugas was found in the boulder field, as it was yesterday. The whales were concentrated and easy to count. From Pt Possession, the survey continued to Little Susitna River and into Knik Arm, which had excellent viewing conditions but no whales. From Pt Woronzof, we went directly to North Foreland then followed a coastal route around the Susitna delta. Belugas were found at the mouth of the Ivan River; another group was nearby but farther offshore; and a third group was farther east, just south of the Big Su. No belugas were in the Little Su.

June 2:

We surveyed from Anchorage south to East Foreland, crossed the inlet to West Foreland, then went north to the Susitna delta and around Knik Arm. Survey conditions were excellent. Two belugas were found midway between Anchorage and Pt Possession (one of the very few offshore sightings ever made on this project). One large group was found at the west side of Big Su, as on previous days. A small group was near Goose Bay in Knik Arm, even though it was a low, falling tide.

After a break in Anchorage, the survey covered Turnagain Arm and Chickaloon Bay, again in excellent conditions. One group of belugas was found in Chickaloon Bay, in the same area as on the previous two days. The group was compact and easy to count.

June 3:

The weather and marine forecast was for good conditions in the lower inlet, so we flew south on offshore transects to Cape Douglas and returned on a coastal route up the west side, including Augustine Island and transects to and from Homer. Conditions were generally good to excellent throughout. A group of belugas were seen at the Little Su, but no counts were made. In the lower inlet, sightings included 1 gray whale, 1 male killer whale in mid inlet, 2 fin whales, >20 humpbacks, numerous sea otters, many sea lions (more than have been seen before), the usual number of harbor seals, many brown bears, and one walrus (in Tuxedni Bay), but no harbor porpoise.

June 4:

We flew the east side of the lower Inlet, proceeding from Anchorage to Pt Possession and then along the coast down the east side of Cook Inlet. Kenai and Kosilof Rivers were surveyed several miles inland. Although conditions were good, no marine mammals were seen until we approached Kachemak Bay. Sea otters were more common than usual; many were in large rafts. Harbor seals were abundant at Bradley River. One humpback and 4 killer whales were seen on the south side of Kachemak Bay. We crossed north across Kachemak

Bay to take a lunch break in Homer, then returned to the same location on the coast and continued surveying deep into bays around the peninsula until we circled Elizabeth Island. On the south side of the Kenai Peninsula, the winds rose to 36 knots, lowering visibility for the most part. Because of the rough seas, we did not cross the inlet to Cape Douglas and went instead to a waypoint in the middle of the inlet north of the incoming wind. On the trackline north up the inlet, no marine mammals were seen except 2 harbor porpoise (the only porpoise seen this season). Kalgin Island was circled once; no marine mammals were seen.

While on the transect through the upper Inlet, a pilot in a nearby aircraft reported a dead whale, so we deviated from our route and found an upside down gray whale on the mudflats near the airstrip. The whale was fairly well decomposed and had a stick in its mouth (which the pilot in the other aircraft had reported as a harpoon in the head). Other's reports indicated that the whale had been dead in upper Cook Inlet for at least a week.

In summary, the lower inlet was well surveyed with very few areas lost to poor visibility. Most marine mammals were more abundant than usual, but harbor porpoise were rare (possibly a function of observer effort because porpoise are only seen by looking close to the aircraft).

June 5:

We surveyed Turnagain Arm and Chickaloon Bay on a falling tide with excellent conditions. No belugas were seen in Turnagain Arm, but one large group of belugas was very close to Burnt Island (northeast Chickaloon Bay) swimming southwest along the coast. After a break in Anchorage, the survey continued south to Moose Pt, across the inlet to North Foreland, around the Susitna delta (not including the Beluga and Big Susitna Rivers but including Little Susitna River). A large group was found in the Susitna delta, in the same area as on previous days. The group formed in a long, thin line, making it very easy to count. No belugas were found elsewhere, including in Knik Arm, in spite of good conditions.

