

Final

**Aerial Surveys of Polar Bears Along the Coast and Barrier Islands of the Beaufort
Sea, Alaska,
September – October 2001**

by
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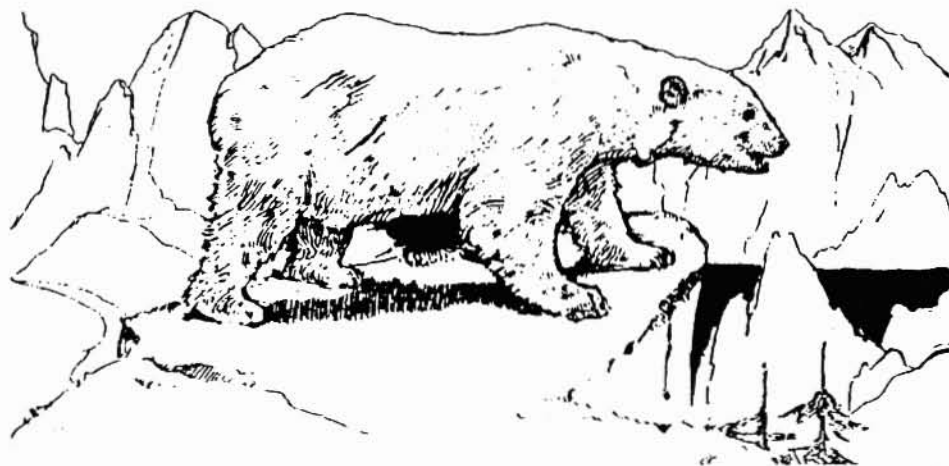


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INTRODUCTION

The Northstar Project includes construction of the first off-shore oil production facility incorporating sub-sea pipeline technology in arctic North America. It is operated by BP Exploration (Alaska) Inc. (BP) and located approximately six miles off-shore from Point Storkersen in the Alaskan Beaufort Sea, northwest of Prudhoe Bay. In February 1999, the U.S. Army Engineer District, Alaska, completed the *Final Environmental Impact Statement, Beaufort Sea Oil and Gas Development/Northstar Project* (Northstar EIS). The Northstar EIS identified potential effects of development and production of the Northstar Unit on the surrounding environment, as well as stipulations to mitigate for potential effects on biological resources, including polar bears (*Ursus maritimus*). Lease stipulation #7 states:

“Operators [are] required to conduct resource surveys if biological populations or habitats that may require additional protection are identified...”

Special condition #14 of the U.S. Army Corps of Engineers permit for the Northstar Project states:

“The permittee shall conduct or support studies to address the following: ...(c) conduct aerial surveys to determine the distribution of polar bears on barrier islands and along the coast within the Project Area during August through October. Study objectives, designs, and methods will be developed by the U. S. Fish and Wildlife Service (Marine Mammals Management), the U. S. Geological Survey (Biological Resources Division), and the permittee, in coordination with the Corps of Engineers.”

The range of the southern Beaufort Sea population of polar bears extends from near Point Hope, Alaska, to Cape Bathurst, Canada (Figure 1). Polar bear distribution is primarily related to sea ice and prey availability (Lentfer 1972). During fall and winter months polar bears often travel along the Beaufort Sea coast and barrier islands between feeding locations or to search for denning areas. Polar bear aggregations may occur in areas of high seal availability (Stirling et al. 1981, Stirling 1980) and have also been observed at bowhead whale (*Balaena mysticetus*) carcass sites at Barter Island and Cross Island, Alaska (U.S. Fish and Wildlife Service unpublished data, Kalxdorff 1997). Bowhead whale remains on these islands are believed to serve as attractants for polar bears visiting coastal areas in the fall.

Scientific observations and anecdotal information from local North Slope residents and workers indicate that use of coastal areas along the Beaufort Sea in Alaska by polar bears has increased in recent years (Amstrup 2000). Amstrup and Gardner (1994) and Stirling and Andriashek (1992) noted increased use of mainland terrestrial denning habitat by female polar bears over the last decade. The demographics of polar bears present on land during the fall open water period are unknown. In 2000, the U.S. Fish and Wildlife Service (FWS) initiated a three-year study to document polar bear distribution along the Beaufort Sea coast and barrier islands. Aerial surveys for the first year of the study were

conducted during the fall open water period of 2000; survey results are available from the FWS Marine Mammals Management Office, Anchorage, Alaska (Schliebe et. al. 2001). This report summarizes findings from surveys flown during the fall open water period in 2001.

OBJECTIVES

The purpose of conducting aerial surveys is to determine the spatial and temporal distribution and abundance of polar bears using coastal habitats and barrier islands during the open water period prior to fall freeze-up. Documenting the number, sex, and age classes of polar bears using coastal habitat will: 1) increase understanding of the ecological significance of these areas to polar bears; 2) provide information useful for assessing the effects of various on- and off-shore exploration and production activities on polar bears; and 3) provide information for developing oil spill contingency plans, bear/human interaction plans, and for implementing better strategies related to human activities in polar bear habitat.

METHODS

The FWS, in cooperation with BP and LGL Alaska Research Associates Inc. (LGL), initiated the second year of aerial surveys along the Beaufort Sea coastline and barrier islands in Alaska after FWS was notified that polar bears were present in the survey area (September 19, 2001). Surveys were continued weekly until freeze-up occurred and polar bears began to disperse to off-shore marine habitats (October 17, 2001). The study (survey) area included the southern Beaufort Sea coastline and barrier islands between Atigaru Point (in Harrison Bay) and Jago Spit (east of Kaktovik, Barter Island), a survey distance of approximately 732 km (Figure 2).

A turbine Aero Commander aircraft operated by Commander Northwest Limited was used for all survey flights. Surveys were flown parallel to and slightly off-set from barrier islands and the mainland shoreline at an elevation of 70-170 m (200 – 500 ft) and a speed of 90-110 knots. The crew consisted of two pilots and four observers. Two front seat observers and two rear seat observers collected data; the front left seat observer was the primary observer. The right front or rear seat observer recorded all survey data, including wildlife sightings, weather conditions, flight start/end points, and time of each event (Appendix I).

Pilots flew along the coastline until notified by an observer of a polar bear sighting, then circled the animal(s) while observers collected accurate counts. Observers attempted to identify the number, age, and sex of the observed animal(s). Sightings of more than one animal (a group) included females with dependent young, and any combination of adult, sub-adult, or unknown age/sex bears within 50 m of each other.

A global positioning system recorded the position of the aircraft at 15 second intervals. At the end of each survey, flight tracks and survey data were entered into a Microsoft Access database and time linked.

The location, number, and sex/age classes of observed bears were summarized in tables using WordPerfect 9 software. Maps were created using Arc View 3.1 software. Polar bear encounter frequencies, defined as the number of polar bears encountered per survey km flown, were computed for the following areas: 1) Atigaru Point to Prudhoe Bay; 2) Prudhoe Bay to Brownlow Point; 3) Brownlow Point to the western tip of Barter Island; and 4) Barter Island to Jago Spit. These areas were determined by flight start/end points which, in turn, were determined by the presence of easily recognizable geographic features.

“Habitat types” were classified as: barrier island, mainland, shore-fast ice, or open water. Barter and Tigvariak Islands were included as mainland for purposes of these analyses because of their proximity and physical similarity to the mainland, versus the barrier islands that typically occur farther off-shore, and are long and narrow in form.

RESULTS

Five surveys were flown along the southern Beaufort Sea coastline and barrier islands on September 19, September 26, October 3, October 10, and October 17, 2001. Flight distance averaged 683 km/survey; distance among surveys varied due to weather conditions, ice conditions, and slight deviations in the survey routes. During all flights, the larger barrier islands (Thetis, Pingok, Cross, and Flaxman) were circled to obtain full survey coverage.

