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Abstract

The National Marine Fisheries Service (NMFS) conducted aerial surveys of the beluga whale (*Delphinapterus leucas*) population in Cook Inlet, Alaska, almost monthly between June 2001 and June 2002. The surveys were flown in a twin-engine, high-wing aircraft at an altitude of 244 m (800 ft) and speed of 185 km/hour (100 kt). Tracklines were approximately 1.4 km offshore, and systematic transects were made across the inlet, covering much of upper Cook Inlet. These methods were consistent with NMFS' abundance surveys conducted each June or July since 1993, except that only in June were there multiple surveys (repeat samplings) within a block of days. During the 2001-02 monthly surveys, aerial counts of belugas (median counts when more than one observer was counting) generally stayed high from June through October (n = 211 in June, 39 and 152 in July, 205 in August, 185 in September, 162 in October, respectively), but counts dropped from November to April (n = 24 in November, 15 in January, 0 in February, 18 in April, respectively) before rising again the following June (n = 192). Low counts in winter were probably due to ice in the inlet, making it hard to see the white whales. This study provides evidence of the presence of belugas in upper Cook Inlet in nearly every month of the year, but it is not clear what proportion of the population remains in the upper inlet year-round.

Contents

Introduction

Each June or July since 1993, the National Marine Fisheries Service (NMFS) has conducted annual aerial surveys to document the distribution and abundance of belugas (*Delphinapterus leucas*) in Cook Inlet (Withrow et al. 1994; Rugh et al. 1995, 1996, 1997a, 1997b, 1999, 2000a, 2001, 2002, 2003). The small size of this beluga stock (approximately 350 whales; Hobbs et al. 2000a) and their isolation from other stocks (O'Corry-Crowe et al. 1997; Laidre et al. 2000; Rugh et al. 2000b) has raised concerns about the management of this population. On 31 May 2000, this stock was designated as depleted under the Marine Mammal Protection Act (65 FR 34590). A small, regulated harvest by Alaska Native has continued.

As a part of the research to help reach management goals, it has proved important to establish where the Cook Inlet stock of belugas are throughout the year, not just in June or July when all of the abundance surveys have been conducted. The winter distribution has been an issue raised by local Natives (Huntington 2000), and establishing whether the whales use upper Cook Inlet year-round may play an important role in identifying and protecting appropriate habitat. Accordingly, the current study was designed to survey beluga distribution in upper Cook Inlet (north of East and West Forelands) every 1-2 months between the annual abundance surveys conducted in June 2001 (Rugh 2002a) and June 2002 (Rugh 2002b). The intent was to keep the search effort as consistent as possible with the previous surveys, except the emphasis would be on beluga distribution, not abundance, reducing the need for multiple counts across several days.

Methods

Study Area

Cook Inlet is a major marine feature in south-central Alaska with 1,350 km of shoreline and a surface area of approximately 20,000 km^2. The aerial surveys in this study covered the northern half of Cook Inlet, an area in which nearly all belugas have been seen in the recent past (Rugh et al. 2000b). A description of beluga habitat in Cook Inlet can be found in Moore et al. (2000). Inlet waters in this area are extremely turbid, and during winter there are extensive areas of ice coverage. Both factors, especially sea ice, can make it difficult to see whales. Anchorage served as the base of operations for these aerial surveys.

Survey Procedure

The survey aircraft (also used during the abundance surveys, an Aero Commander 680 FLP) has twin-engines, high-wings, and 10-hour flying capability. There are bubble windows at each of the three observer positions (two on the left and one on the right). An intercom system provided communication among the three observers, data recorder, and pilot. Location data were collected from the aircraft's global positioning system (GPS) interfaced with the laptop computer used to enter sighting data. Data entries included routine updates of time, locations (at least once per minute), percent cloud cover, sea state (Beaufort scale), glare (on the left and right), visibility (on the left and right), and ice conditions (percent ice cover within the immediate viewing area). Visibility was documented in five subjective categories from excellent to useless; conditions rated poor or useless were considered unsurveyed. Flight dates were a function of availability of aircraft and crew. Timing of flights was a compromise between

surveying the respective areas at low tide and flying during hours when light levels were optimal. At low tide, there is less surface area to search because of the extensive tidal flats near the Susitna rivers, Knik Arm, and Turnagain Arm, and belugas tend to form tighter groups.

The surveys along the coast were generally conducted 1.4 km offshore (10° below horizontal while the aircraft was at the standard altitude of 244 m (800 ft)), as is done during the June surveys (Rugh et al. 2000b). Ground speed was approximately 185 km/hour (100 knots). Systematic transects were also flown across the inlet following a "sawtooth" pattern that provided an efficient and thorough coverage of most areas north of Kalgin Island.

Counting Protocol

When a beluga group was seen, the sighting was reported immediately to the data recorder. Subsequently, the aircraft left the trackline to begin a series of counting passes over the group. These passes were on extended ovals with the counts done along the longitudinal axes; turns were made well beyond the ends of the 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. The observers wrote down their counts 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). Only quality A and B estimates were used in the analysis. Only whales that were at the surface during the counting period were included; whale tracks or ripples in the muddy water

were not counted. There was little confusion as to whether or not a whale was at the surface because the water was opaque within a few centimeters. As in the June surveys, a video camera documented whale groups, providing images that could later be analyzed in the laboratory.

All aerial counts were made by the two primary observers (Mahoney and Smith). In the analysis, each observer's counts were sorted by the respective whale group, and a median was taken of the multiple counts for each group. The average of the two observer's medians provided an approximation of relative group size, albeit without corrections for whales totally underwater and out of sight during the count or whales that were missed even though at the surface. Corrections for missing whales were only done to calculate abundance estimates made from the June surveys (Hobbs et al. 2000a, 2000b) because only one survey was made through the area during the monthly flights, and there was no independent search effort. The medians used here are calculated in the same manner as is done for the annual index counts (e.g., Rugh et al. 2000b).

Results

Survey Effort

Between June 2001 and June 2002, there were flights on 16 days representing 9 survey periods generally 3 weeks apart (Table 1). Daily flight duration (total time = 81.4 hours) ranged from 3 to 10 hours per day, all based out of Anchorage. Systematic search effort was conducted for a total of 63.6 hours across this period (78% of the effective search time), not including time spent deadheading without a search effort, circling whale groups, or periods with poor visibility (as determined by the left-front observer). Of the two primary observers, Smith has flown with

this project three times in the past, and Mahoney has participated in all but one season since the project began in 1993. Each of these surveys provided a thorough coverage of most coastal areas of upper Cook Inlet and much of the offshore areas (Figs. 1-9).

Daily Reports

2 July 2001 - - This survey followed the standard pattern of flying from Anchorage (starting from south and east of the city) to Point Possession and on to East Foreland, then across the inlet to West Foreland and north to Beluga River where a group of belugas was found. At this point, a quick flight was made back to Anchorage to correct a computer problem; the survey then picked up again at Beluga River. From there, the survey continued north and east along the shore to Point MacKenzie and into Knik Arm as far as Birchwood Airport. After Knik, the survey went around Anchorage and into Turnagain Arm, then to Chickaloon Bay. When the coastal track was complete, the survey continued with a series of transects across the inlet as far south as Kasilof and Drift Rivers (Fig. 1).

