

ALASKA BELUGA WHALE COMMITTEE  
REPORT 99-1

**Alaska Beluga Whale Committee Surveys of Beluga Whales in the  
eastern Chukchi Sea, 1996-1998**

Prepared by

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## SUMMARY

In 1996-1998, the Alaska Beluga Whale Committee (ABWC) conducted aerial surveys of beluga whales in the eastern Chukchi Sea. Surveys were flown on 10 days in 1996, 4 days in 1997, and 9 days in 1998. In 1996 belugas were seen on most surveys with a peak count of 1,035 on 30 June. In 1997, belugas were seen only on one day with a peak count of 130 on 7 July. In 1998 the peak count was 1,172 on 6 July. During 1996 and 1998 peak counts, belugas were seen both nearshore and offshore in sea ice. When the 1998 count was made, four of five whales that had been equipped with satellite tags near Point Lay were more than 110 nm to the northeast of the main concentration, far from the area covered by the surveys. Counts from 1996-1998 surveys should not be used for estimating population abundance because of the unknown fraction of animals in the ice that were not counted and a lack of suitable correction factors. At the present time, the best estimate of population size for the eastern Chukchi Sea beluga stock is 3,710, derived from counts made in 1990. Counts of whales in the Kasegaluk Lagoon area made during 1978-1998 show no evidence of changes in abundance.

## INTRODUCTION

Beluga whales (*Delphinapterus leucas*) occur in coastal and offshore waters of western Alaska (Seaman et al. 1988). During summer months they predictably concentrate in certain coastal locations, and this distribution pattern was initially used to identify three provisional management stocks (Seaman et al. 1988, Frost and Lowry 1990). Studies of mitochondrial DNA have confirmed the existence of three beluga stocks that occur in western Alaska during summer months (O’Corry-Crowe et al., 1997), which are currently referred to as the Bristol Bay stock, the eastern Bering Sea stock, and the eastern Chukchi Sea stock.

In the eastern Chukchi Sea during summer months beluga whales occur all along the coast, but they are most commonly seen in Kotzebue Sound and the Kasegaluk Lagoon region (Frost and Lowry 1990). Based on movement patterns and the timing of sightings, Frost and Lowry (1990) speculated that belugas seen in Kotzebue Sound and at Kasegaluk Lagoon belong to the same stock. Samples from belugas taken by subsistence hunters in Kotzebue Sound have recently become available, and the genetic characteristics of those animals are being analyzed and compared with animals from the Kasegaluk Lagoon area (G. O’Corry-Crowe, personal communication). In this report we will use the term eastern Chukchi Sea stock to include all the beluga whales that occur in Kotzebue Sound, near Kasegaluk Lagoon, and in adjacent regions, during the open water season.

The National Oceanic and Atmospheric Administration (NOAA) has provided funds to the Alaska Beluga Whale Committee (ABWC) to conduct studies of beluga whales in Alaska. Part of the ABWC research program consists of aerial surveys to estimate the abundance and trends of western Alaska beluga stocks. This report describes the results of ABWC surveys flown in the eastern Chukchi Sea during 1996-1998, and compares these results with previous beluga population estimates for this area.

## REVIEW OF PREVIOUSLY AVAILABLE INFORMATION

One of the earliest recorded records of belugas in the eastern Chukchi Sea was by Nelson (1887) who in August 1881 saw many belugas close to shore from Kotzebue Sound to Point Hope. He stated that belugas were very abundant in Kotzebue Sound at times, and that local people hunted them from kayaks.

Footo and Williamson (1966) described the movement of belugas into Kotzebue Sound after breakup and stated that the whales were commonly seen in groups of 30-100. They described organized beluga hunts that were annual events at Sisualik in northern Kotzebue Sound. According to Seaman and Burns (1981) beluga hunting at Sisualik became much more sporadic after about 1965, possibly due to development of a salmon fishery in the area. Organized drive hunts continued through the 1970s in Eschscholtz Bay in southeastern Kotzebue Sound (Seaman and Burns 1981), but harvests there declined markedly after 1983 due to a scarcity of whales (Frost and Lowry 1990). Frost and Lowry (1990) documented sightings of 1,000 or more belugas in Kotzebue Sound in several years between 1960 and 1981, but usually fewer than 100 were reported seen in 1982-1988. In response to this apparent decline in local abundance, Frost and Lowry (1990) flew a series of aerial surveys that covered all of Kotzebue Sound during 13 June-9 July 1987. The only belugas seen were in Eschscholtz Bay, with a maximum count of 51 animals.

Belugas have apparently been using the Kasegaluk Lagoon region during summer for many years. Warren Neakok described hunting belugas there in what must have been about 1930 (Neakok et al. 1985). Childs (1969) reported a group of 50 or more belugas near Cape Sabine on 24 June 1958. In recent years, the occurrence of belugas off Kasegaluk Lagoon has been quite predictable, and that region has been surveyed numerous times. Seaman et al. (1988) took photographs of belugas concentrated at Kasegaluk Lagoon passes, and estimated that there were 2,282 animals there on 15 July 1979. This estimate included correction factors for whales outside the concentration area (+10%), whales too deep to be seen on the photographs (+20%), and dark colored yearlings that are difficult to see (+8%). Frost and Lowry (1990) flew an aerial strip transect survey over a large concentration of belugas off Point Lay on 8 July 1987. They counted 723 whales, and suggested that there may have been 1,400-2,100 animals in the concentration (using correction factors of 2 to 3 to account for animals diving in relatively deep water). Frost et al. (1993) flew 24 aerial surveys for belugas in the Kasegaluk Lagoon region during 3-14 July 1990 and 4-16 July 1991. Belugas were seen in the area on every survey flight, with the highest single day count of 1,212 whales on 6 July 1991. Comparing the 1990-1991 counts with abundance estimates from 1979 and 1987, they concluded that the number of belugas using the Kasegaluk Lagoon area had been relatively constant over those years.

## ABWC SURVEYS

### Methods

Aerial surveys were flown during 26 June-6 July 1996, 7-11 July 1997, and 25 June-6 July 1998 (Table 1). The aircraft used was a high-wing, twin-engine AeroCommander (N7UP).