Flights were divided into the following legs: 1) Prudhoe Bay (start at Reindeer Island) east along the barrier islands (Argo, Cross, Narwhal, Jeanette, Karluk, Pole, Challenge, Alaska, Duchess, North Star and Flaxman) to Barter Island (including Bernard Spit and Jago Spit); 2) Barter Island to Prudhoe Bay along the mainland (including Arey and other small un-named barrier islands, and Tigvariak Island); 3) Prudhoe Bay to Atigaru Point along the mainland; and 4) Atigaru Point (start at Thetis Island) to Prudhoe Bay along the barrier islands (Thetis, Spy, Leavitt, Pingok, Bodfish, Cottle, Long, Egg, and Stump; end at Stump Island). Deadhead (commuting versus surveying) portions occur between Flaxman and Barter Islands, and between Atigaru Point and Thetis Island.

The amount of open water and ice varied among surveys (see Appendix III-VII); during the initial survey on September 19, approximately 75% of the ocean area within the study area was classified as open water and by the final survey on October 17, less than 5% of the ocean area was classified as open water.

September 19, 2001 survey: Heavy fog and poor weather conditions resulted in poor visibility and an incomplete survey; therefore survey results from this day were excluded from data analysis. Observers noted no bears and very few tracks in the survey area

during visible portions of the flight, most of which were east along the barrier islands and mainland between Prudhoe Bay and Barter Island.

September 26, 2001 survey: Visibility was fair throughout the survey; heavy snow cover on the barrier islands may have caused observers to miss sighting some polar bears. The survey was initiated in Prudhoe Bay and flown east to Barter Island along the barrier islands with return along the mainland. After re-fueling, the survey was flown from Prudhoe Bay toward Atigaru Point west along the mainland with return along the barrier islands.

October 3, 2001 survey: Good visibility prevailed throughout the survey, which was initiated at Thetis Island and flown east to Prudhoe Bay. After re-fueling, the survey was flown from Prudhoe Bay to Barter Island along the barrier islands with return along the mainland. After a second re-fueling, the survey was flown from Prudhoe Bay toward Atigaru Point along the mainland.

October 10, 2001 survey: Fair to good visibility was encountered. The survey route was the same as flown on October 3, 2001.

October 17, 2001 survey: Diminished daylight and poor observer conditions precluded survey of the mainland between Prudhoe Bay and Atigaru Point. Otherwise, the survey route was the same as flown on October 3, 2001; fair observer conditions were encountered.

Due to poor survey conditions, results from the September 19, 2001 were not included in results. During the remaining surveys, a total of 97 polar bears were observed over 2732 survey km. The distribution of polar bears observed during each survey is illustrated in Figures 3-7 and described in Tables 1-4. Polar bear distribution varied among surveys; some areas, however, were consistently utilized by polar bears. We observed polar bears in the vicinity of Cross Island, Bernard Spit, and Jago Spit during every survey.

A summary of the age and sex composition of observed bears is described in Table 5. Of the 97 bears observed, approximately 20% were adult females, 3% were adult males, 14% were yearlings, 16% were cubs of the year, 8% were adults of unknown sex, and 39% were bears of unknown sex or age. No sub-adults were identified. Family groups (adult females with dependent young) comprised approximately 50% of the total number of animals sighted.

Table 6 describes the frequency rate of observing (encountering) polar bears along the survey route. During the September 26, 2001 survey, two polar bears were incidentally sighted in Camden Bay while commuting over open water between Flaxman and Barter Islands these sightings were not included in frequency rate estimate. The Barter Island to Jago Spit area had the highest encounter rate ($x = 0.17$ bears/ survey km) and Atigaru Point to Prudhoe Bay had the lowest encounter rate ($x = 0.00$ bears/ survey km). The overall encounter rate was similar among all surveys ($x = .04, .03, .04,$ and $.03$ bears/ survey km, respectively).

Table 7 compares the habitat types used by the observed bears. During all surveys, 69% of all bears were observed on barrier islands, 19% were observed on shore-fast ice, 5% were observed in open water, 4% were observed on the mainland, and 3% were observed on ice floes. Since the amount of each habitat type available in the survey area has not been quantified, and the observer biases associated with observing bears in water versus on land has not been estimated, these data have limited utility in determining habitat preference of polar bears; rather they simply reflect polar bear habitat use observed during aerial flights.

Additional mammals observed during surveys are included: ringed seals (*Phoca hispida*), unknown species of seals, Arctic fox (*Alopex lagopus*), musk ox (*Ovibos moschatus*), and barren ground caribou (*Rangifer tarandus*) (Table 8).

DISCUSSION

The distribution and abundance of polar bears in 2001 varied among surveys, as did the presence and amount of shore-fast ice. Comparison of 2000 and 2001 results indicate that polar bears were less abundant throughout the study area in 2001 than in 2000. During both years, polar bears were most frequently observed between the Barter Island to Jago Spit portion of the survey route; however the density (frequency of observation) dropped from 0.65 bears/km in 2000 (Schliebe et al. 2001) to 0.17 bears/km in 2001. Reasons for the decrease are unknown but are likely related to differences in weather, ice, or observer conditions between surveys. In both years, the majority of bears were observed on barrier islands. In 2001, the relative amount of mainland use decreased and the relative amount of shore-fast ice use increased. The sex/age composition of observed bears appeared to be consistent between years, however the larger proportion of unidentified age/sex bears during 2001 make comparisons difficult. The percentage of animals observed in family groups decreased from approximately 54% in 2000 to approximately 50% in 2001.

Both the first year (Schliebe et. al. 2001) and second year aerial surveys indicate large numbers of polar bears aggregate around Barter Island and Cross Island. Remains from subsistence hunter-harvested bowhead whales on these islands may attract bears to these areas. The FWS is planning a study in 2002-2003 to investigate the ecological significance of hunter-harvested bowhead whale carcasses to polar bears at Barter Island and Cross Island.

An additional set of aerial surveys during the fall is necessary to compare polar bear distribution, abundance, sex/age composition, and habitat use among years. This set of surveys is planned for fall 2002 (and possibly 2003).

ACKNOWLEDGMENTS

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Special thanks to Dave Weintraub and Ralph Aiken of Commander Northwest Limited for the many hours of safe flying.

LITERATURE CITED

- Amstrup, S. C. 2000. Polar Bear. Pp. 133-157 in J. J. Truett and S. R. Johnson, eds., *The natural history of an Arctic oil field: development and the biota*. Academic press, Inc. New York. 299pp.
- Amstrup, S.C. and Gardner, G. 1994. Polar bear maternity denning in the Beaufort Sea. *Journal of Wildlife Management*, 58:1-10.
- Kalxdorff, S.B. 1997. Collection of local knowledge regarding polar bear habitat use in Alaska. U.S. Fish and Wildlife Service Technical Report MMM 97-2, Anchorage, Alaska. 72pp.
- Lentfer, J. W. 1972. Polar bear – sea-ice relationships. Pages 165-171 in S. Herrero, ed. *Bears: their biology and management*. IUCN Publ. New Series 23.
- Schliebe, S.; Kalxdorff, S.; and Evans, T. 2001. Aerial surveys of polar bears along the coast and barrier islands of the Beaufort Sea, Alaska, September-October 2000. U. S. Fish and Wildlife Service Technical Report, Anchorage, Alaska. 23 pp.
- Stirling, I. 1980. The biological importance of polynyas in the Canadian Arctic. *Arctic*, 33:303-315.
- Stirling I.; Andriashek, D. and Calvert, W. 1981. Habitat preferences and distribution of polar bears in the western Canadian Arctic. Final report to Dome Petroleum Limited, Esso Resources Canada, Limited, and Canadian Wildlife Service. 49 pp.
- Stirling, I. and Andriashek, D. 1992. Terrestrial maternity denning of polar bears in the Eastern Beaufort Sea area. *Arctic* 45:363-366.