June 6:

No survey on this day because the pilot had exceeded hour limitations (the maximum allowance is 36 hrs in 6 days; according to Office of Aircraft Services [OAS] standards).

June 7:

Winds were forecast to rise in the afternoon, so we started the survey by going around Fire Island and entering Turnagain Arm. However, the bay was already so wind blown that visibility was poor or useless. We turned instead to Knik Arm to see if there were any whales that the tagging team could approach. Although the waters were calm and visibility good to excellent, no whales were seen, so the survey was terminated.

June 8:

In spite of high wind forecasts and heavy overcast, a survey was conducted around upper Cook Inlet in adequate conditions. Fire Island and Turnagain Arm were marginal in places with fair or poor visibility due to glare on rough waters, but large areas had suitable visibility.

Chickaloon Bay had fair conditions. Belugas were found from Chickaloon River to the boulder field by the bluffs, even half way to Pt Possession (where there were boats doing pipeline repair). The belugas were in many small groups, mostly near shore. We took a break in Anchorage, waiting for the tide to drop. On the survey from Anchorage to Pt Possession, we came across three beluga groups just east of Fire Island (a first for our surveys). From Pt Possession, we crossed the inlet to North Foreland and up the coast around the Susitna delta. Because of the low tide, we skipped surveying up the rivers except for crossing the delta of the Big Susitna River near Big Island and going a mile up the Little Su. One group of belugas was found at the Theodore River, at the same place as seen on all of our surveys this year. The two tagging boats were a few miles to the east and had not seen the whales until we circled them. When we were done with our counts, the boats proceeded to make approaches for tagging but did not get any tags on. We continued the survey into Knik Arm. Conditions were excellent. One small group was found in Goose Bay.

June 9:

We surveyed upper Cook Inlet for the sixth time. Turnagain Arm and Chickaloon Bay were rough (wind, glare, rain, and turbulence), but most areas had fair or good visibility. A group was found in Turnagain Arm opposite Bird Pt along the shore. In Chickaloon Bay, a group was found at the mouth of the river and another near the bluff. A group was found on the east side of Fire Island, where they have never been seen prior to June 8. The survey went from Moose Pt to Shirleyville and up the coast around the Susitna delta. A lone whale was seen offshore east of Theodore River, and a large group was found near the Theodore River (where a group has been seen each day this season). Several small groups were along the edge of the mouth of the Big Su. The tagging boats were hurrying to the east as we passed over them, not far from some of these whales. It seems that some of the scatter of the whales may have been a function of the boats going through the area. We surveyed Knik Arm on a rising tide. No whales were seen in Goose Bay this time, but a large group was in Eagle Bay. After surveying Knik Arm, we made transects across the upper inlet, trying to sample more offshore areas, but the wind rose and compromised the effort (mostly poor visibility). The survey ended with 54.5 hours of flight time, only 1.5 hours short of the proposed 56 hr.

Summary counts of belugas

Medians of counts of belugas are shown in Table 1, and sighting locations are shown in Figure 3. In 2005, the daily medians ranged from 118 to 192, varying little from day to day.

As has been the standard procedure in the past, the highest median is used as the annual index count; therefore, in June 2005 the index count was 192. This summary count does not reflect any correction for missed whales. Calculations for whales missed during these aerial counts and estimates of abundance were described in Hobbs *et al.* (2000a, 2000b). This median index (192) is essentially the same as counts from 1998-2004 (174-217; Table 2).

Other marine mammals

Besides belugas, the only other marine mammals seen in upper Cook Inlet were harbor seals (*Phoca vitulina*). Harbor seals were seen every day, mostly between the Theodore and

Ivan Rivers (7 recorded sightings ranging 1-75; median 10), near the Chickaloon River (13 sightings ranging 4-101; median 14), and in Trading Bay (one sighting of 7 seals).