Survey coverage emphasis was on coastal waters of Kotzebue Sound and the eastern Chukchi Sea coastline as far north as northeastern Kasegaluk Lagoon (Figure 1). Many flights followed the coastline with the aircraft centerline approximately 0.6 nm off shore. Some offshore lines were flown. When large aggregations of beluga whales were located, as many animals as possible were positioned on one side of the survey track line, and two to four passes were made while observers counted whales on both sides of the aircraft. The group sizes presented in this report are the sum of the maximum estimates from each side of the aircraft.

The flight crew included the pilot, a data recorder in the right front seat, and 2-4 observers seated behind the pilot on the left and right sides of the aircraft (Table 1). All transects were flown at 120 knots at an altitude of 1000 ft. Navigation was done by using the Global Positioning System. A computerized data logging system recorded the time and position from the GPS at the beginning and end of every transect, at 60 second intervals along the transect, and at every beluga sighting. Weather, sighting conditions, and other relevant information were also recorded. Each observer also kept a written record of the time and number of whales sighted, which was used to check the computer database.

Photographs of beluga aggregations were taken with a KA76 aerial reconnaissance camera that was mounted vertically over a port in the deck of the aircraft. The camera has a 152 mm lens and a forward image motion compensation system that eliminates the loss of image resolution caused by the forward motion of the aircraft. All photographs were taken with Kodak SO-359 aerial transparency film. Altitudes for photographic passes depended partly on the position of the cloud ceiling and varied between 1000 and 3000 ft. Photographic passes were typically done prior to the passes where group size was visually estimated because photographic passes were done at higher altitudes and were not likely to disturb the whales. Upon processing the film, the following information was determined directly from the photographic image, according to the methods described in Perryman and Lynn (1993): 1) group size; 2) length distribution of all animals that were measurable; 3) length distribution of all measurable calves (i.e., animals accompanied by a large adult); 4) the percent of calves accompanied by cows; and 5) the percent of animals in various categories of “color” (ranging from dark gray to white).

### 1996 Survey Results

Surveys were flown on 10 days during the period 26 June through 6 July. On several days survey conditions were not good with windy conditions and low ceilings or fog, but survey conditions were good to excellent on several other days. The areas covered by the survey were Kotzebue Sound (including Kobuk Lake and Eschscholtz Bay), Kasegaluk Lagoon, and the coast between those two areas (Table 1, Figure 2).

Most beluga sightings were made near Kasegaluk Lagoon, with only a few animals seen in Kotzebue Sound and the Point Hope-Cape Lisburne region (Figure 2). Whales were seen in Kotzebue Sound only on 29 June when 13 animals were counted. In the Kasegaluk Lagoon region whales were seen on every survey day except 27 June when the flight covered only a short section of coast between Omalik Lagoon and Point Lay.

Daily counts of belugas near Kasegaluk Lagoon varied considerably, due in part to weather conditions and the area included in the survey (Table 1). The peak count of 1,035 occurred on 30 June when whales were seen both nearshore near Omalik Lagoon, at 11-mile Pass, and in the ice offshore from 11-mile Pass (Figure 3).

### 1997 Survey Results

Surveys were flown on 4 days during the period 7-11 July, in generally poor conditions (Table 1). The area covered extended from Kotzebue to Point Barrow. Most survey effort was along the coast between Cape Sabine and Wainwright, including Kasegaluk Lagoon (Figure 4).

Belugas were seen only on 7 July. They were in a single group sighted very near shore southwest of Wainwright (Figure 4). Conditions were poor for counting (wind and whitecaps) but the group included at least 130 belugas.

### 1998 Survey Results

Surveys were flown on nine days during the period 25 June through 6 July (Table 1, Figure 5). In general conditions for surveying were good, except that the area around Point Hope was covered with ice throughout the survey period and often had fog that precluded surveys in that area.

The coastal portion of Kotzebue Sound from Kotzebue north past Cape Krusenstern was surveyed several times between 25 June and 5 July, and the main Sound including Eschscholtz Bay and Kobuk Lake was surveyed on 30 June and 3 July. Only one beluga was seen, 10 nm east of Cape Espenberg on 3 July. No belugas were seen along the coast or offshore in the area between Kotzebue and Cape Lisburne (Figure 5).

Surveys were flown of the Kasegaluk Lagoon area on 28 and 29 June and 2, 5, and 6 July. Only two belugas were seen in the southern part of this area, one off Cape Sabine and one south of Point Lay, both on 28 June. Most of the belugas seen on 28 June, and all the whales seen on later surveys (except for whales seen in Kasegaluk Lagoon associated with the Point Lay subsistence hunt), were north of Point Lay (Figure 5).

Large numbers of beluga whales were only seen on 5 and 6 July, in the vicinity of Icy Cape. On 5 July, the maximum count based on four passes during which independent counts were made on each pass by observers on the right and left side of the aircraft was 615 animals. The estimated size of this same group based on counts of animals in photographs was 592 animals. On 6 July, the aggregation seen on 5 July had moved a few miles to the north and east. The best visual count based on the maximum count from two passes where observers were able to estimate group size was 917 animals. The comparable count from photographs was 1,018. On 6 July belugas were also numerous offshore from Icy Cape. On a transect line along the ice edge, 151 belugas were counted in a 20 nm long segment, and 3 were seen 12 nm further east (Figure 6). Twenty-one belugas were counted on an east-west transect where it crossed the ice edge transect at the location where whales were concentrated. This latter group of whales was not included in the total count for the day because it may have already been counted on the ice edge transect.

Our total count for 6 July was 1,172 whales, derived by summing the photographic count from the Icy Cape concentration and the visual counts along the ice edge transect.

### CURRENT ABUNDANCE ESTIMATE

Belugas spend much of their time below the surface where they cannot be seen from the air (Frost et al. 1985, Martin and Smith 1992). Therefore, aerial survey counts must be corrected to estimate the actual number of animals that are present, not just the number that are at the surface. Some investigators have proposed correction factors for beluga surveys based on observations of breathing and diving cycles (Sergeant 1973), comparisons of simultaneous aerial and boat counts (Frost et al. 1983), and their impressions of sightability of different age classes (Brodie 1971). Data from radio-tagged belugas can be used to estimate the proportion of time spent at and below the surface (Frost et al. 1985), and that information can then be used to correct the actual survey counts for submerged belugas. Frost and Lowry (1995) analyzed surface and dive time data from two belugas tagged with VHF tags in Bristol Bay and three tagged in Cunningham Inlet (arctic Canada). The calculated correction factors for surveys flown at an altitude of 1000 feet and an airspeed of 120 kts were 2.62 for adult animals (n=3) and 3.24 for juveniles (n=2).