Although survey coverage was thorough and visibility was generally good to excellent, large groups of belugas were not found on this day. Three groups were seen in the Susitna River area (at Beluga River, east of the Susitna River, and at the mouth of the Susitna River), and one group was near Point Possession, but none of these groups were large. The total count for this day (n = 39; Table 2) was only 18% of the index count for the abundance survey in June (n = 211 whales; Rugh et al. 2002a). Officers from the NMFS Office of Enforcement/Alaska Division also flew a survey on 2 July from Point MacKenzie to Tyonek and found only one group of two belugas at the Beluga River. Note that during the systematic surveys in June, there

are also days when large groups of whales are missed (see section on Summary Counts of Belugas).

26-27 July 2001 - - On the first day (26 July), straight-line transects were flown across the inlet as far south as Harriet Point (Fig. 2), but much of the west side of the inlet south of West Foreland was obscured by low clouds/fog. Helicopter traffic near the oil rigs made it too hazardous to survey in these conditions. Visibility was excellent in some areas with calm waters, but conditions deteriorated to poor in other areas due to low clouds, which sometimes forced the plane to fly as low as 300 ft. One group of belugas was seen near the Susitna River (Table 2). On the second day (27 July), a standard coastal survey was flown. Visibility was generally good to excellent. Belugas were found near the Little Susitna River and near Eagle Bay in Knik Arm (Table 2; Fig. 2). The summary count (n = 152; Table 1) was 59 less than the standardized median counts (n = 211) done in the June surveys, but it was within the range of the daily counts (n = 78-208) from June 2001 and June 2002 (Rugh et al. 2002a, 2002b).

27 August 2001 - - Both coastal and straight-line transects were flown on the same day (Fig. 3). Weather was good, allowing for a thorough coverage of the survey area from Kalgin Island north, although rain reduced the search near Kenai. Two beluga groups were found in Turnagain Arm. One group was near the mouth of Little Susitna River. In Knik Arm, one group was near Anderson Dock and another northeast of Eagle Bay (Table 2). A lone beluga was seen in the middle of the inlet north of West and East Forelands. This whale appeared to have a tag, and at that time a tagged whale (DL-01-06; NMFS unpubl. data) was in the same area. Because

the whale was alone, it was not considered to be representative of the beluga distribution during late August. All of the other whale sightings made on this flight were in groups of 3-83 whales by aerial count and were in locations more typical of their summer distribution (Table 2). In August, 50-75% of the tagged whale records (n = 7 belugas) were in Knik Arm, the rest were near the Little Susitna River or to the east in or near Turnagain Arm.

15 and 18 September 2001 - - A standard coastal survey was flown under mostly excellent or good conditions (Fig. 4). Three groups of whales were seen in Knik Arm, one with more than 100 whales (Table 2). Another large group was found in Turnagain Arm. Only single whales were found near the Beluga and Theodore Rivers. The summary median count for this day (n = 185; Table 1) was only 26 less than the median count (n = 211) from the intensive abundance survey done in June, three months earlier, and these September counts were in the middle of the range of the daily counts (n = 98-208) made in June; Rugh et al. 2002a).

Although a transect flight could not be paired with the 15 September coastal survey until 3 days later, the generalized consistency of the beluga distribution during such a time frame (Rugh et al. 2000b) allowed us to consider the coastal survey on 15 September and the transects on 18 September as representing the same distribution. Several belugas were seen near the Little Susitna River prior to starting the transects, but no whales were seen while flying on transects. All of the standard transects were flown. A low cloud ceiling (sometimes forcing the aircraft to fly at 500 ft), scattered fog, and some whitecaps compromised visibility during parts of this survey, but only fair or better conditions are reflected in the flight tracklines in Figure 4.

12 and 15 October 2001 -- Transects were flown on 12 October with good coverage of all lines (Fig. 5). Visibility was good to excellent throughout the survey. No whales were seen while on transects, but a group of belugas was seen near the Little Susitna River after the transects were completed (Table 2). A boat was approaching the whales until the aircraft began circling the area, after which the whales were not seen again.

The coastal survey could not be flown until 15 October. Coverage for the coastal survey was thorough with mostly good to excellent conditions. All of the beluga sightings were in Knik Arm. The sum of the counts from the coastal survey (n = 162; Table 1) is about 50 whales less than the median counts from the intensive surveys in June, but it is well within the range of the daily counts in June (n = 98-208; Rugh et al. 2002a), which meant that in October most of the whales were still in upper Cook Inlet.

8-9 November 2001 -- Standard transects were flown on 8 November (Fig. 6). Ice covered much of the area except in the middle of the inlet. Generally, visibility was fair or good, but no belugas were seen.

A thorough coastal survey was flown on 9 November (Fig. 6) with mostly good to excellent conditions, but ice did compromise the search effort, especially in the Susitna Delta, Turnagain Arm, and parts of Knik Arm, areas where belugas are usually found on summer surveys. Two small groups were seen in Turnagain Arm, 1-2 whales were in Trading Bay, and a few whales were seen in Knik Arm (Table 2), but the summary count (n = 24; Table 1) was only 11% of the index count made in June.

Except for the 1-2 whales in Trading Bay, the sighting distribution was typical of where whales have been seen in upper Cook Inlet in the summer (Rugh et al. 2000; 2002b).

22-23 January 2002 - - Transects were flown on 22 January with good viewing conditions until fog was encountered near Kenai (Fig. 7). Areas north of Trading Bay were generally 50-100% ice-covered with large areas of ice south of there as well. In spite of the widespread ice, five small groups of belugas were seen (Table 2), all of them in a tight concentration west of Moose Point, well away from shore (Fig. 7).

On 23 January, during the coastal survey, no whales were seen. Much of the area was ice-covered, making it difficult to find whales. The coastal survey followed the same route used during open-water periods.

25-26 February 2002 -- Standard transects were flown on 25 February and a coastal survey on 26 February (Fig. 8). Visibility ranged from poor to good. Ice was extensive across much of the inlet north of Trading Bay, with large areas of ice south of there as well. However, some areas – such as south of the Susitna River – were almost ice free. No whales were seen during either of the flights in February.

2-3 April 2002 -- On 2 April, the full array of offshore transects were conducted, and on 3 April a thorough coastal survey was flown (Fig. 9). Viewing conditions ranged from fair to excellent. Ice was extensive in some areas, as with the winter surveys, and few whales were

found (Table 2). The distribution of sightings in April was very similar to the distribution in January with a few small groups seen west of Point Possession.

Summary Counts of Belugas

Medians of counts of belugas are presented in Table 1, and sighting locations are shown in Figures 1-9. The counts from July to October were similar to the counts in June, except for one low count in early July; however, counts were consistently low from November to April.