Table 1. Age/sex composition and location of polar bears observed during the September 26, 2001 survey. AF = Adult Female; AM = Adult Male; SA = Sub-adult (2.5-5 year old); YEAR = Yearling (1 – 2.5 year old); COY = cub of the year (<1 year old); UA = Unidentified Adult (>5 years old); and Unknown = unknown age or sex animal.

Sighting Number	Number of Polar Bears	Age/Sex Composition	Location
1	2*	1 AF with 1 YEAR	Ice floe in Camden Bay
2	1	1 Unknown	Bernard Spit
3	3	1 AF with 2 COY	Bernard Spit
4	1	1 Unknown	Bernard Spit
5	2	2 Unknown	Bernard Spit
6	2	2 Unknown	Bernard Spit
7	3	1AF with 2 COY	Bernard Spit
8	1	1 AM	Bernard Spit
9	1	1 UA	Bernard Spit
10	2	1AF with 1 YEAR	Jago Spit
11	1	1 Unknown	Jago Spit
12	1	1 Unknown	Jago Spit
13	1	1 Unknown	Jago Spit
14	1	1 Unknown	Jago Spit
15	1	1 Unknown	Mainland near Manning Point
16	1	1 UA	Arey Island
17	1	1 UA	Arey Island
18	2	1 AF with 1 COY	Barrier island near Konganevik Point
19	1	1 AM	Tigvariak Island
20	1	1 Unknown	Ice floe near Thetis Island
Total	29	5AF, 2 AM, 2 YEAR, 5 COY, 3 UA, 12 Unknown	

* This sighting is not included in frequency rate (density) estimates because it was not part of the survey effort; rather, it was made incidentally during a commute between Flaxman and Barter Islands.

Table 2. Age/sex composition and location of polar bears observed during the October 3, 2001 survey. AF = Adult Female; AM = Adult Male; SA = Sub-adult (2.5-5 year old); YEAR = Yearling (1 – 2.5 year old); COY = cub of the year (<1 year old); UA = Unidentified Adult (>5 years old); and Unknown = unknown age or sex animal.

Sighting Number	Number of Polar Bears	Age/Sex Composition	Location
1	2	1 AF with 1 YEAR	Leavitt Island
2	1	1 Unknown	Cross Island
3	2	1 AF with 1 YEAR	Cross Island
4	1	1 Unknown	Flaxman Island
5	3	1AF with 2 COY	Bernard Spit
6	1	1 Unknown	Bernard Spit
7	1	1 Unknown	Bernard Spit
8	1	1 Unknown	Bernard Spit
9	1	1 Unknown	Open water off Bernard Spit
10	3	1 AF with 2 YEAR	Open water off Bernard Spit
11	2	1 AF with 1 YEAR	Jago Spit
12	1	1 Unknown	Jago Spit
13	1	1 UA	Open water near Brownlow Point
14	2	1 AM and 1 UA	Mainland near mouth of Sagavanirktok River
Total	22	5 AF, 1 AM, 5 YEAR, 2 COY 2 UA, 7 Unknown	

Table 3. Age/sex composition and location of polar bears observed during the October 10, 2001 survey. AF = Adult Female; AM = Adult Male; SA = Sub-adult (2.5-5 year old); YEAR = Yearling (1 – 2.5 year old); COY = cub of the year (<1 year old); UA = Unidentified Adult (>5 years old); and Unknown = unknown age or sex animal.

Sighting Number	Number of Polar Bears	Age/Sex Composition	Location
1	3	1 AF with 2 COY	Cross Island
2	1	1 Unknown	Shore-fast ice off Cross Island
3	3	1 AF with 2 YEAR	Cross Island
4	3	1 AF with 2 COY	Shore-fast ice off Cross Island
5	1	1 Unknown	Cross Island
6	1	1 Unknown	Flaxman Island
7	3	1 AF with 2 COY	Bernard Spit
8	1	1 Unknown	Bernard Spit
9	5	2 UA, 1AF with 2 YEAR	Bernard Spit
10	4	2 Unknown, 1AF with 1 YEAR	Jago Spit
11	2	1 AF with 1 YEAR	Jago Spit
12	1	1 UA	Jago Spit
13	1	1 Unknown	Jago Spit
14	1	1 Unknown	Shore-fast ice near Jago Spit
Total	30	7 AF, 6 YEAR, 6 COY, 3 UA, 8 Unknown	

Table 4. Age/sex composition and location of polar bears observed during the October 17, 2001 survey. AF = Adult Female; AM = Adult Male; SA = Sub-adult (2.5-5 year old); YEAR = Yearling (1 – 2.5 year old); COY = cub of the year (<1 year old); UA = Unidentified Adult (>5 years old); and Unknown = unknown age or sex animal.

Sighting Number	Number of Polar Bears	Age/Sex Composition	Location
1	2	1 Unknown	Shore-fast ice near Cross Island
2	3	1AF with 1YEAR, 1 Unknown	Shore-fast ice near Cross Island
3	3	1AF with 2 COY	Bernard Spit
4	1	1 Unknown	Shore-fast ice near Bernard Spit
5	1	1 Unknown	Shore-fast ice near Bernard Spit
6	1	1 Unknown	Shore-fast ice near Jago Spit
7	1	1 Unknown	Shore-fast ice near Jago Spit
8	1	1 Unknown	Shore-fast ice near Jago Spit
9	1	1 Unknown	Shore-fast ice near Jago Spit
10	1	1 Unknown	Shore-fast ice near Jago Spit
11	1	1 Unknown	Shore-fast ice near Jago Spit
Total	16	2 AF, 1 YEAR, 2 COY, 11 Unknown	

Table 5. Age and sex composition of polar bears sighted during aerial surveys along the coast and barrier islands of the Beaufort Sea, Alaska, September – October 2001. Adult animals = >5 years old; Sub-adult = 2.5 – 5 years old; Yearling = 1 – 2.5 years old; Cub of the Year = < 1 year old; Other Unknown = unknown age or sex class.

Survey Date	Age Class							Total Observed
	Adult Female	Adult Male	Sub-adult	Yearling	Cubs of the Year	Adults of Unknown Sex	Other Unknown	
09-26-01	5	2	0	2	5	3	12	29
10-03-01	5	1	0	5	2	2	7	22
10-10-01	7	0	0	6	6	3	8	30
10-17-01	2	0	0	1	2	0	11	16
Total	19	3	0	14	15	8	38	97

Table 6. Frequency rate of polar bears observed during aerial surveys along the coast and barrier islands of the Beaufort Sea, Alaska, September – October 2001. Flight distances varied due to presence of fog, shore-fast ice, and slight deviations in survey routes.

Survey Date	Number of Polar Bears Observed/Survey Kilometer				
	Atigaru Point to Prudhoe Bay (~ 276 km)	Prudhoe Bay to Brownlow Point (~ 263 km)	Brownlow Point to Barter Island (~ 102 km)	Barter Island to Jago Spit (~ 91 km)	Average/survey
09-26-01	1/271 = .00	1/268 = .00	4/112 = .04	21/92 = .23	27/743 = .04
10-03-01	2/287 = .01	7/264 = .03	0/101 = .00	13/90 = .14	22/742 = .03
10-10-01	0/269 = .00	12/259 = .05	0/102 = .00	18/90 = .20	30/720 = .04
10-17-01	0/83 = .00	5/261 = .02	0/93 = .00	11/90 = .12	16/527 = .03
Average/Segment	3/910 = .00	25/1052 = .02	4/408 = .01	63/362 = .17	

Table 7. Habitat types used by polar bears observed during aerial surveys along the coast and barrier islands of the Beaufort Sea, Alaska, September – October 2001. Barter and Tigvariak Islands were included as “mainland” for purposes of these analyses because of its proximity and physical similarity to mainland, versus the barrier islands which typically occur further off-shore and are longer and narrow in form. The amount of habitat type available in the survey area has not been quantified.