Hill et al. (1997) reported the abundance of the eastern Chukchi beluga stock as 3,710 animals. This was derived from a count of 1,200 made in July 1990 (Frost et al. 1993; note that the actual total count for 6 July 1990 was 1,212) with correction factors for animals submerged at the time of the survey (2.62; Frost and Lowry 1995) and unseen neonates and yearlings (1.18; Brodie 1971). When the 1990 count was made the whales were almost all in a single group nearshore at the southern end of Kasegaluk Lagoon in relatively muddy water. Estimating the population size using this count and these methods was considered reasonable as it seemed likely that the entire group of whales was counted and the correction factors were appropriate for the circumstances.

On the days of our peak counts in both 1996 and 1998, whales occurred both nearshore and offshore in the ice (Figures 3 and 6). We think that surveys flown on those days probably detected all groups of whales nearshore, but it is very likely that many whales that were in the ice were missed. For that reason, and because we do not have correction factors appropriate for whales diving in the ice or nearshore in clear water (as was the case at Icy Cape in 1998), we cannot calculate a new abundance estimate from the recent counts.

### COMPARISON WITH PREVIOUS ABUNDANCE ESTIMATES

Surveys of whales in the Kasegaluk Lagoon region have been done at intervals since 1978 (Seaman et al. 1988, Frost and Lowry 1990, Frost et al. 1993). Peak counts from those surveys have varied considerably (Table 2) with the highest count of 1,601 resulting from photographs taken of whales at a pass east of Icy Cape in 1979. The peak 1996 and 1998 counts of 1,035 and 1,172 are quite close to the highest visual count made in the previous years (1,212 in 1990). While these data are not sufficient for a rigorous analysis of trend, we conclude that there is no evidence of recent changes in abundance for the eastern Chukchi Sea beluga stock.

## ADEQUACY OF POPULATION ASSESSMENT

Few belugas were counted in Kotzebue Sound during 1996-1998 aerial surveys. However, in June 1996 hunters in the Kotzebue region harvested more whales than in any year since 1983 (Frost and Lowry 1990, ABWC unpublished data). This apparent contradiction may be due to the fact that surveys began too late, after most belugas had left the Sound. While in some previous years large numbers of whales have been seen in the area in late June and July, many large sightings have been in mid-June (Frost and Lowry 1990). Also, in 1996 summer conditions developed early in Kotzebue Sound as indicated, for example, by the arrival of chum salmon (*Onchorynchus keta*) two weeks sooner than usual (W. Goodwin and R. Schaeffer personal communications). In 1997 and 1998 we wanted to try and count whales in Kotzebue Sound while they were still common there, and intended to begin surveys as soon as the first sightings were made by local residents. But, apparently relatively few whales came into the Sound in those years, and we saw very few on our surveys.

Our estimates of abundance for the eastern Chukchi beluga stock are based on counts made in the Kasegaluk Lagoon region. An important assumption that is made is that the surveys cover the entire area where whales occur at the time. In our previous studies of whales in the Kasegaluk Lagoon area (e.g., Frost et al. 1993) we assumed that if we surveyed for several consecutive days in early July, on at least one of those days all, or nearly all, of the whales would be in the nearshore survey area. Because counts of standard nearshore transects fluctuated considerably, it was obvious that whales were moving in and out of the survey area and very likely they were sometimes offshore. Furthermore, residents of Point Lay told us that belugas commonly moved from onshore to offshore and into the ice.

The distribution of belugas that we saw on our surveys in 1996-1998 was different from 1990-1991. We never saw only a single very large group at the southern part of Kasegaluk Lagoon. On the two days with high counts in 1996 and 1998 many animals were offshore in the ice, but we were not able to determine how many there were as we only flew a relatively small segment of the sea ice habitat. As part of another ABWC study, satellite-linked tags were attached to five beluga whales that were part of the group hunted by Point Lay residents on 28 June 1998 (R. Suydam, personal communication). On 6 July, one of those whales was off Icy Cape and very likely in the large group that was counted there, but the other four whales were more than 110 nm to the northeast (Figure 7). Based on the results from tagged whales, it is apparent that the belugas that had been off Kasegaluk Lagoon had split into at least two groups, and that many of the whales were no longer in the area covered by the 6 July survey.

We have no way to know whether the July 1990 count that has been used to estimate abundance of the eastern Chukchi beluga stock included all or most of the animals, or if a significant number were offshore in the ice as was the case in 1996 and 1998. If the July 1990 count did not include most of the belugas in the area then the population estimate of 3,710 is very conservative.

The current abundance estimate for eastern Chukchi belugas depends not only on the quality of the count data, but also on the reliability of the correction factors used to expand the counts. The

correction factor for submerged animals that has been used was derived from data collected in Bristol Bay and Cunningham Inlet. While the environmental conditions in those areas are in many ways similar to nearshore Kasegaluk Lagoon, information on whale diving behavior in the Kasegaluk Lagoon area would be useful. Also, if counts of whales in clear shallow waters or offshore in the ice are to be used for estimating population size, information on the fraction of time that whales spend at the surface where they can be counted in those situations will be needed. Data on diving behavior of belugas near Kasegaluk Lagoon were collected from the whales equipped with SDRs in 1998, but the information has not yet been analyzed (R. Suydam, personal communication).

## DISCUSSION AND CONCLUSIONS

A strong El Nino-Southern Oscillation event occurred in the Pacific Ocean in 1996-1997 which caused strong positive sea surface temperature anomalies that extended north past Point Barrow. This event may have had an effect on beluga whale distribution in the eastern Chukchi Sea. As mentioned earlier, 1996 was an early spring in Kotzebue Sound and local residents noted many unusual happenings. For the first time since about 1982 belugas were common in Kotzebue Sound, and many were taken by subsistence hunters in the area. Near Kasegaluk Lagoon conditions in 1996 appeared more normal, although the peak count of belugas occurred somewhat earlier than it had in previous years (Table 2).