The single-sample approach used during this study of seasonal distribution was more efficient than flying each area many times (as is done during the abundance surveys in June), but a single flight through an area means observers are more vulnerable to missing major groups, resulting in low counts such as on 2 July (Table 1). By comparison, during the intensive abundance surveys, flights are made across the same area on several different days, producing multiple samples, primarily as a test of variance. These samples can produce repeatable results; for instance, on 5 of 6 days during the June 2001 survey, median counts in the Susitna/Knik Arm area only ranged from 67 to 97 (one day the count was 181; Rugh et al. 2002a), and in June 2002 in the same area, 5 of 6 counts were 131 to 175 (one count was 98; Rugh et al. 2002b). However, if one large group is missed, the counts can be drastically lower, which probably explains the low count in July 2001.

Counts made from videotapes collected on the respective flights are presented in Table 2 whenever video images were of sufficient quality for counting. When multiple video counts were made for a group, only the median is shown in Table 2. There were no significant differences ($P > 0.60$; Table 3) between counts made by the two observers in the aircraft relative

to the video counts for the same aerial pass. Similar results were obtained when comparing video counts to the same observers' aerial counts in June 2001 and June 2002 ($P > 0.25$; Table 3).

There was no attempt in this study to assess total abundance as is done annually during the June surveys (Hobbs et al. 2000a) because the objective of the project was to assess beluga distribution through many months of surveying rather than attempting abundance estimates through multiple samples within a short season. Medians of multiple aerial counts were used here (e.g., Table 1) as an indication of relative group sizes to best depict whale distribution.

Summary of Sighting Distributions

These monthly surveys in upper Cook Inlet resulted in beluga sighting distributions generally similar to those recorded during the abundance surveys in June/July (Rugh et al. 2000b) in that belugas in Cook Inlet tend to be in shallow coastal areas, especially near river mouths (such as the Susitna Rivers) and bays (Knik Arm, Turnagain Arm, and Chickaloon Bay). Of the 34 sightings recorded during the monthly surveys, 26 were in the same areas where belugas have been found almost every year in June or July. The exceptions were one (tagged) whale seen in mid-inlet off the McArthur River on 27 August (Fig. 3); 1-2 whales in Trading Bay on 9 November (Fig. 6); all sightings in one small area near the middle of the inlet west of Moose Point on 22 January (Fig. 7); and all sightings well offshore west of Point Possession on 2 April (Fig. 9). Although it is not unusual to find belugas in Turnagain Arm, as recorded in August (Fig. 3), September (Fig. 4), and November (Fig. 6), sightings were not common here during the spring; only twice were beluga groups seen here even though there were nine flights

over Turnagain Arm in June 2001 and June 2002 (Rugh et al. 200a and 2000b). The generalized locations of beluga sightings are presented in Table 4 relative to the dates of the sightings.

Other Marine Mammals

Other than belugas, only harbor seals (*Phoca vitulina*) were encountered during these surveys of upper Cook Inlet. There were six sightings recorded, ranging from 8 to 150 seals. Harbor seal concentrations were found at the Susitna Delta (n = 50 on 27 July 2001), in the Little Susitna River (n = 150 on 27 July 2001), Chickaloon River (n = 70 on 27 July 2001), Ivan River (n = 8 on 27 August 2001), McArthur River (n = 20 on 27 August 2001), and Beluga River (n = 55 on 18 September 2001).

Discussion

The distribution of belugas in Cook Inlet has been well documented by aerial surveys conducted during June and July (Rugh et al. 2000b), through local Native knowledge (Huntington 2000), and by the tracking of whales with satellite tags (Ferrero et al. 2000; NMFS unpubl. data), but relatively little is known about beluga distribution during the winter. The aerial surveys described here, flown most months of the year, continued to find belugas in upper Cook Inlet (except in February). These observations suggest that at least some whales inhabit this area year-round, although their distribution may be more offshore in winter than in summer. On the other hand, beluga counts were very low from November to April (Table 2). This is interpreted here as being mostly a function of the difficulty of finding belugas when there is sea ice (which was prevalent from November through April, even though NOAA and the US Army

Corps of Engineer's Ice Forecast Center indicated it was a light ice year), when the whales are offshore doing deep, long dives (NMFS unpubl. data), and when the whales are not grouped near in shallow water near river mouths. The drop in sightings in winter is not considered to be evidence that these whales leave the area. Hansen and Hubbard (1999) also flew surveys in February and March, counting 150 belugas in 10 sightings (including resightings; median = 29) mostly in the central parts of the Inlet north of Kalgin Island. Also, a variety of other sources have indicated that belugas are seen north of the Forelands throughout the winter (see Rugh et al. 2000b), including Native hunters (Huntington 2000), sightings from drilling platforms (R. F. Dahlheim, Jr., 16126 Dubuque Road, Snohomish, WA 98290. pers. commun.), commercial flights across the inlet (R. Priewe, Priewe Air Service, Anchorage, Alaska, pers. commun.), and 14 whales carrying satellite tags between July and March 2000 to 2003 (NMFS unpubl. data). Calkins (1983) concluded that belugas were present in all seasons in the inlet, based on his own sightings. The sum of these sightings and records suggest that upper Cook Inlet, north of Kalgin Island, may be important habitat for these belugas throughout the year (Fig. 10).

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Table 1. Aerial surveys for belugas in Cook Inlet during 2001 and 2002, showing days between surveys, flight hours, and time spent in systematic search (not including time in poor visibility or while circling whales for counts). Median counts are from the two primary observers during multiple passes over whales. The counts include all groups seen on the respective days, whether on coastal surveys or transects.

	Date	Days since last survey	Flight hours	Survey hours	Comments	Median count
2001	June 5-12*	--	54.71	29.4	Entire inlet	**211**
"	July 2	20	10.25	6.74	Transects + coastal	**39**
"	July 26	24	4.49	4.27	Transects	**152**
"	July 27	1	5.67	4.45	Coastal	
"	Aug. 27	31	9.25	6.73	Transects + coastal	**205**
"	Sep. 15	19	4.25	3.43	Coastal	**185**
"	Sep. 18	3	5.05	3.85	Transects	
"	Oct. 12	24	5.05	4.37	Transects	**162**
"	Oct. 15	3	5.07	4.10	Coastal	
"	Nov. 8	24	5.05	4.15	Transects	**24**
"	Nov. 9	1	4.50	2.90	Coastal	
2002	Jan. 22	74	3.83	3.27	Transects	**15**
"	Jan. 23	1	2.92	2.33	Coastal	
"	Feb. 25	33	4.13	3.74	Transects	**0**
"	Feb. 26	1	3.25	2.12	Coastal	
"	Apr. 2	35	5.03	4.65	Transects	**18**
"	Apr. 3	1	3.60	2.50	Coastal	
"	June 4-11†	62	44.65	25.0	Entire inlet	**192**

* Reported in Rugh et al. 2002a.
† Reported in Rugh et al. 2002b.

Table 2. Dates, locations, and counts of belugas in Cook Inlet between July 2001 and April 2002. Numbers in bold print were used to summarize monthly medians.