Although belugas were not seen in lower Cook Inlet, many other marine mammals were observed (Fig. 4). Harbor seals occurred in the southern part of Kamishak Bay (48); Kamishak to Tuxedni Bays (386); Redoubt Bay (50); and Bradley River (420). One walrus (*Odobenus rosemarus*) was seen in Tuxedni Bay. Sea otters (*Enhydra lutris*) were seen in or near Kachemak Bay (28 sightings for a total of 393 otters) and Kamishak Bay (29 sightings of 534 otters). Steller sea lions (*Eumetopias jubatus*) were near Cape Douglas (5 sightings of 104 sea lions). Whale sightings included 2 fin whales (*Balaenoptera physalus*) northwest of Cape Douglas, 12 sightings of 18 humpback whales (*Megaptera novaeangliae*) in groups of 1 to 3 individuals in the southernmost portion of Cook Inlet, one gray whale (*Eschrichtius robustus*) near Cape Douglas and a dead gray whale near Beluga River. Only 2 harbor porpoise (*Phocoena phocoena*) were seen.

Discussion

The June 2005 survey of Cook Inlet was very similar to previous surveys in terms of research protocol and coverage. The type of aircraft, window configuration, altitude, air speed, and coastal search patterns were kept as constant as possible between years, and at least two of the observers have returned for almost every survey, maintaining continuity in effort. This consistency has the benefit of minimizing variables. In addition to the many years this project has been underway (1993-2005), each of these annual surveys has involved several replicate flights around upper Cook Inlet in June or July. The large number of flights and consistency of effort has helped us detect patterns of whale distribution. In 2005, as in most years, belugas were found in small groups near river mouths along the northwestern shores of upper Cook Inlet, in particular near the Susitna River, Little Susitna River, Knik Arm, and along the shores of Chickaloon Bay; however, no belugas were found south of the Forelands in lower Cook Inlet (Fig. 3; Table 1). Prior to 1996 it was not uncommon to see groups of belugas south of North Foreland (Rugh *et al.* 2000), but since then only one or two belugas have been found there, if any. Sighting conditions have generally been ideal during the searches of coastal and offshore waters, but the only places where belugas were seen regularly have been in the upper inlet. Because many other marine mammals were seen in the lower inlet, the lack of beluga sightings was not due to visibility.

The uncorrected sum of median estimates (192 belugas) made from the June 2005 aerial observations in Cook Inlet is essentially the same as similar index counts made each year since 1998, generally near 200 whales (Table 2). Index counts made prior to 1998 were higher, generally near 300. These medians must be treated as merely a rough index that provides a quick assessment of the raw counts made from the air. Calculated abundances B including corrections for whales missed within the viewing range of observers and whales missed because they were beneath the surface B are shown in Table 2 with estimates from 1994-2000 reported in Hobbs *et al.* (2000a) and 2001-04 from NMFS unpublished data. The abundance estimates, with their associated CV, are the appropriate values to be used in interyear trend analyses.

Acknowledgments

Rod Hobbs has served as Task Leader for the Cook Inlet beluga studies. Dave Weintraub (Commander NW, Ltd., Wenatchee, WA) helped provide us with the aircraft and flew with us on each survey. His investment in this project is greatly appreciated. Our primary pilot in 2005, Jeremy Weintraub, filled a critical role in keeping the aircraft at the preferred altitude and distance from shore while flying intricate patterns over whale groups as they moved in different directions and watching for aircraft in an exceptionally busy airspace. Data entries were made on a program originally developed for harbor porpoise surveys in the northeast Atlantic (made available through Debi Palka, Woods Hole, MA; software designed by Lex Hiby of Conservation Research Ltd, UK and Phil Lovell of Sea Mammal Research Unit, Scotland). Christy Sims went the extra mile to prepare cameras and train the field team how to use them. Kim Shelden provided the maps for the survey. 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, 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. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Tech Memo. NMFS-AFSC-149. 71p.
- Sims, C.L, R.C. Hobbs, and D.J. Rugh. 2003. Developing a calving rate index for beluga in Cook Inlet, Alaska using aerial videography and photography. Abstract (poster) in the Fifteenth Biennial Conference on the Biology of Marine Mammals. Greensboro, North Carolina. 14-19 Dec. 2003.