Results of our 1997 survey were very unusual, with belugas counted on only one day. We only surveyed on four days in 1997, partly because of poor weather. However, reports from local residents confirmed that there were few whales in the area. Point Lay hunters reported that belugas were present at the passes at the south end of Kasegaluk Lagoon by about 20 June, which is the earliest sighting we know of since 1978. Belugas were seen farther north on 4 and 5 July at Akunik (11-mile) and Utukok passes. We saw belugas on a 7 July survey, 11 nm south of Wainwright. Based on previous records and reports of hunters, the sighting near Wainwright is unusually far north for so early in July. Belugas were then sighted and hunted near Point Barrow on 12 July, which is also unusual. The 1997 harvest of belugas at Point Lay was only three animals, the lowest number since 1984.

In 1998, the village of Pt. Lay had a successful hunt on 28 June, several days earlier than usual. On our aerial surveys there were no whales seen south of Point Lay after 28 June. This was in marked contrast to previous years when whales were generally abundant off the southern part of Kasegaluk Lagoon until mid-July (Frost et al. 1993).

We have not succeeded in conducting a survey of belugas in Kotzebue Sound at a time when whales were common in that area. At least in 1996 our surveys probably were flown too late. However, the variable and unpredictable nature of the spring movements of belugas into Kotzebue Sound make it very difficult to design a survey. Currently, the whales taken in Kotzebue Sound are considered to belong to the same stock as those seen at Kasegaluk Lagoon (Frost and Lowry 1990), and if that is truly the case it may not be important to make a separate assessment of the number of whales coming into Kotzebue Sound. The genetic relationship between belugas from Kotzebue Sound and Kasegaluk Lagoon is currently under investigation (O'Corry-Crowe, pers. comm.).



Prior to our 1996-1998 surveys, we thought that aerial surveys in the Kasegaluk Lagoon region were straightforward and likely to produce reliable indices of abundance for the eastern Chukchi Sea beluga stock. In contrast to Kotzebue Sound, where it was clear that aerial surveys were problematic, it appeared that the occurrence and distribution of belugas off Kasegaluk Lagoon were quite predictable, and that counts made in that area in early July would be useful for population monitoring (Frost et al. 1993). However, recent results suggest that climactic events may affect whale distribution and behavior in this area. Furthermore, it now seems very possible that animals seen in nearshore waters represent only a fraction of the population, a large portion of which may be offshore in sea ice. That is, the situation with belugas in the eastern Chukchi Sea may be similar to that in the eastern Beaufort Sea, where the animals that occur in nearshore summer concentration areas represent only a relatively small fraction of the total stock (Harwood et al. 1996). Clearly there is much left to be learned about the biology of belugas in the eastern Chukchi Sea.

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Table 1. Beluga whale aerial surveys in the eastern Chukchi Sea, June-July 1996-1998.

Date	Observers	Area surveyed	# belugas counted	Comments
6/26/96	Lowry, Frost, DeMaster	Eschscholtz Bay	0	windy and low ceilings
6/26/96	Lowry, Frost, DeMaster	Cape Sabine-Pt. Lay	23	low ceilings
6/27/96	Lowry, Frost, DeMaster, Goodwin	Kotzebue Sound	0	windy
6/27/96	Lowry, Frost, DeMaster	Omalik- Point Lay	0	fair conditions
6/28/96	Lowry, Frost, DeMaster	Kotzebue- Point Lay	332	good conditions
6/29/96	Lowry, Frost, DeMaster	Kotzebue Sound	13	good conditions
6/29/96	Lowry, Frost, DeMaster	Cape Sabine-Point Lay	509	good conditions
6/30/96	Lowry, Frost, DeMaster	Cape Sabine-Icy Cape	1035	excellent conditions
7/1/96	Lowry, Frost, DeMaster, Goodwin	Kobuk Lake	0	good conditions
7/1/96	Lowry, Frost, DeMaster	Cape Sabine-11 Mile Pass	4	poor conditions; very windy
7/3/96	Lowry, Frost, DeMaster	Kotzebue Sound	0	good conditions
7/3/96	Lowry, Frost, DeMaster	Cape Sabine-11 Mile Pass	219	low ceilings and low count
7/4/96	Lowry, Frost, DeMaster	Kotzebue-Point Lay	536	very good conditions
7/5/96	Lowry, Frost, DeMaster	Cape Sabine-Icy Cape	393	good conditions
7/6/96	Lowry, Frost, DeMaster	Cape Sabine-11 Mile Pass	751	excellent conditions
7/7/97	Lowry, Frost, DeMaster	Cape Sabine-Point Barrow	130	poor conditions; windy
7/8/97	Lowry, Frost, DeMaster	Point Barrow-Kotzebue	0	poor conditions; windy/low ceilings
7/9/97	Lowry, Frost, DeMaster	Cape Sabine-Wainwright	0	poor conditions; windy/low ceilings
7/11/97	Lowry, Frost, DeMaster	Cape Krusenstern-Wainwright	0	good conditions

Table 1. Continued.

Date	Observers	Area surveyed	# belugas counted	Comments
6/25/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue Sound-Kivalina	0	
6/26/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue Sound-Kivalina	0	
6/28/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue-Icy Cape	56	
6/29/98	DeMaster, Blaesing, Goodwin, Perryman	Cape Sabine-Icy Cape	0	
6/30/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue-Kivalina-Kobuk Lake	0	excellent conditions
7/2/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue-Point Barrow	21	
7/3/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue Sound-Eschscholtz Bay	1	
7/5/98	DeMaster, Blaesing, Goodwin, Perryman	Kotzebue-Point Franklin	615	
7/6/98	DeMaster, Blaesing, Perryman	Icy Cape and offshore ice	1172	

Table 2. Results of counts of beluga whales in the Kasegaluk Lagoon region, 1978-1998.