Survey Date	Barrier Island	Mainland	Shore-fast Ice	Ice Floe	Open Water
09-26-01	24	2	0	3	0
10-03-01	15	2	0	0	5
10-10-01	25	0	5	0	0
10-17-01	3	0	13	0	0
Total	67	4	18	3	5

Table 8. Additional mammals observed during aerial surveys along the coast and barrier islands of the Beaufort Sea, Alaska, September – October 2001.

Species	09-19-01	09-26-01	10-03-01	10-10-01	10-17-01
Ringed Seal	0	0	8	5	12
Unknown Seal	5	13	0	0	0
Arctic Fox	0	1	1	0	1
Musk Ox	0	0	21	0	0
Caribou	0	0	6	209	0

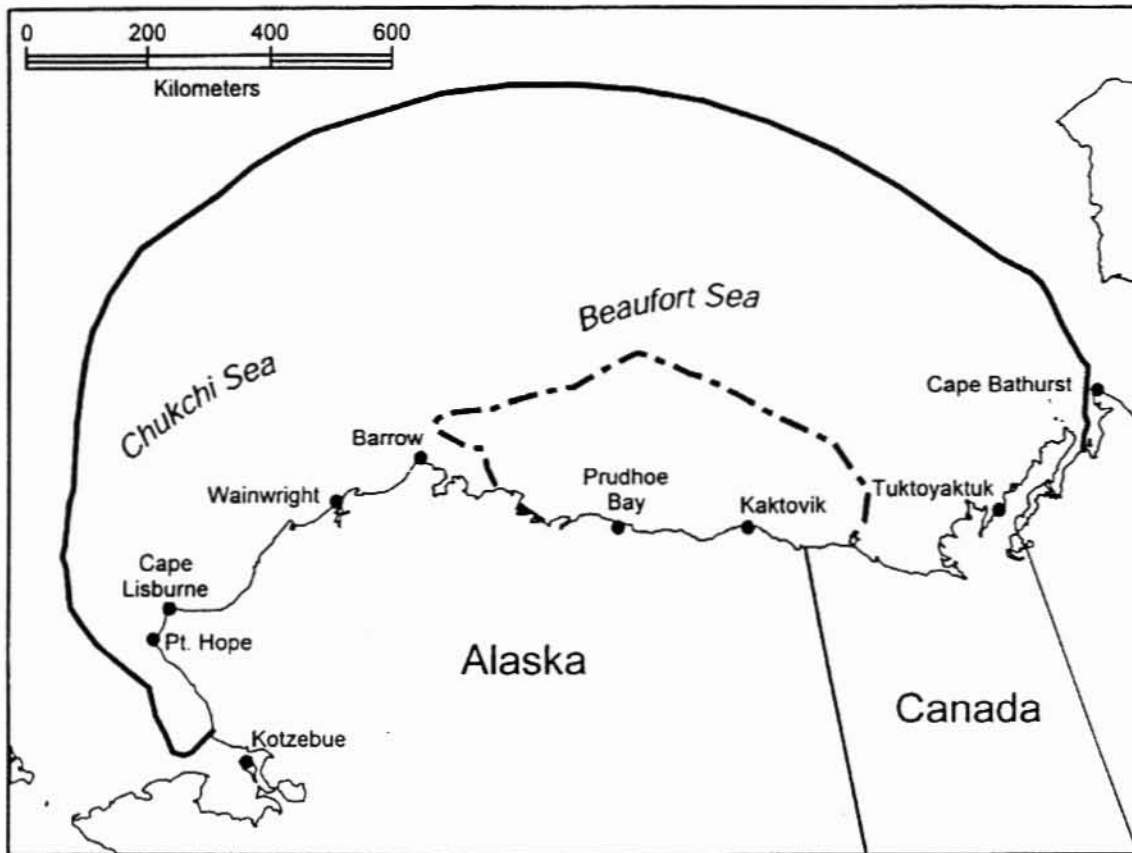


Figure 1. Approximate boundary of the Beaufort Sea polar bear population (solid line) and core activity are (dotted line) as determined by harmonic mean analysis of satellite radiotelemetry data collected during 1985-1993 (Amstrup 2000).

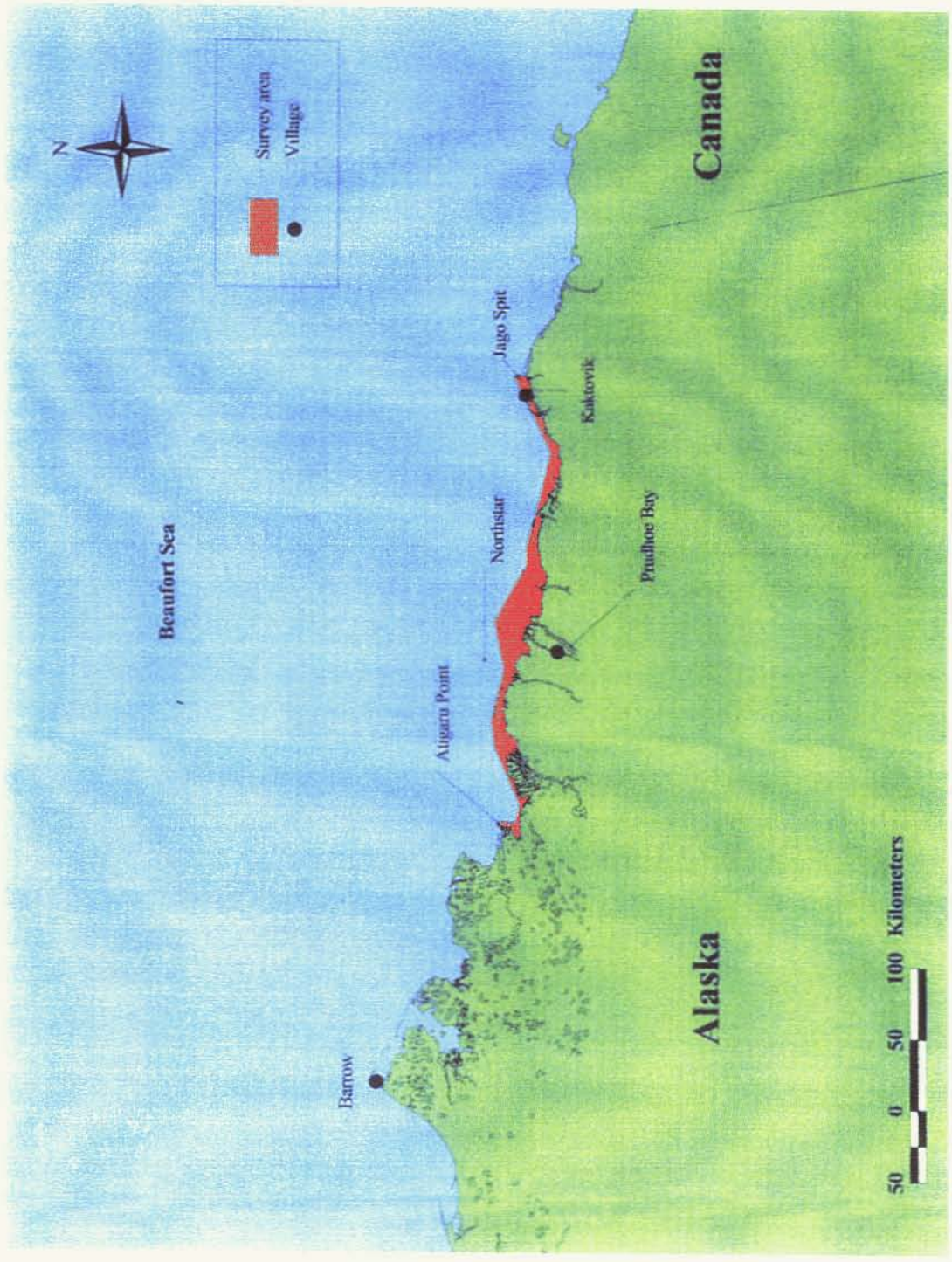


Figure 2. Survey area for aerial polar bear surveys conducted in September/October, 2001.