Date	Location	Group number	Number of passes	Median count	Max count	Video count
2001 July 2	Beluga River	1	6	16	28	--
"	East of Susitna River	2	2	3	4	--
"	Susitna River	3	4	13	17	--
"	Point Possession	4	2	5	7	4
"	East of Susitna River	5	1	2	2	--
2001 July 26	Little Susitna River	1	1	15	15	--
2001 July 27	Little Susitna River	1	7	87	100	--
"	Eagle River (Knik Arm)	2	7	65	89	81
2001 Aug. 27	Turnagain Arm	1	4	31	46	29
"	Turnagain Arm	2	4	83	113	90
"	Little Susitna River	3	4	16	20	15
"	Point MacKenzie (Knik Arm)	4	1	3	3	--
"	Knik Arm	5	5	71	94	--
"	mid-inlet	6	1	1	1	--
2001 Sep. 15	Knik Arm	1	1	1	1	--
"	Eagle River	2	2	7	8	--
"	Eagle River	3	5	105	115	69
"	Turnagain Arm	4	5	70	107	72
"	Beluga River	5	3	1	2	--
"	Theodore River	6	1	1	1	--
2001 Sep. 18		--	--	0	0	--
2001 Oct. 12	Little Susitna River	1	3	0	3	--
2001 Oct. 15	Knik Arm	1	7	155	254	--
"	Knik Arm	2	1	7	7	--
2001 Nov. 9	Turnagain Arm	1	6	3	7	--
"	Turnagain Arm	2	3	6	11	--
"	Trading Bay	3	2	1	2	--
"	North of Eagle Bay (Knik)	4	6	14	98	--

Table 2 continued.

2002 Jan. 22	mid-inlet	1	5	6	11	4
"	mid-inlet	2	4	1	6	2
"	mid-inlet	3	1	2	2	--
"	mid-inlet	4	1	1	1	--
"	mid-inlet	5	1	5	5	--
2002 Jan. 23	mid-inlet	--	--	0	0	--
2002 Feb. 25		--	--	0	0	--
2002 Feb. 26		--	--	0	0	--
2002 Apr. 2	west of Point Possession	1	2	8	9	--
"	west of Point Possession	2	4	10	14	--

Table 3. Comparison of video and observer counts made during aerial surveys of belugas in Cook Inlet.

Survey	Video	Mahoney	ANOVA (video-Mahoney)	Video	Smith	ANOVA (video-Smith)
June 2001	$\bar{x}$ = 36.3 SE = 5.2 n = 60	$\bar{x}$ = 36.5 SE = 3.7 n = 60	P = 0.96	----	----	----
Monthly surveys 2001-02	$\bar{x}$ = 44.4 SE = 7.5 n = 32	$\bar{x}$ = 45.9 SE = 6.3 n = 32	P = 0.88	$\bar{x}$ = 45.4 SE = 7.5 n = 32	$\bar{x}$ = 49.5 SE = 7.2 n = 32	P = 0.69
June 2002	$\bar{x}$ = 17.3 SE = 4.1 n = 26	$\bar{x}$ = 24.9 SE = 5.3 n = 26	P = 0.26	$\bar{x}$ = 20.4 SE = 5.5 n = 27	$\bar{x}$ = 28.6 SE = 7.3 n = 27	P = 0.37

Table 4. Beluga sightings (median counts) in Cook Inlet as a function of generalized locations and survey date.

Generalized locations	2001 July 2	2001 July 26-27	2001 Aug. 27	2001 Sep. 15&18	2001 Oct. 12&15	2001 Nov. 9	2002 Jan. 22-23	2002 Feb. 25-26	2002 Apr. 2
Susitna area (Beluga R. to Little Susitna R.)	34	102	16	2	0	0	0	0	0
Knik Arm	0	65	74	113	162	14	0	0	0
Turnagain Arm	0	0	114	70	0	10	0	--	0
Chickaloon R. to Pt. Possession	2	0	0	0	0	0	0	0	0
Mid-inlet	0	0	1	0	0	0	15	0	18
Trading Bay	0	0	0	0	0	1	0	0	0

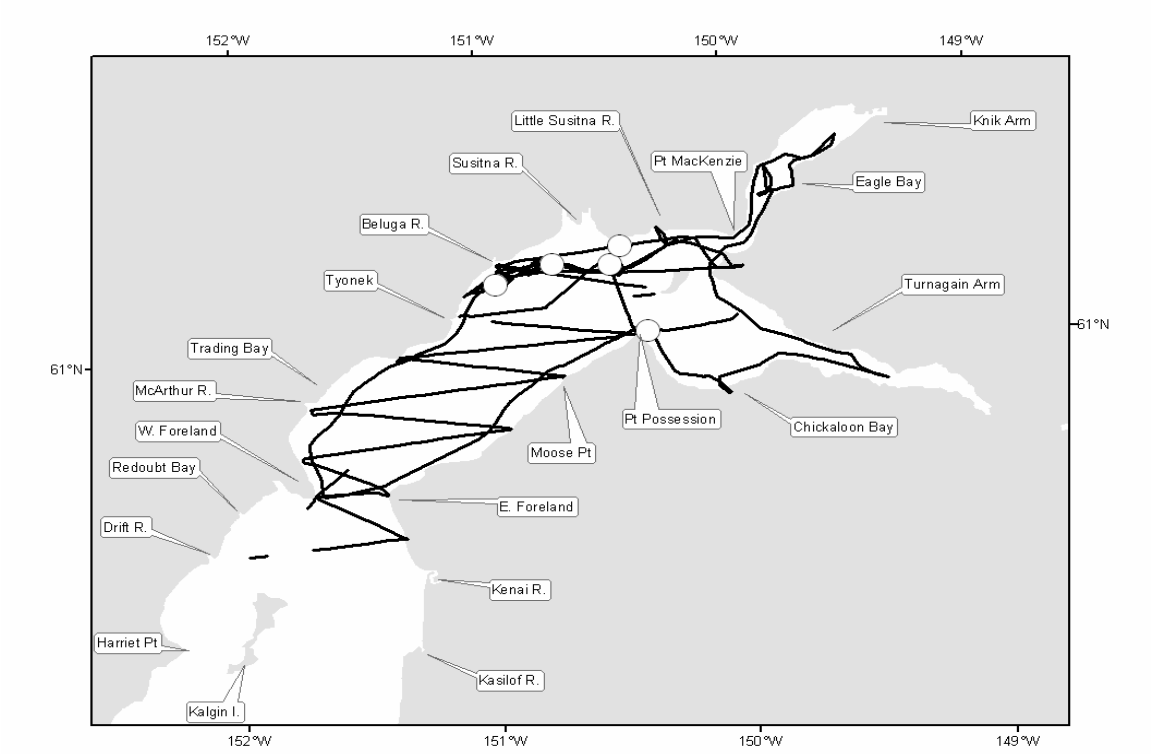

Figure 1. Tracklines flown on 2 July 2001. Only search areas where visibility was recorded as fair to excellent are included. Beluga groups are shown as open circles. Four groups were seen along the north side of the inlet and one in Chickaloon Bay, locations typical of beluga summer distribution.