Year	Maximum Count	Date	Number of Surveys	Comments
1978 <sup>1</sup>	703	10 July	5	nearshore, count from photos
1979 <sup>1</sup>	1,601	15 July	5	nearshore, count from photos
1981 <sup>1</sup>	670	8 July	5	nearshore, visual count
1987 <sup>2</sup>	724	8 July	1	offshore, visual count
1990 <sup>3</sup>	1,212	5 July	12	nearshore, visual count
1991 <sup>3</sup>	938	6 July	12	nearshore, visual count
1996	1,035	30 June	10	nearshore and offshore, visual count
1997	130	7 July	4	mostly poor survey conditions
1998	1,172	6 July	5	nearshore and offshore

<sup>1</sup> Seaman et al. 1986

<sup>2</sup> Frost and Lowry 1990

<sup>3</sup> Frost et al. 1993

Following figures are correct but the numbers are not. Should start with Figure 1. Figures taken from IWC report.

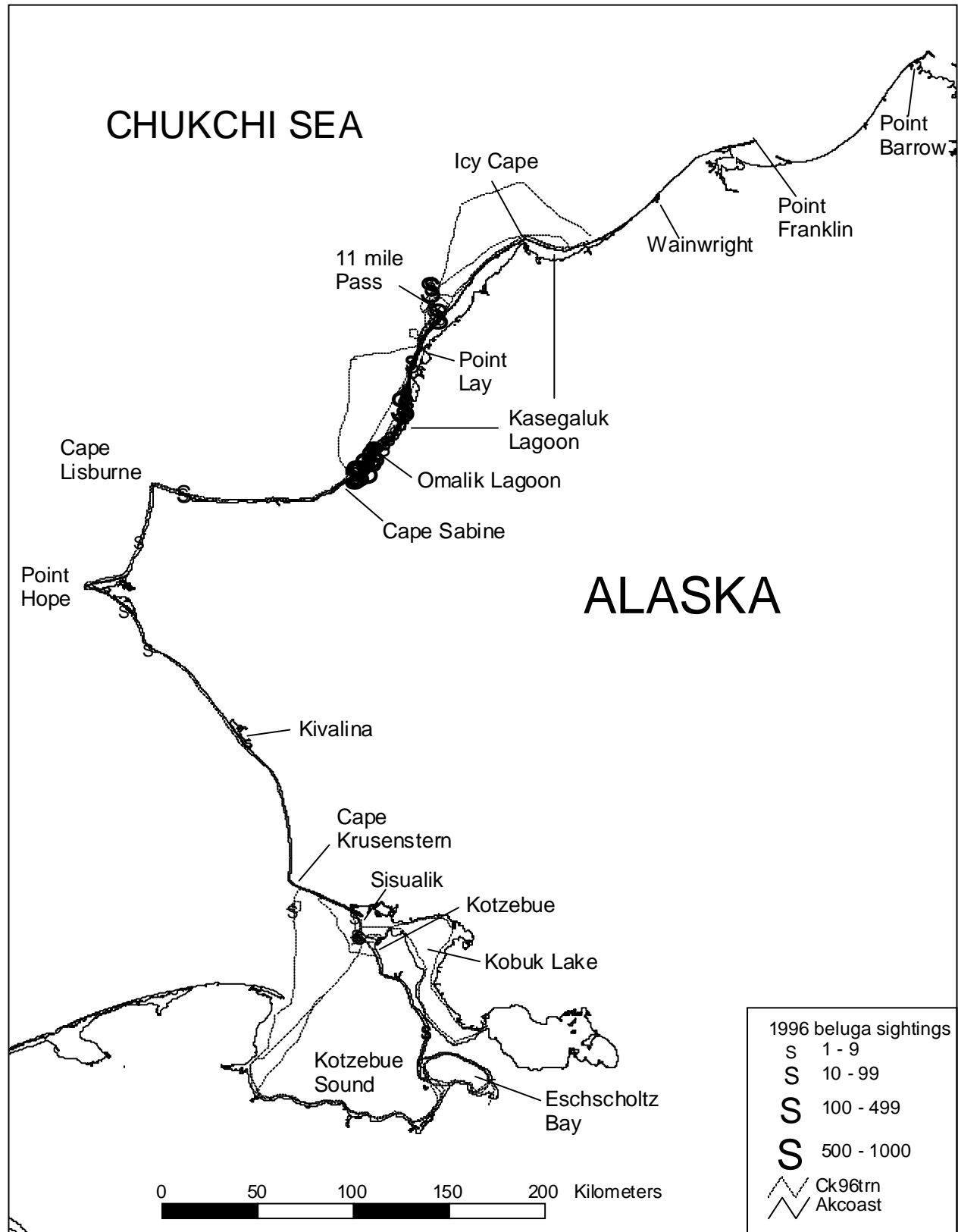


Figure 2. Map of the eastern Chukchi Sea showing flight lines and beluga whale sightings from ABWC aerial surveys conducted 26 June-6 July 1996.