Table 1. Summary counts of belugas made during aerial surveys of Cook Inlet in June 2005. Counts are medians from the four observers doing multiple counts of each group of whales. Dashes indicate no survey, and zeros indicate that the area was surveyed but no whales were seen. Sites are listed in a clockwise order around Cook Inlet.

Location	31 May	1 June	2 June	3 June	4 June	5 June	8 June	9 June
Turnagain Arm (not including Chickaloon Bay)	0	0	0	----	----	0	0	21
Chickaloon Bay/ Pt. Possession	24	37	25	----	----	33	50	66
Pt. Possession to East Foreland	0	----	0	----	----	----	----	----
Mid-inlet east of Trading Bay	----	----	----	0	0	----	----	----
East Foreland to Homer	----	----	----	----	0	----	----	----
Kachemak Bay	----	----	----	----	0	----	----	----
West side of lower Cook Inlet	----	----	----	0	----	----	----	----
Redoubt Bay	----	----	----	0	----	----	----	----
Trading Bay	0	----	0	----	----	----	----	----
Susitna delta (N Foreland to Pt. Mackenzie)	97	155	110	----	----	116	23	36
Knik Arm	0	0	2	----	----	0	16	43
Fire Island	0	0	2	----	----	0	29	16

Table 2. Summary of index counts of belugas made during aerial surveys of Cook Inlet in June or July 1993-2004 with abundance estimates and the respective CV where available (Hobbs *et al.* 2000a; NMFS unpubl. data). Percentages of sightings made in three generalized zones are indicated.

Year	Dates	Index Counts	Abundance estimates	CV	Lower Cook Inlet	Susitna delta	Elsewhere in Upper Cook Inlet
1993	June 2-5	305	---	---	0%	56%	44%
1994	June 1-5	281	653	0.43	4%	91%	5%
1995	July 18-24	324	491	0.44	4%	89%	7%
1996	June 11-17	307	594	0.28	0%	81%	19%
1997	June 8-10	264	440	0.14	0%	28%	72%
1998	June 9-15	193	347	0.29	0%	56%	44%
1999	June 8-14	217	367	0.14	0%	74%	26%
2000	June 6-13	184	435	0.23	0%	62%	38%
2001	June 5-12	211	386	0.09	1%	35%	64%
2002	June 4-11	192	313	0.12	0%	48%	52%
2003	June 3-12	174	357	0.11	0%	9%	91%
2004	June 2-9	187	366	0.20	0%	6%	94%
2005	May 31- June 9	192	---	---	0%	60%	40%