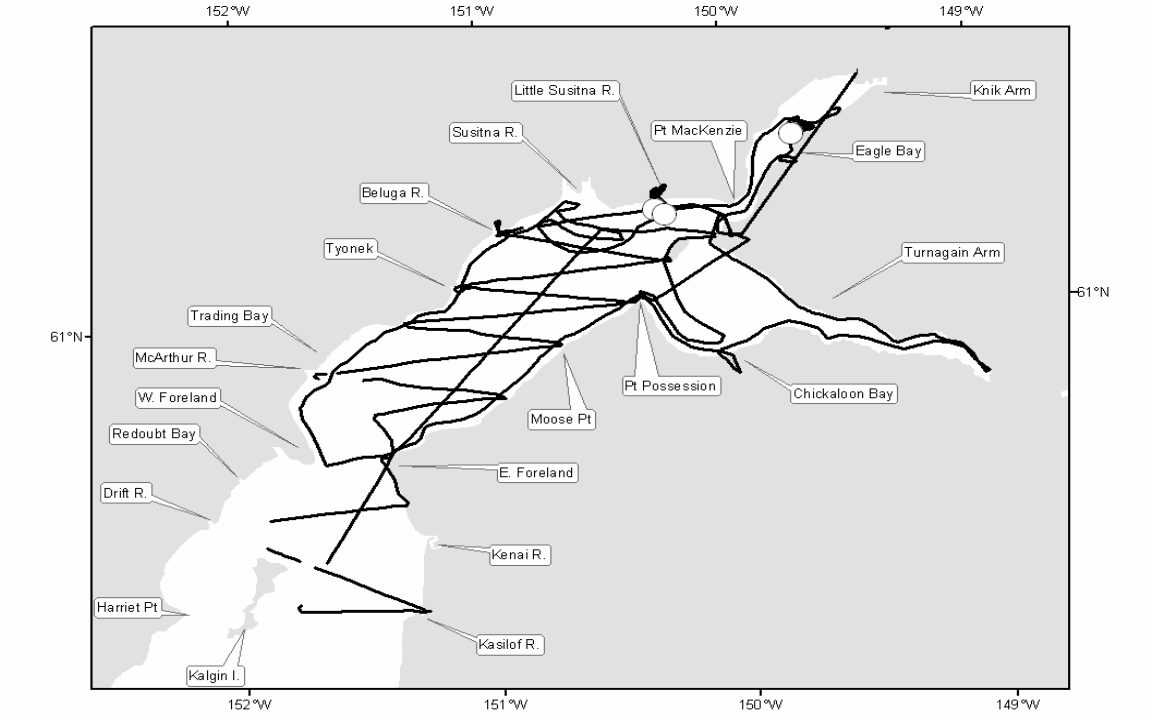

Figure 2. Tracklines flown on 26-27 July 2001. Only search areas where visibility was recorded as fair to excellent are included. Beluga groups are shown as open circles. A group was found at the mouth of the Little Susitna River on both days, and a large group was seen north of Eagle Bay in Knik Arm.

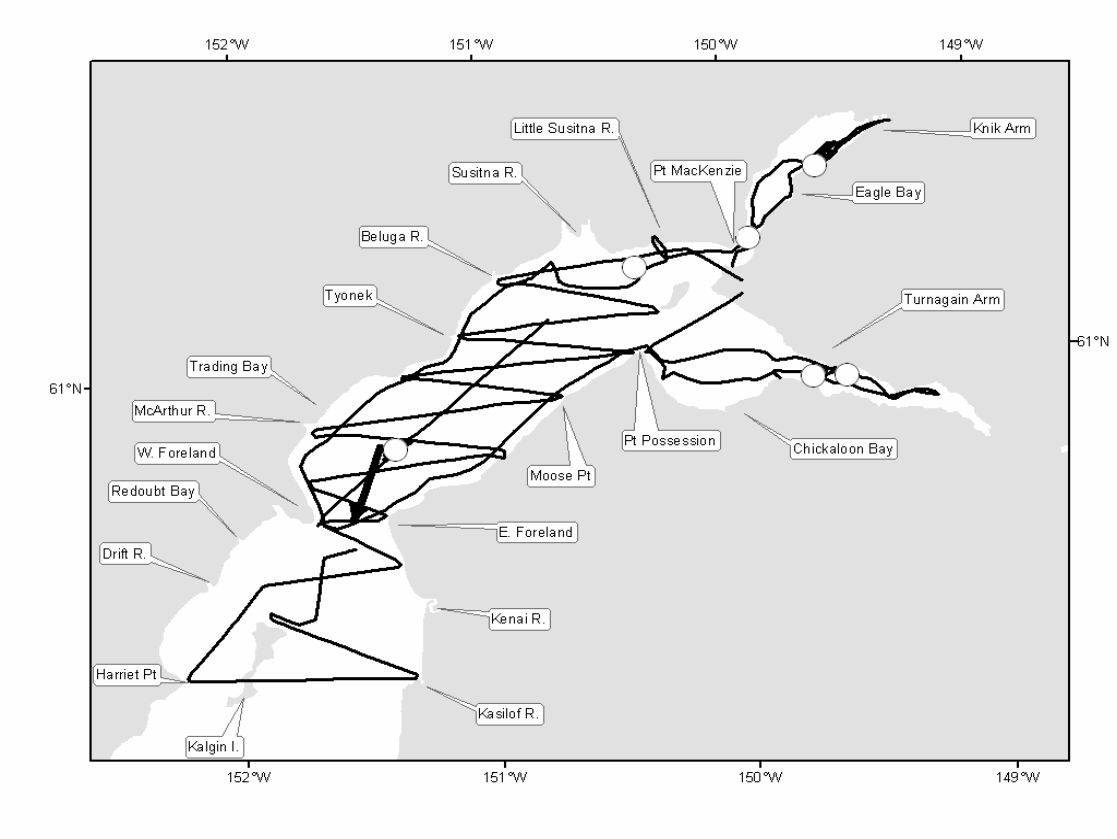

Figure 3. Tracklines flown on 27 August 2001. Only search areas where visibility was recorded as fair to excellent are included. Beluga groups are shown as open circles. One group was seen near the Little Susitna River, two in Knik Arm, two in Turnagain Arm, and one whale (with a satellite tag) was seen mid-inlet near the Forelands.