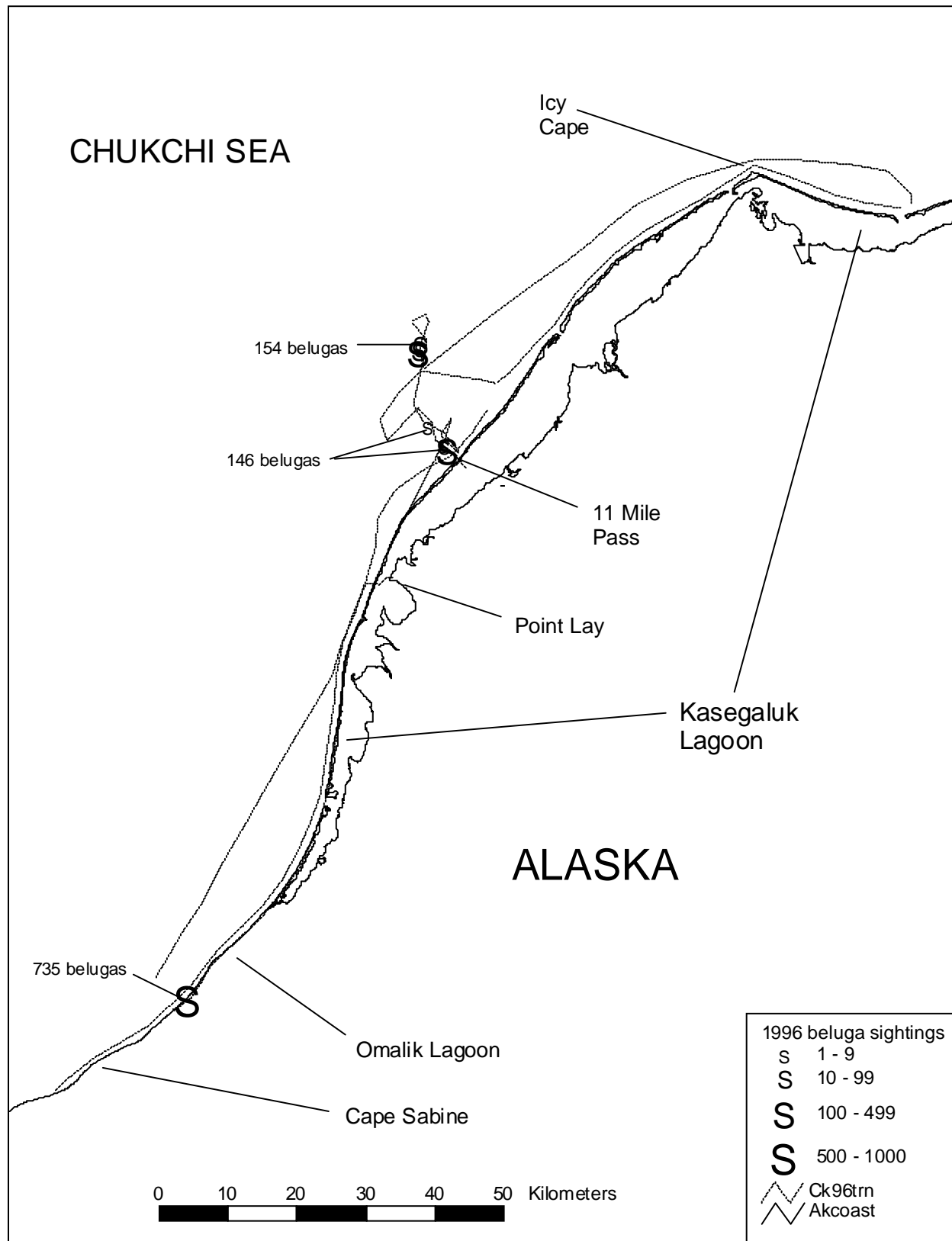


Figure 3. Map of the eastern Chukchi Sea showing flight lines and beluga whale sightings from ABWC aerial surveys conducted on 30 June 1996.



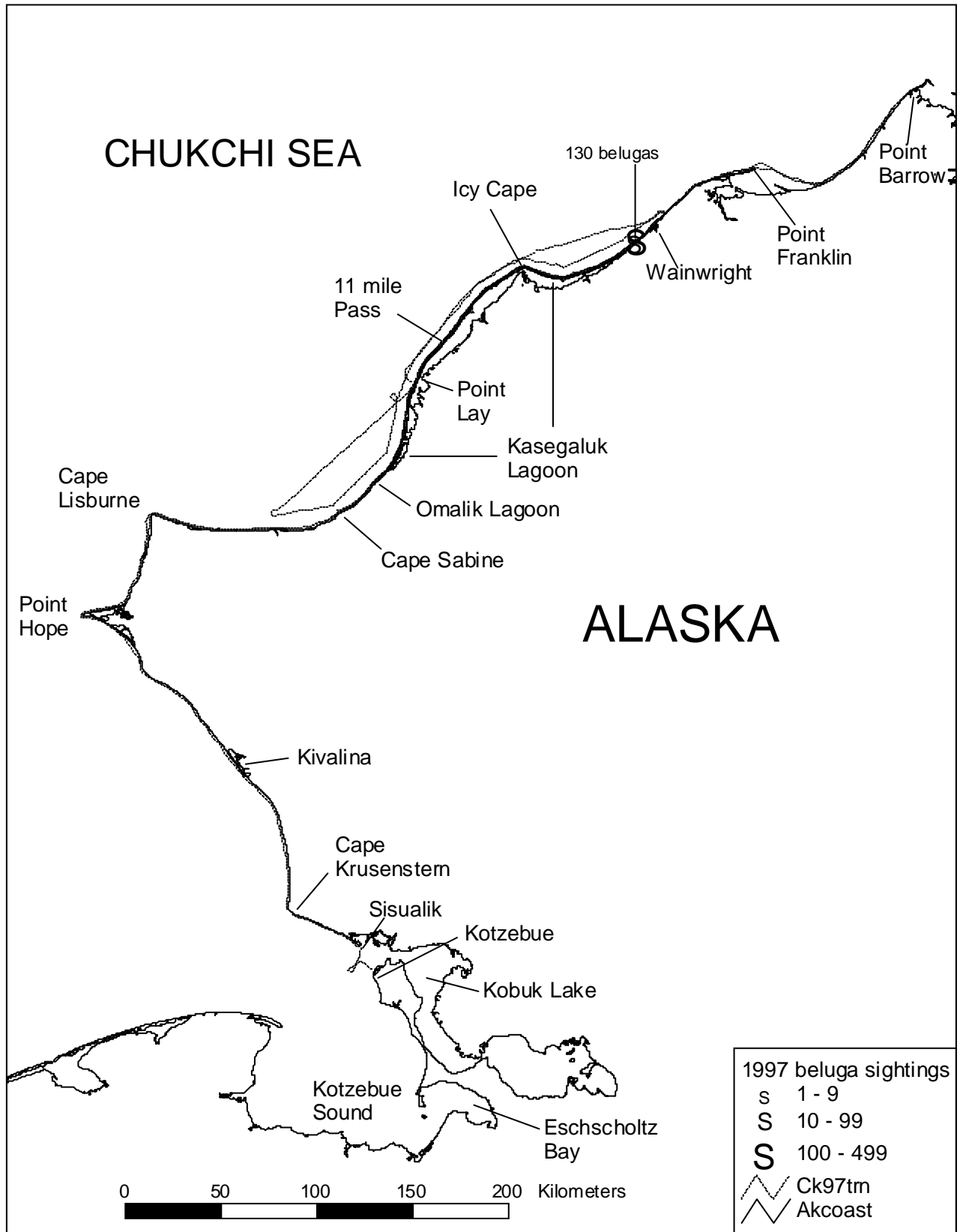


Figure 4. Map of the eastern Chukchi Sea showing flight lines and beluga whale sightings from ABWC aerial surveys conducted 7-11 July 1997.