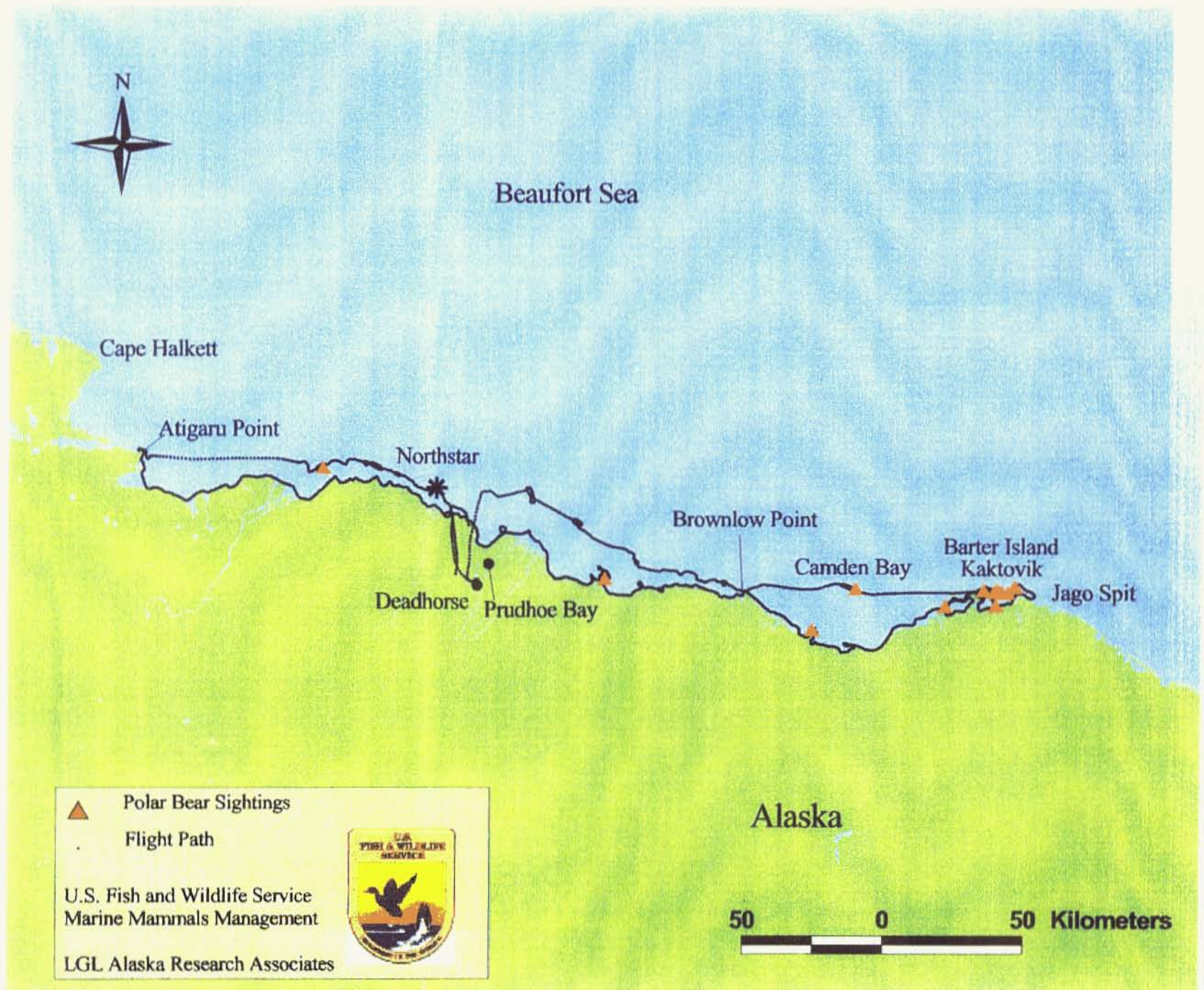


Figure 3. Polar bears observed during an aerial survey conducted along the coast and barrier islands of the Beaufort Sea, Alaska, September 26, 2001.



Figure 4. Polar bears observed during an aerial survey conducted along the coast and barrier islands of the Beaufort Sea, Alaska, October 3, 2001.



Figure 5. Polar bears observed during an aerial survey conducted along the coast and barrier islands of the Beaufort Sea, Alaska, October 10, 2001.