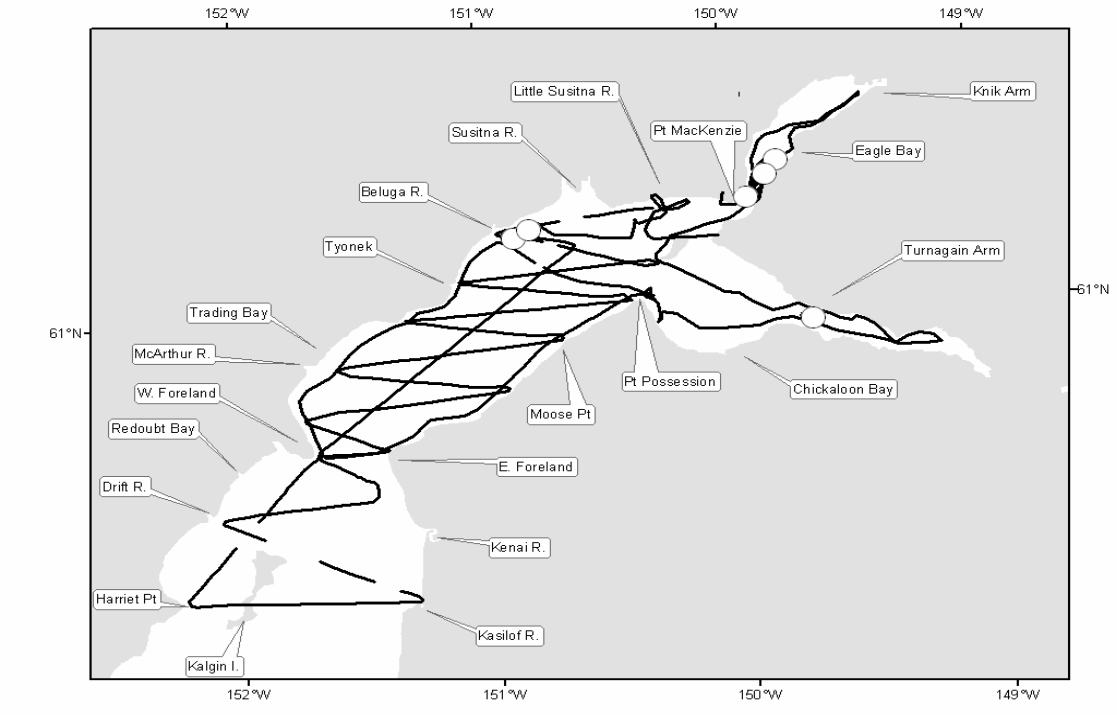

Figure 4. Tracklines flown on 15 and 18 September 2001. Only search areas where visibility was recorded as fair to excellent are included. Beluga groups are shown as open circles. Two or three whales were seen near Beluga River, three groups (one large) were in Knik Arm, and one large group was in Turnagain Arm.

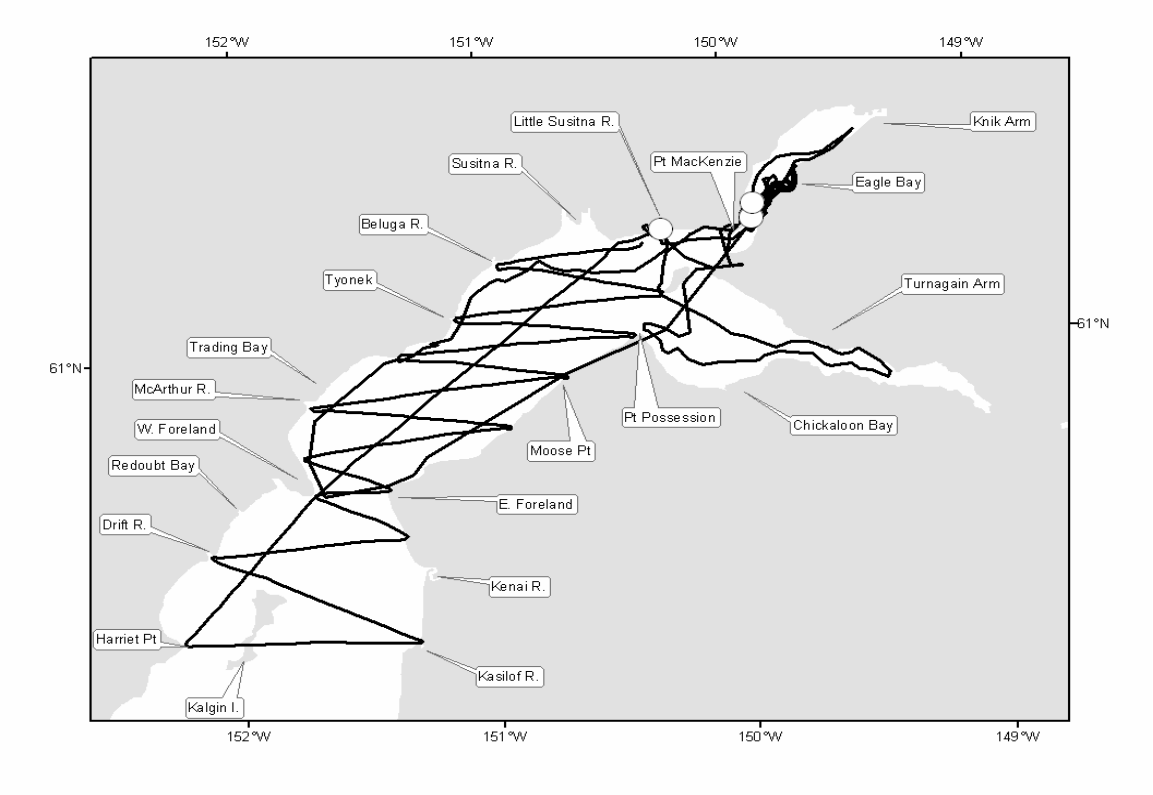

Figure 5. Tracklines flown on 12 and 15 October 2001. Only search areas where visibility was recorded as fair to excellent are included. Beluga groups are shown as open circles. A few whales were seen near the Little Susitna River, but most were in Knik Arm.