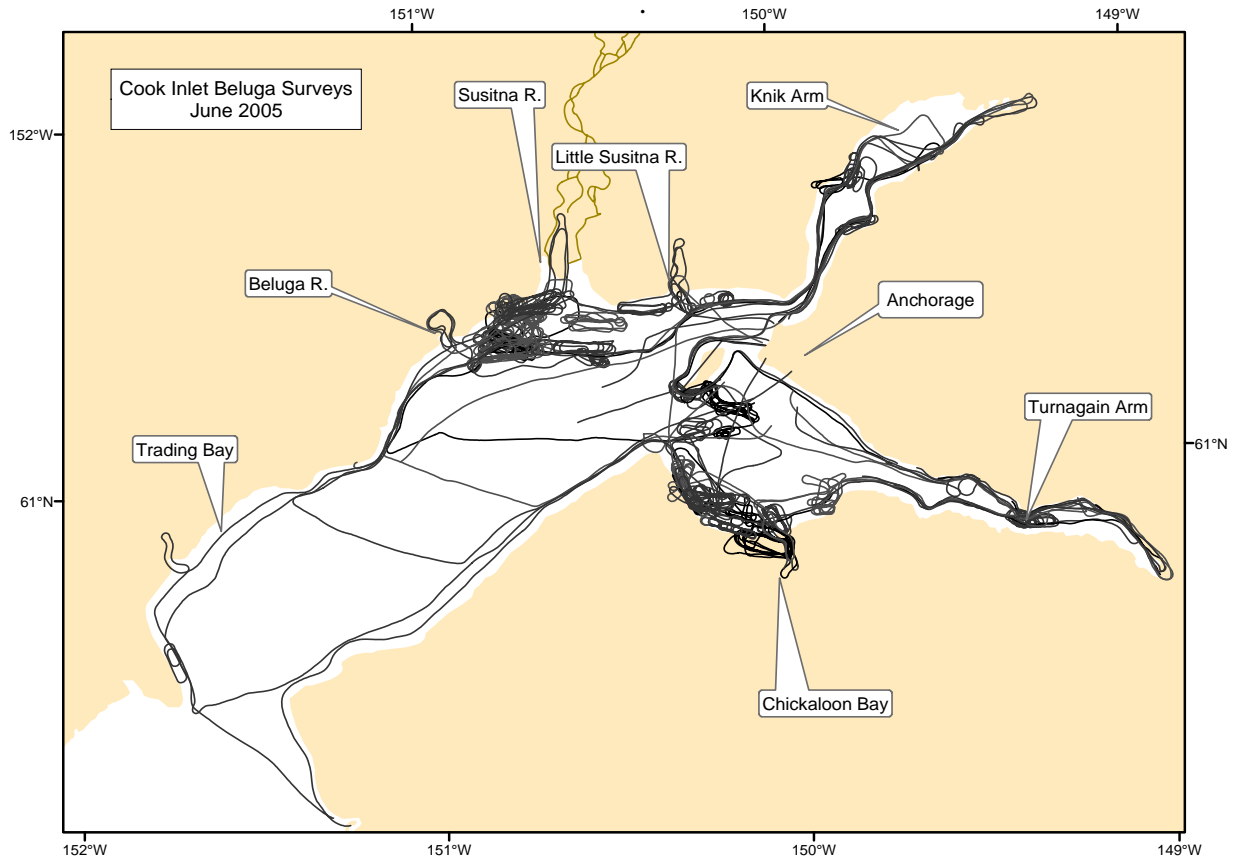


Figure 1. Tracklines in upper Cook Inlet in June 2005.