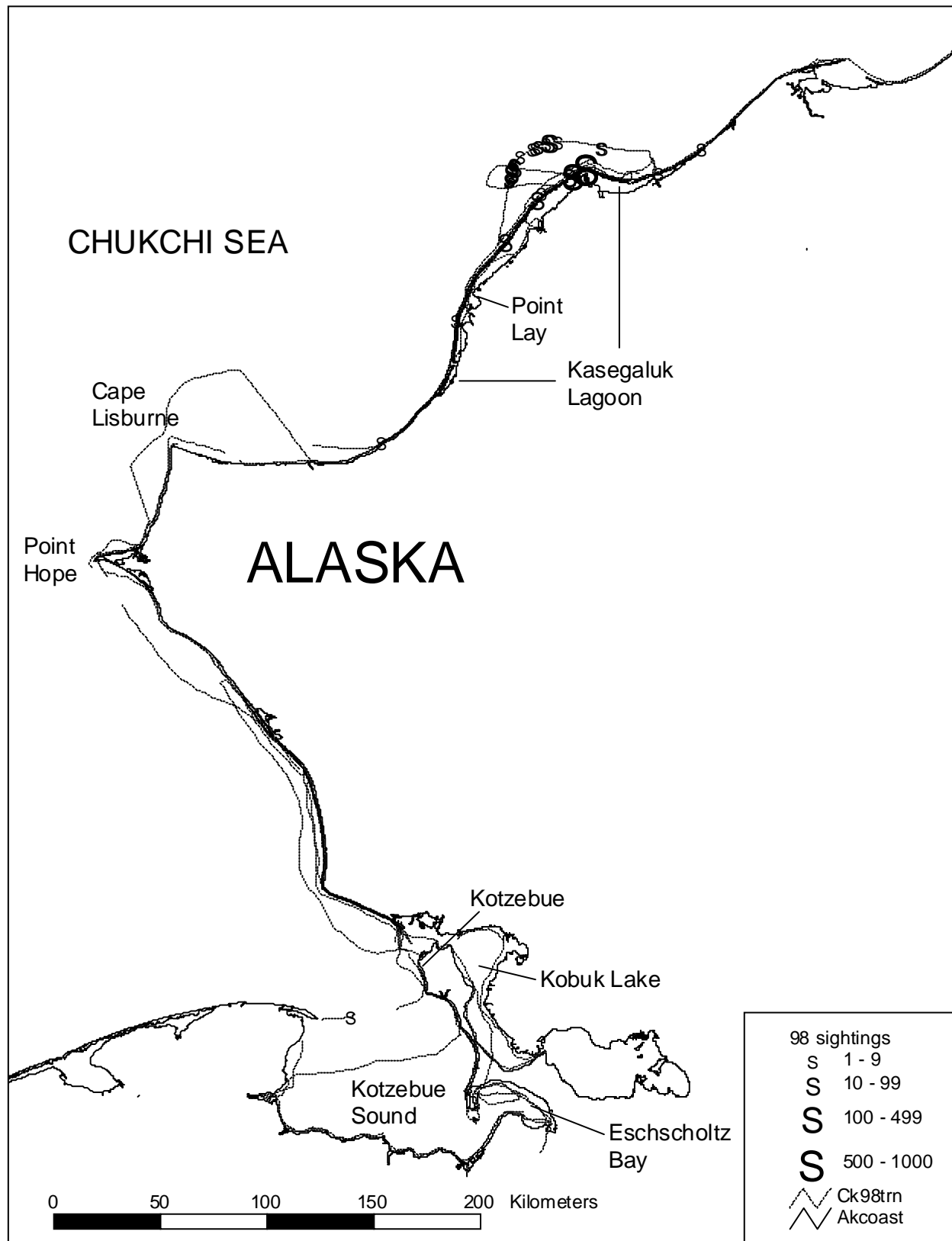


Figure 5. Map of the eastern Chukchi Sea showing flight lines and all beluga sightings made during ABWC aerial surveys conducted 25 June-6 July 1998.