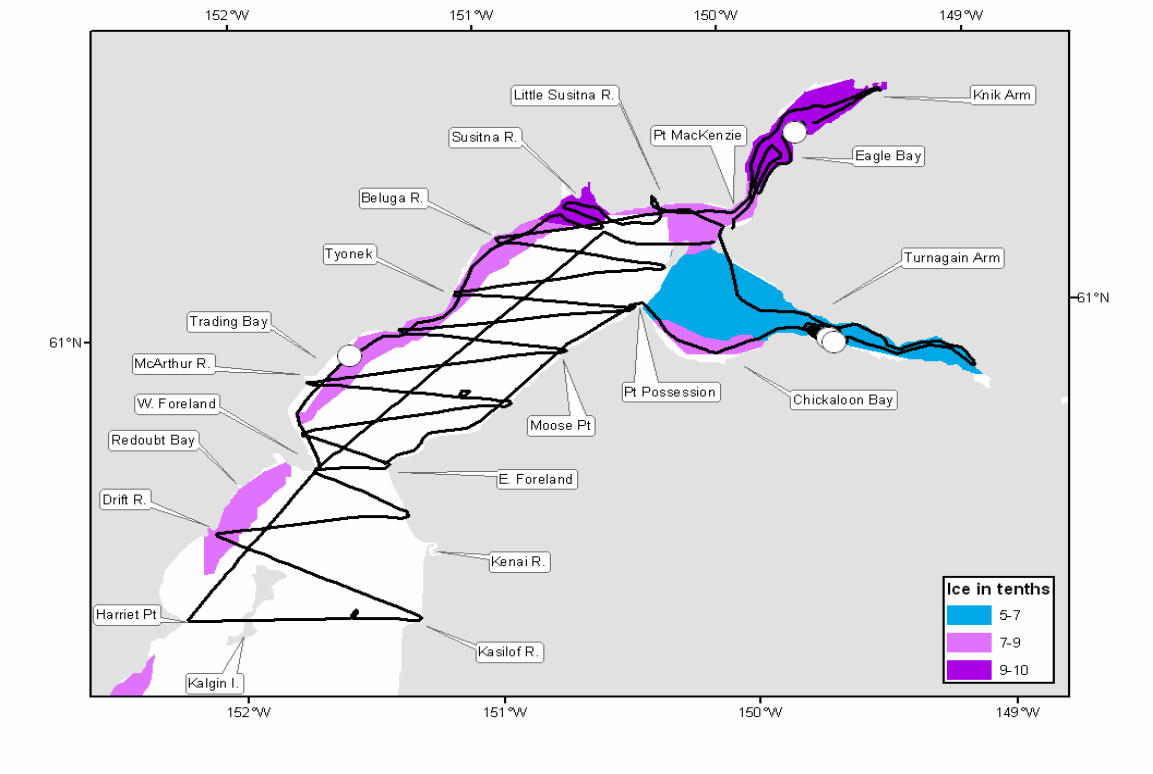

Figure 6. Tracklines flown on 9 November 2001. Only search areas where visibility was recorded as fair to excellent are included. Sea ice covered much of the area. Beluga groups are shown as open circles. Two small groups were in Turnagain Arm, 1-2 whales were near Trading Bay, and most were in Knik Arm, but summary counts were lower than on the previous surveys.

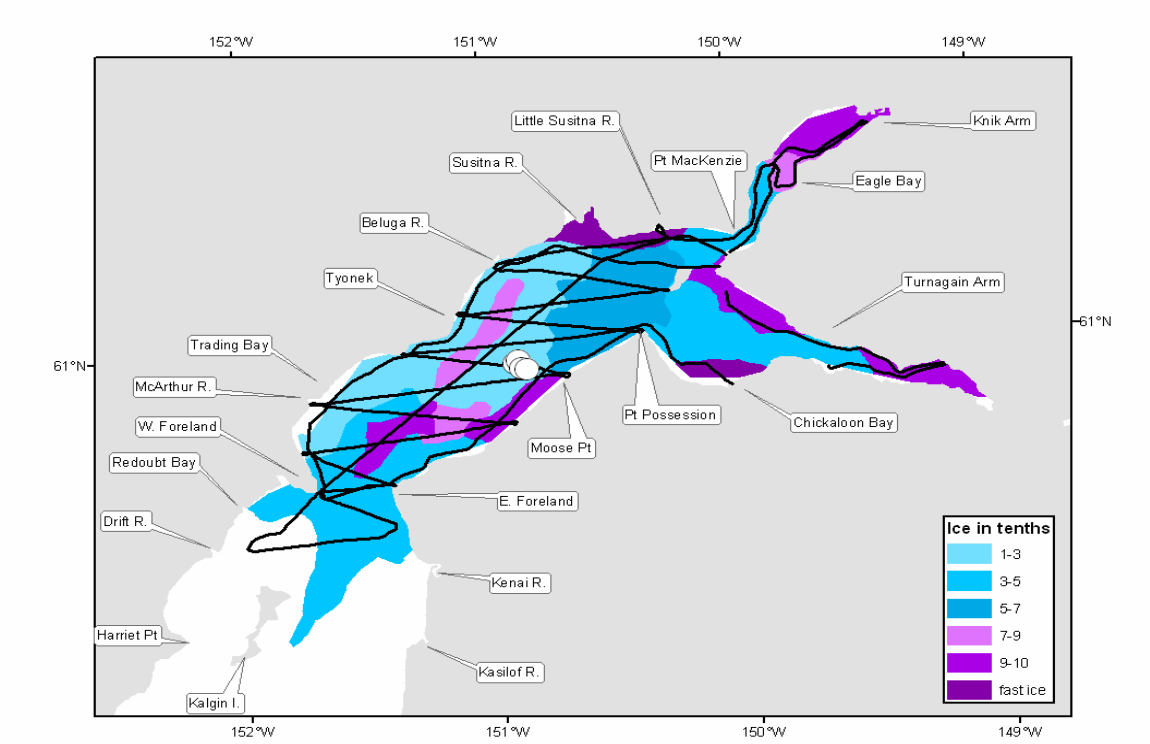

Figure 7. Tracklines flown on 22 and 23 January 2002. Only search areas where visibility was recorded as fair to excellent are included. Sea ice covered much of the area. Beluga groups are shown as open circles. Five small groups were seen, all of them offshore toward the middle of the inlet, atypical of the summer distribution.

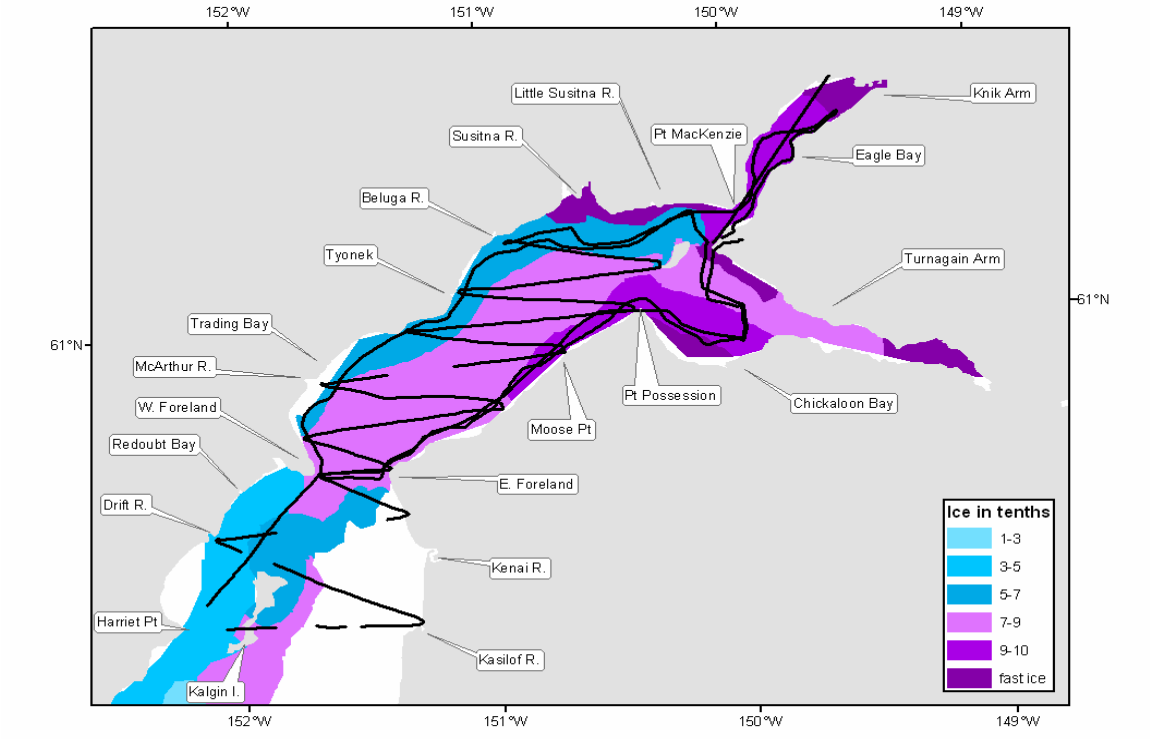

Figure 8. Tracklines flown on 25 and 26 February 2002. Only search areas where visibility was recorded as fair to excellent are included. Sea ice covered much of the area. No belugas were seen on these flights.