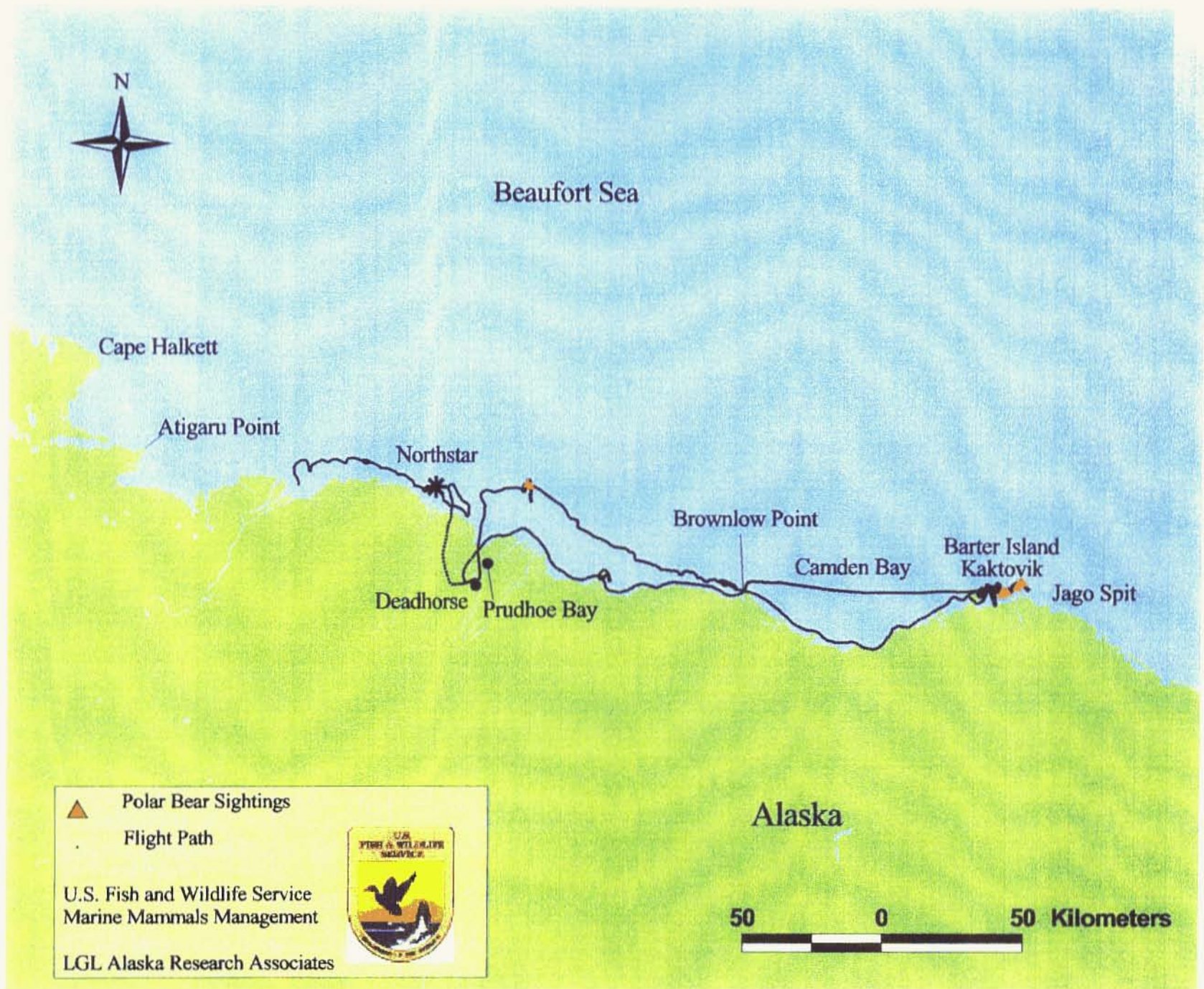


Figure 6. Polar bears observed during an aerial survey conducted along the coast and barrier islands of the Beaufort Sea, Alaska, October 17, 2001.

Appendix 1. Data Sheet and Survey Codes

FLIGHT DATA SHEET

LIGHT: _____ Aircraft: _____ N _____
 yyyy-mm-dd [A/B/C] [1/2] FAA#

A,B... = survey effort of day
 1,2 = aircraft in survey
 fill in when GPS is downloaded

Departure Time: _____
 Arrival Time: _____
 Flight Summary: _____

Survey Type: Independent Inline
 Aircraft Position: 1/1 1/2 2/2
 Target Survey Altitude: _____ feet
 Target Ground Speed: _____ knots

Entered	Error Checked
PAGE	OF
Crew	Role Data
_____	Pilot Right
_____	Pilot Left
_____	Mechanic ○
_____	RA RF LA LF ○
_____	RA RF LA LF ○
_____	RA RF LA LF ○

Time	Flight Mode	Observation	Count	Activity	Before	After	Ice Stage	Form	Observation Conditions	Visibility / Wx / Precip
:00:00	Fly	Polar Bear	Ist	Inactive	OO		Open Water	New Brush	Good/Fair/Poor	Mist
	Land	PB Track [old/new]		Walk	OO		Nilas	Pancake	Glare? ○	Drizzle
	Circle	Seal	Full	Run	OO		Young	Cake	Fog? ○	Rain
	Hover	Walrus		Eat	OO		First-Year	Belt Strip		Snow/Sleet
	Transect	Other		Swim	OO		Multi-Year	Floe: [S M L V G]		
ansect id: _____		Zone: 1 2 3 4 5 6 7 _____°					____%Ice cover ____%Snow cover		Max. Zone Visible: R 1 2 3 4 5 6 7 L 1 2 3 4 5 6 7	____% cloud C

:00:00	Fly	Polar Bear	Ist	Inactive	OO		Open Water	New Brush	Good/Fair/Poor	Mist
	Land	PB Track [old/new]		Walk	OO		Nilas	Pancake	Glare? ○	Drizzle
	Circle	Seal	Full	Run	OO		Young	Cake	Fog? ○	Rain
	Hover	Walrus		Eat	OO		First-Year	Belt Strip		Snow/Sleet
	Transect	Other		Swim	OO		Multi-Year	Floe: [S M L V G]		
ansect id: _____		Zone: 1 2 3 4 5 6 7 _____°					____%Ice cover ____%Snow cover		Max. Zone Visible: R 1 2 3 4 5 6 7 L 1 2 3 4 5 6 7	____% cloud C

:00:00	Fly	Polar Bear	Ist	Inactive	OO		Open Water	New Brush	Good/Fair/Poor	Mist
	Land	PB Track [old/new]		Walk	OO		Nilas	Pancake	Glare? ○	Drizzle
	Circle	Seal	Full	Run	OO		Young	Cake	Fog? ○	Rain
	Hover	Walrus		Eat	OO		First-Year	Belt Strip		Snow/Sleet
	Transect	Other		Swim	OO		Multi-Year	Floe: [S M L V G]		
ansect id: _____		Zone: 1 2 3 4 5 6 7 _____°					____%Ice cover ____%Snow cover		Max. Zone Visible: R 1 2 3 4 5 6 7 L 1 2 3 4 5 6 7	____% cloud C

:00:00	Fly	Polar Bear	Ist	Inactive	OO		Open Water	New Brush	Good/Fair/Poor	Mist
	Land	PB Track [old/new]		Walk	OO		Nilas	Pancake	Glare? ○	Drizzle
	Circle	Seal	Full	Run	OO		Young	Cake	Fog? ○	Rain
	Hover	Walrus		Eat	OO		First-Year	Belt Strip		Snow/Sleet
	Transect	Other		Swim	OO		Multi-Year	Floe: [S M L V G]		
ansect id: _____		Zone: 1 2 3 4 5 6 7 _____°					____%Ice cover ____%Snow cover		Max. Zone Visible: R 1 2 3 4 5 6 7 L 1 2 3 4 5 6 7	____% cloud C

SURVEY CODES

LIGHT INFORMATION	SIGHTING INFORMATION		OBSERVER CONDITIONS
<p>Flight ID Assign when the GPS tracklog is downloaded, using the format: yyy-mm-dd-[A/B/C]-[1/2] where A, B, C ... = sequential survey effort of day 1 or 2 = aircraft position in survey.</p> <p>Aircraft Note model of aircraft and FAA number.</p> <p>Departure and Arrival Time Time of sighting in 24 hour clock (hh:mm:ss) synchronized with GPS in GMT -8 (summer), -9 (daylight savings time).</p> <p>Survey Type Independent = one aircraft flying in independent survey effort In-line = two aircraft flying survey effort in line.</p> <p>Aircraft Position /1 = aircraft flying independent survey /2 = first aircraft flying in-line survey /2 = second aircraft flying in-line survey.</p> <p>Crew Last name of each participant, their role, and who maintained the datasheet</p> <p>Pilot (right and/or left) Mechanic LF = Left Forward Observer LA = Left Aft Observer RF = Right Forward Observer RA = Right Aft Observer.</p> <p>Check Data next to data recorder's name.</p>	<p>Time Time of sighting in 24 hour clock (hh:mm:ss) synchronized with GPS in GMT -8 (summer) or -9 (daylight savings time).</p> <p>Flight Mode Circle each change in flight mode: Fly = aircraft in flight, not on survey Land = aircraft lands on ground, ice or ship Circle = aircraft leaves transect line to circle polar bear group and verify count Hover = aircraft ceases forward movement while in the air Transect = aircraft begins survey transect (record transect number).</p> <p>Observation Circle observation type. Note whether polar bears tracks are old or new. Note species as follows: ARFO = Arctic Fox BESE = Bearded Seal BEWH = Beluga Whale BOWH = Bowhead Whale GRWH = Gray Whale RBSE = Ribbon Seal RISE = Ringed Seal SPSE = Spotted Seal UNWH = Unidentified Whale</p> <p>Other = note kill sites and additional observations.</p> <p>Initial and Full Counts Note number(s) of polar bears initially observed (1st) and number(s) observed at completion of circle (Full).</p> <p>Zone/Angle Note zone in which polar bear(s) was observed. Record angle of sighting.</p>	<p>Activity Check polar bear activity when first sighted and when circling of bear is completed.</p> <p>1st Observer Note role of person who first made the observation. If only observed by video camera, make a new entry at the end of the flight datasheet and note "Video Camera" as the observer.</p> <p>Notes Add additional information in the space below each event entry.</p> <p>ICE CONDITIONS</p> <p>Ice Stages and Forms Circle stages and forms that are present (see attached definitions).</p> <p>Ice and Snow Cover Record to nearest 10%.</p>	<p>Visibility Note overall visibility as: Good = 100% of survey area from aircraft to horizon is completely visible to both observers with no interference from glare, fog, precipitation, etc. Fair = 75-100% " " Poor = 50-75% " "</p> <p>Glare and Fog Check if present.</p> <p>Precipitation Note as follows: Mist = water floating in the atmosphere as a fine spray Drizzle = water falling lightly in the atmosphere in small droplets Rain = water falling steadily in the atmosphere Snow/sleet = large droplets of precipitation in the form of crystals formed from freezing water.</p> <p>Zone Note maximum zone of visibility for both right and left observers.</p>