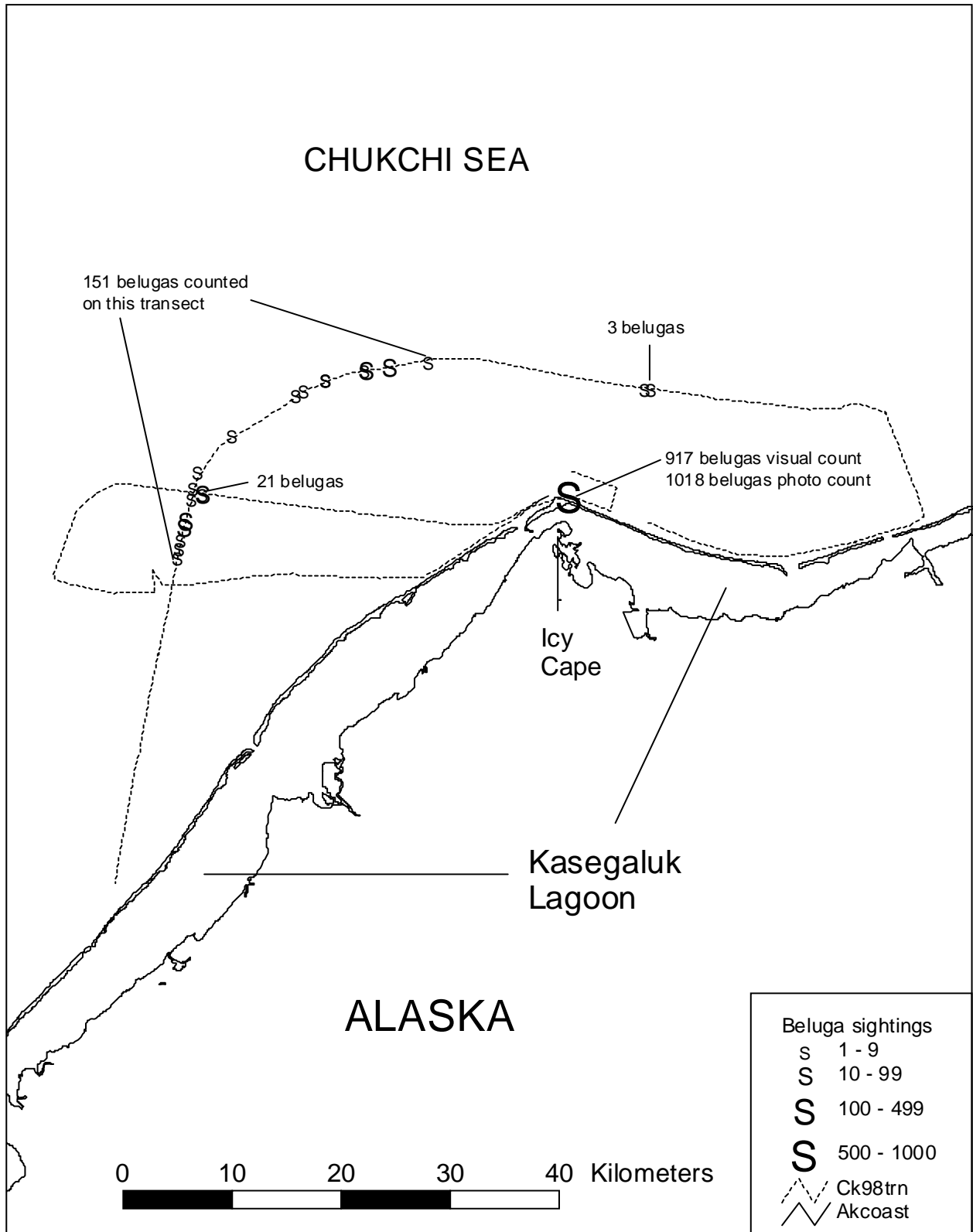


Figure 6. Map of the Kasegaluk Lagoon area showing flight lines and beluga sightings made during ABWC aerial surveys conducted on 6 July 1998.

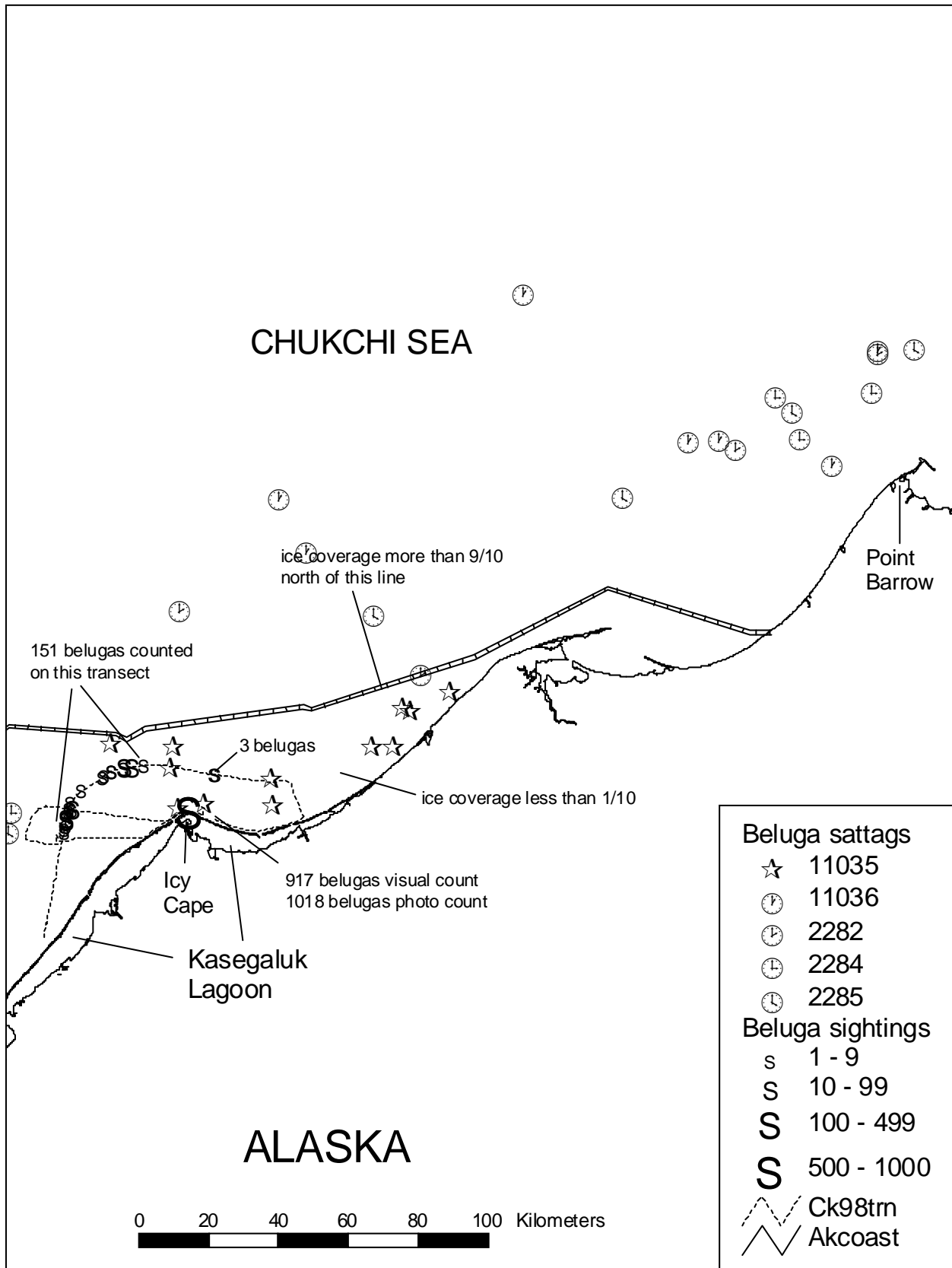


Figure 7. Map of the northeastern Chukchi Sea showing flight lines and beluga sightings made on 6 July 1998, and the average locations of five satellite tagged beluga whales on 6 July (numbers in circles).