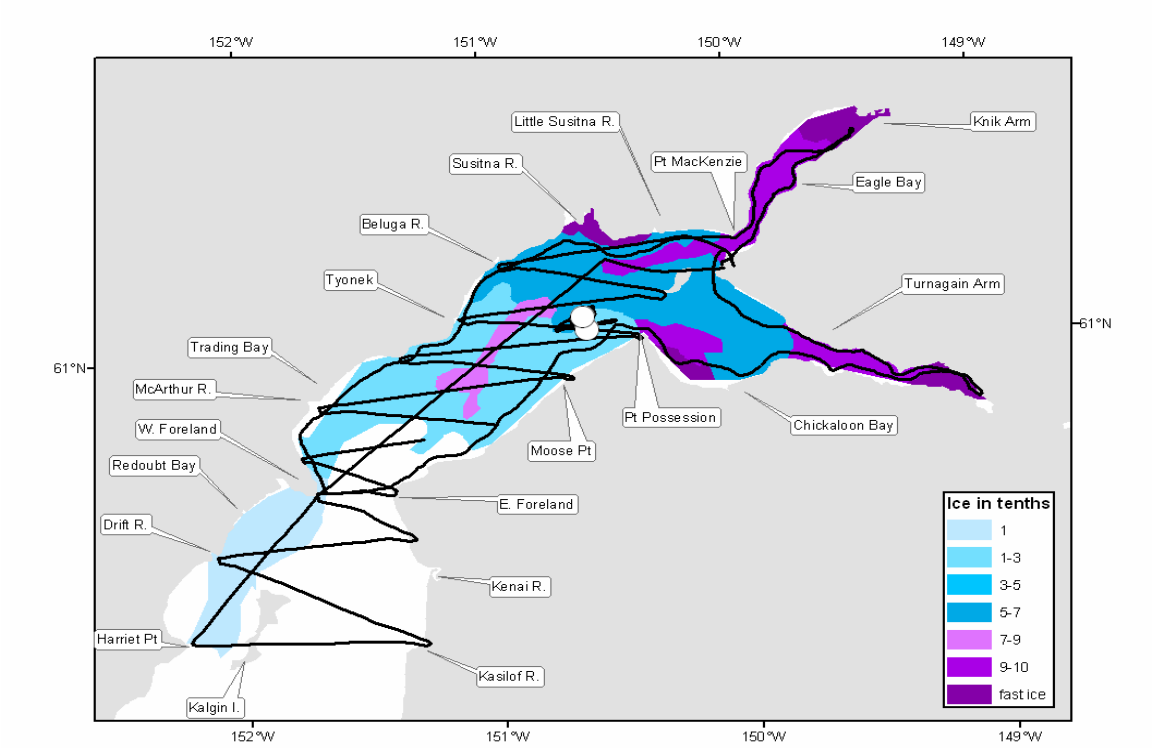

Figure 9. Tracklines flown on 2 April 2002. Only search areas where visibility was recorded as fair to excellent are included. Sea ice covered much of the area. Beluga groups are shown as open circles. Similar to the January sightings, the only groups that were seen were well offshore toward the center of the inlet.

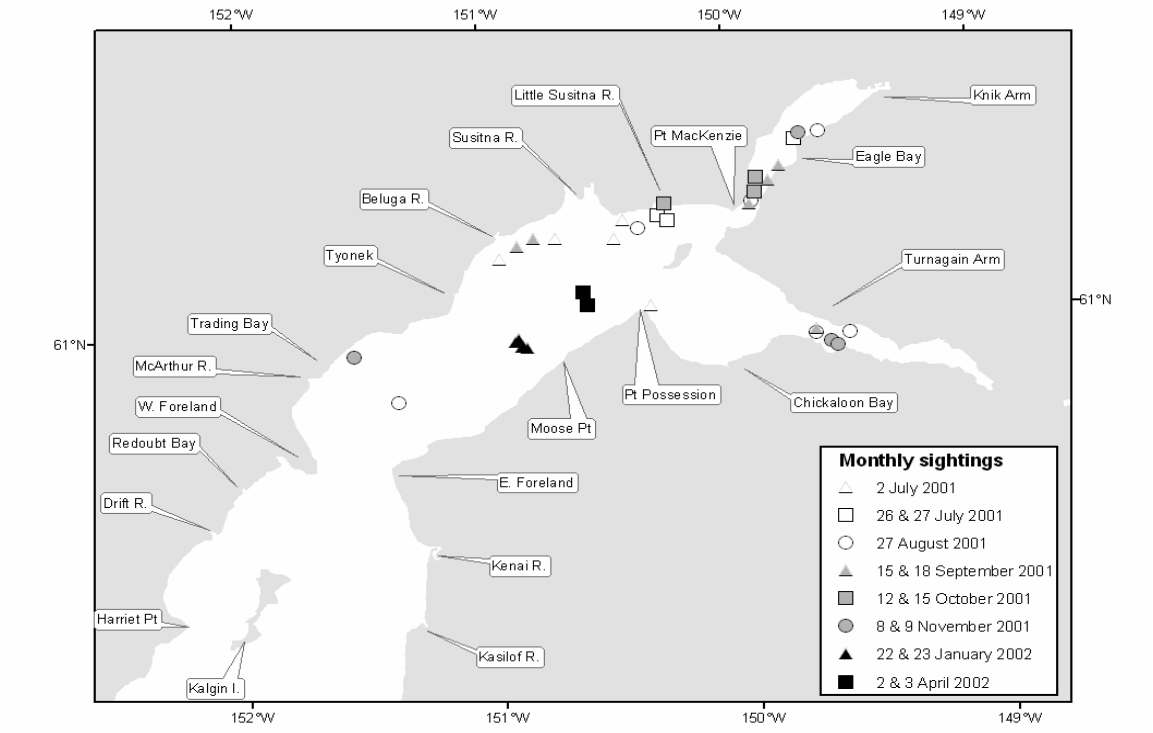

Fig. 10. Summary map showing locations in Cook Inlet where beluga groups were seen during aerial surveys relative to sighting date in 2001-02.

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