DEFINITIONS OF ICE STAGES

Modified from *Observer's Guide to Sea Ice*, prepared by the University of Alaska Anchorage, School of Engineering for the National Oceanic and Atmospheric Administration. For copies of this document, send e-mail request to library@hazmat.noaa.gov or fax your request to 206-6-4442.

New: ice in one of the following stages of formation:

- a) **Frazil:** separate fine needles or plates suspended in water
- b) **Grease:** a thin soapy-looking surface layer of coagulated frazil ice
- c) **Slush:** snow mixed with water in a viscous surface layer
- d) **Shuga:** an accumulation of spongy white lumps

Nilas: a thin elastic crust of ice, less than 10 cm (4 in) thick; easily bends on waves, often has striped or chevron appearance

Young: Ice 10-30 cm (4-12 in) thick in one of the following stages:

- a) **Gray:** young ice 10-15 cm (4-6 in) thick; less elastic than Nilas; breaks on swell and rafts (one layer over another) under pressure
- b) **Gray-White:** young ice 15-30 cm (6-12 in) thick, that buckles to form ridges on its edges from pressure or collisions

First-year ice: sea ice that, in uniform level areas without ridges or other deformations, is 30 cm - 1.2 m thick (12 in - 4 ft)

- a) **First-year thin:** Sea ice that, in uniform level areas without ridges or other deformations is 30-70 cm (12-27 in) thick
- b) **First-year medium:** sea ice 70-120 cm (27-48 in) thick
- c) **First-year thick:** sea ice over sea ice over 1.2 m (4 ft) thick

Old or multi-year: sea ice 3 m (10 ft) thick or more that has survived at least one melting season; characterized by undulating, weathered edges and a well-defined melt water drainage pattern.

DEFINITIONS OF ICE FORMS

New: small thin newly formed dinner plate-sized pieces

Brash: broken pieces less than 2 m (6 ft) across

Pancake: rounded floes 30 cm - 3 m (1-10 ft) across with ridged rims

Cake: level piece 3-20 m (6-65 ft) across

Floe Ice: level pieces ranging in size from 20 m to > 10 km

- a) **Small floe:** level piece 20-100 m (65-328 ft.) across
- b) **Medium floe:** level continuous piece 100-500 m (328-1640 ft) across
- c) **Big floe:** level continuous piece 500 m 2 km (1/3-1 mi) across
- d) **Vast floe:** level continuous piece 2-10 km (1-6 mi) across
- e) **Giant floe:** level continuous piece greater than 10 km (6 mi) across

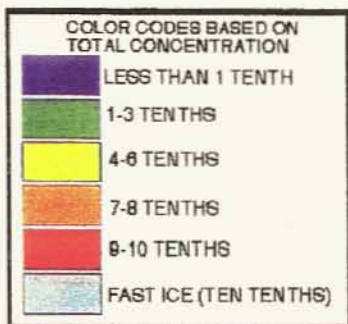
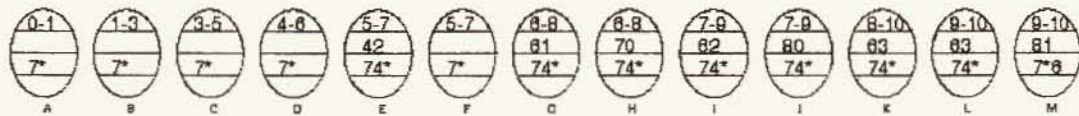
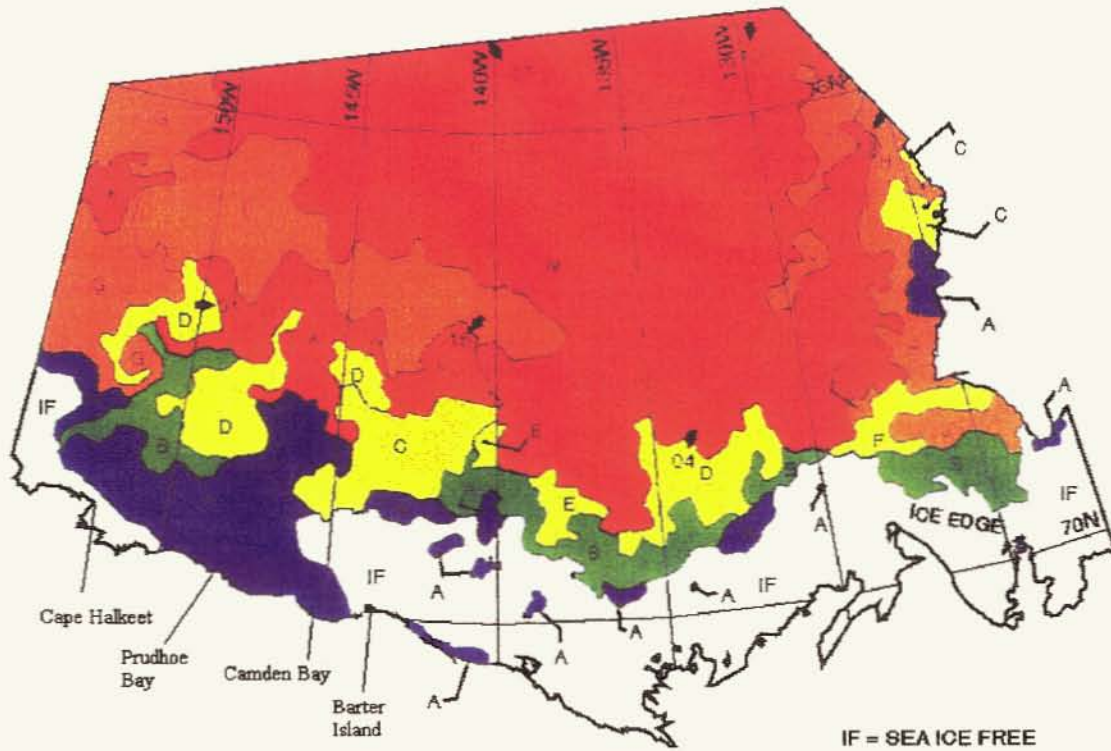
Strip: a linear accumulation of sea ice less than 1 km (0.6 mi) wide

Belt: a linear accumulation of sea ice from 1 km to over 100 km (0.6-60 mi) wide

Beach Ice or Stamukhas: irregular, sediment-laden blocks that are grounded on tidelands, repeatedly submerged, and floated free by spring tides