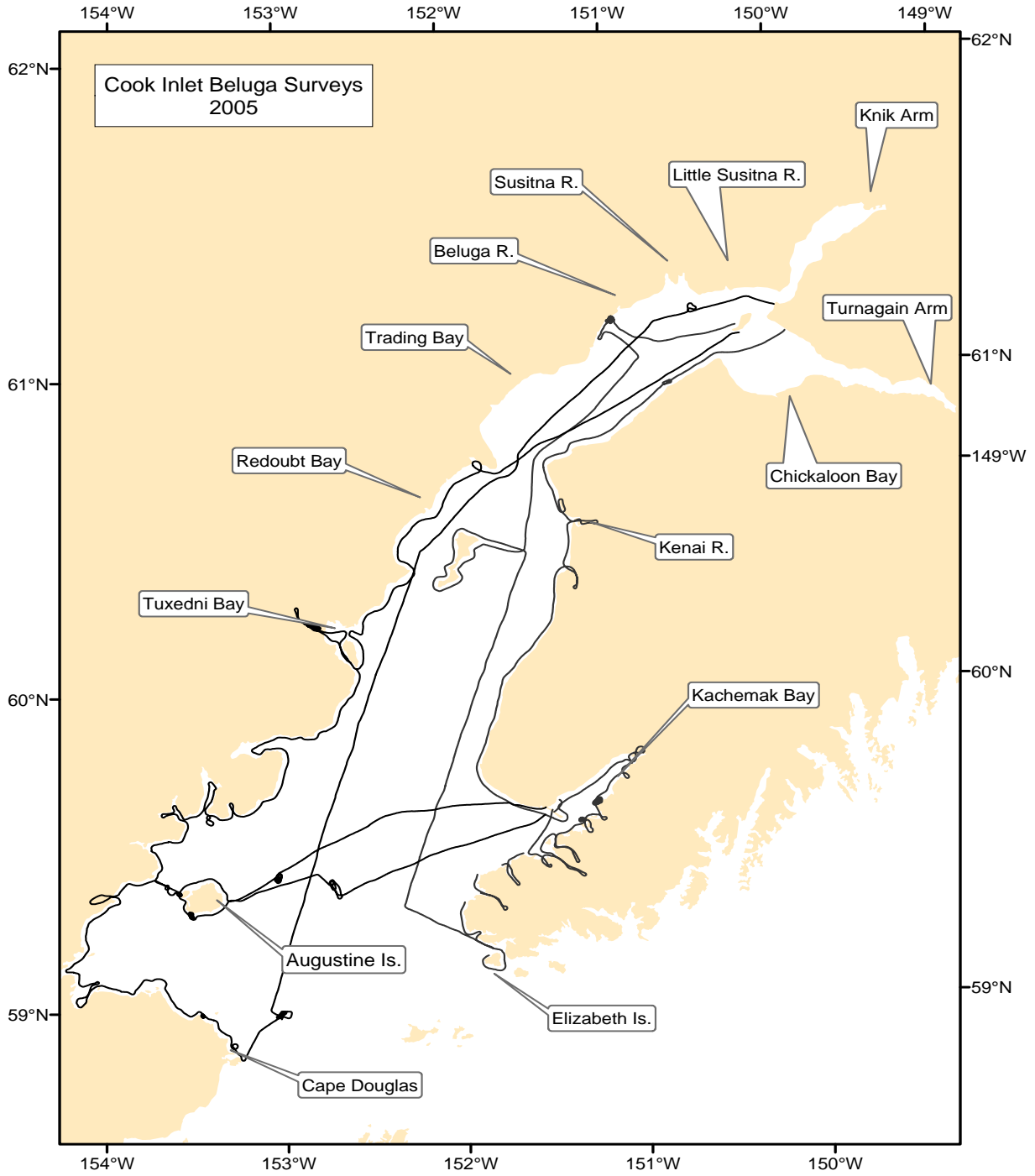


Figure 2. Tracklines used to survey lower Cook Inlet, 3-4 June 2005.

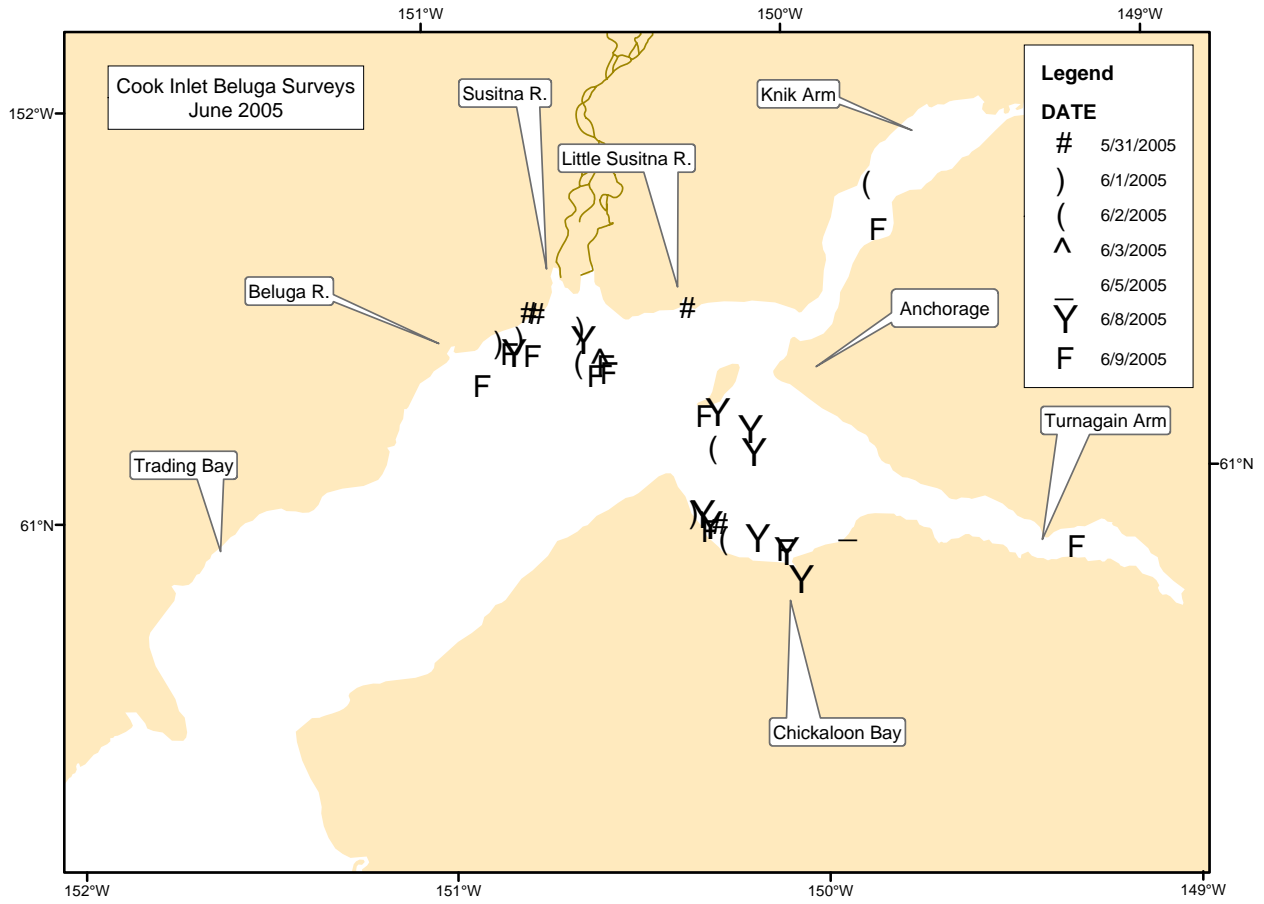


Figure 3. Beluga sightings in upper Cook Inlet in June 2005.

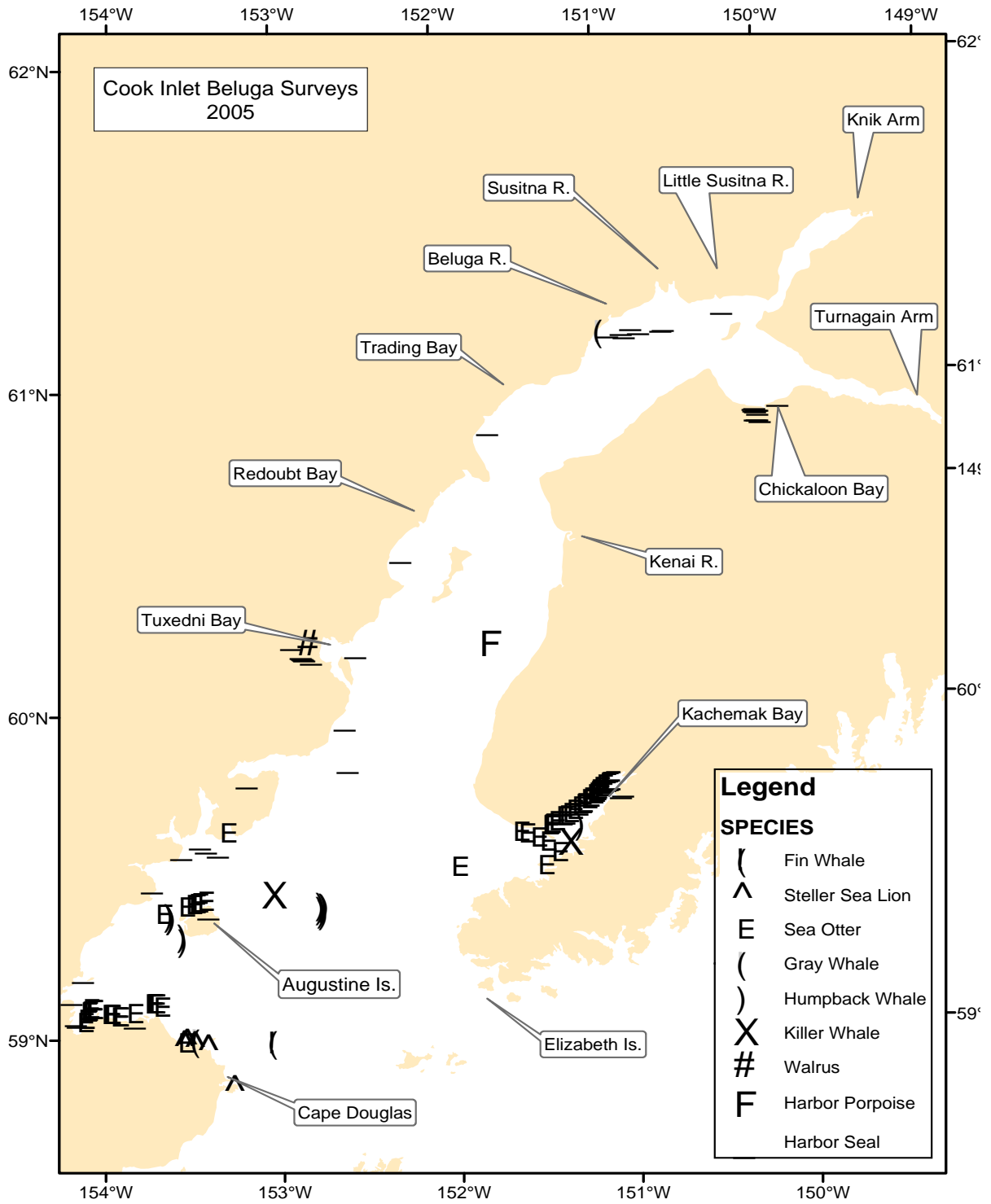


Figure 4. Sightings of marine mammals other than belugas in Cook Inlet in June 2005.

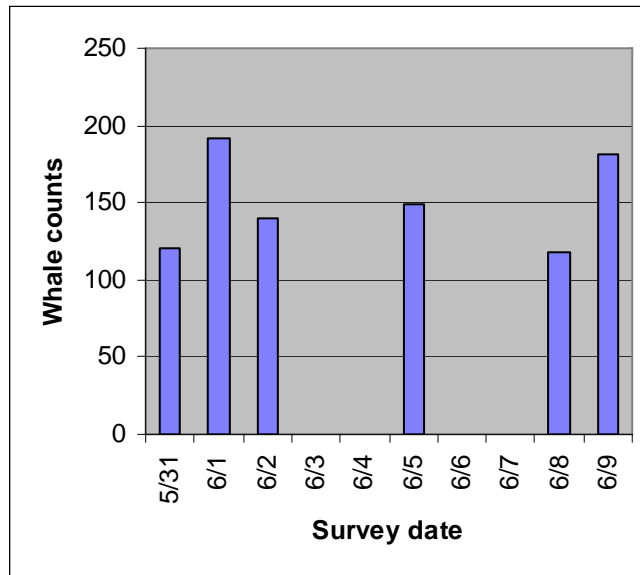


Figure 5. The median counts in 2005 were fairly similar from day to day.