Fast Ice: ice formed and remaining attached to shore

**Appendix II. Ice map for September 19, 2001. Map taken from
www.natice.noaa.gov.**

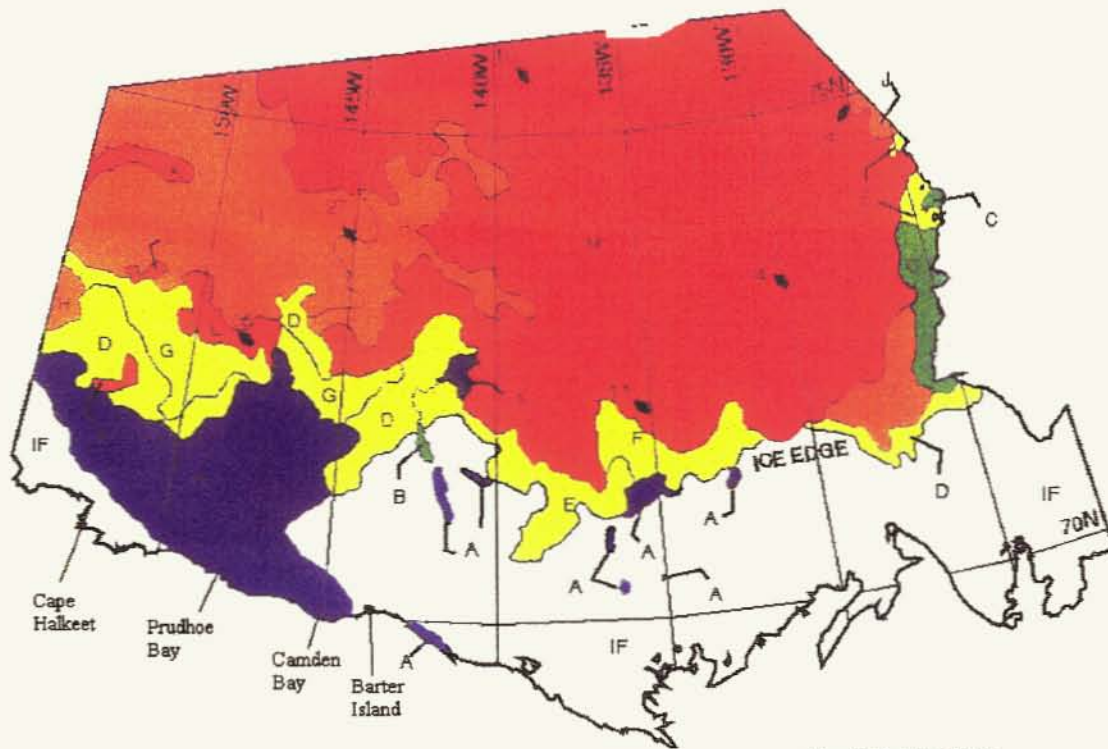


**ICE ANALYSIS
BEAUFORT
NATIONAL/NAVAL ICE CENTER
ANALYSIS WEEK: 17-21 SEP 2001**

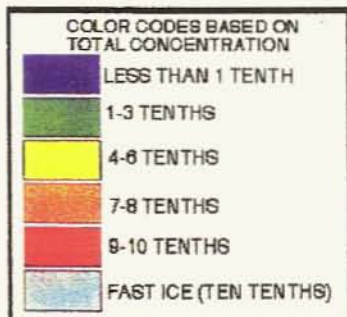
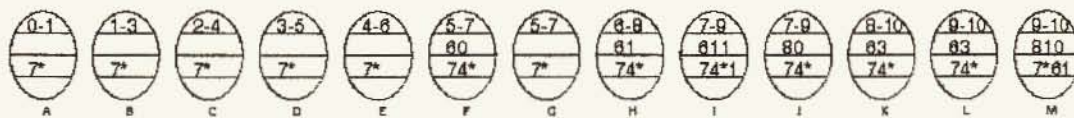
DATA SOURCES	DATE
RADARSAT	5-17 SEP

**ANALYST: CHRISTOPHER SZORC
UNCLASSIFIED**

**Appendix III. Ice map for September 26, 2001. Map taken from
www.natice.noaa.gov.**



IF = SEA ICE FREE

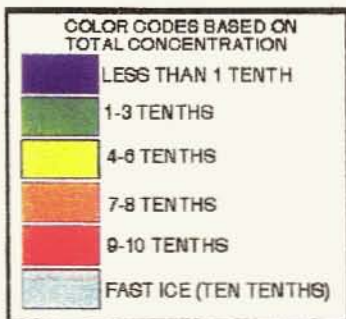
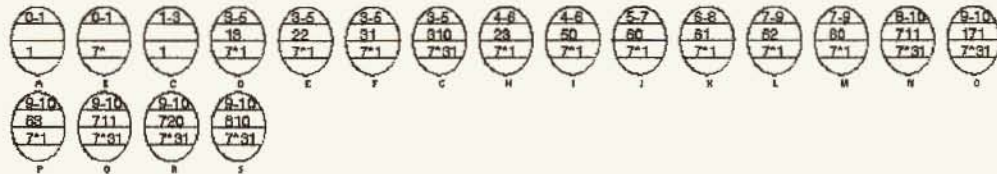
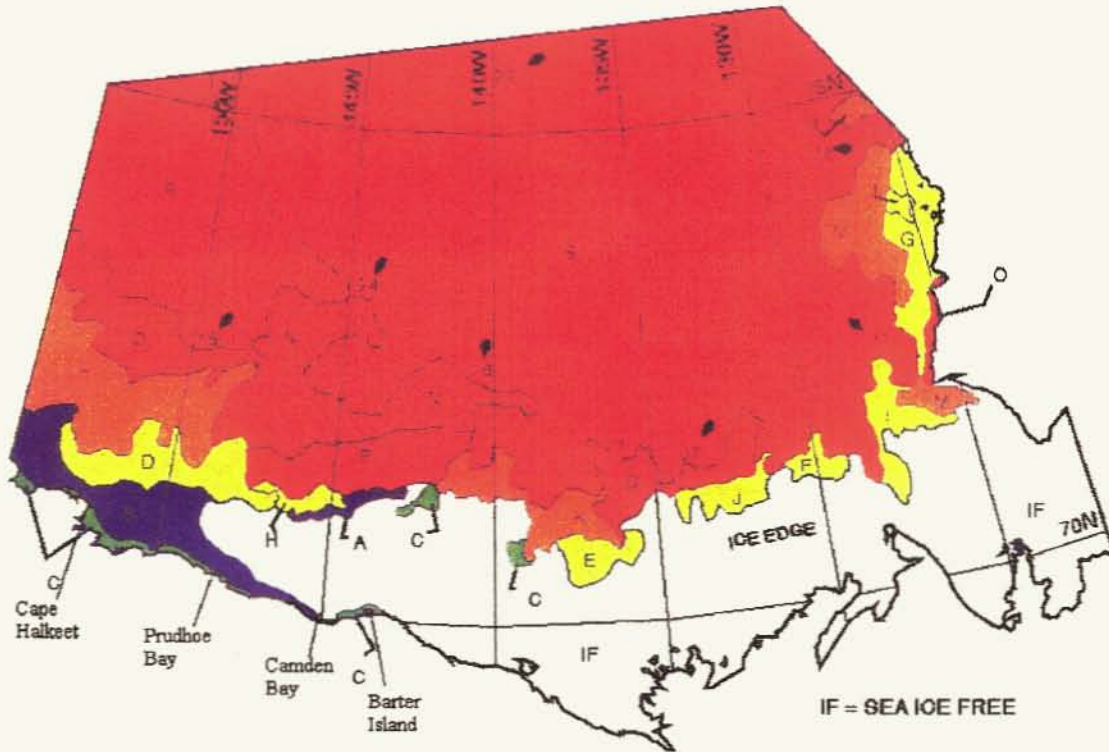


**ICE ANALYSIS
BEAUFORT
NATIONAL/NAVAL ICE CENTER
ANALYSIS WEEK: 24-28 SEP 2001**

DATA SOURCES: RADARSAT DATE: 22-24 SEP

ANALYST: CHRISTOPHER SZORC
UNCLASSIFIED

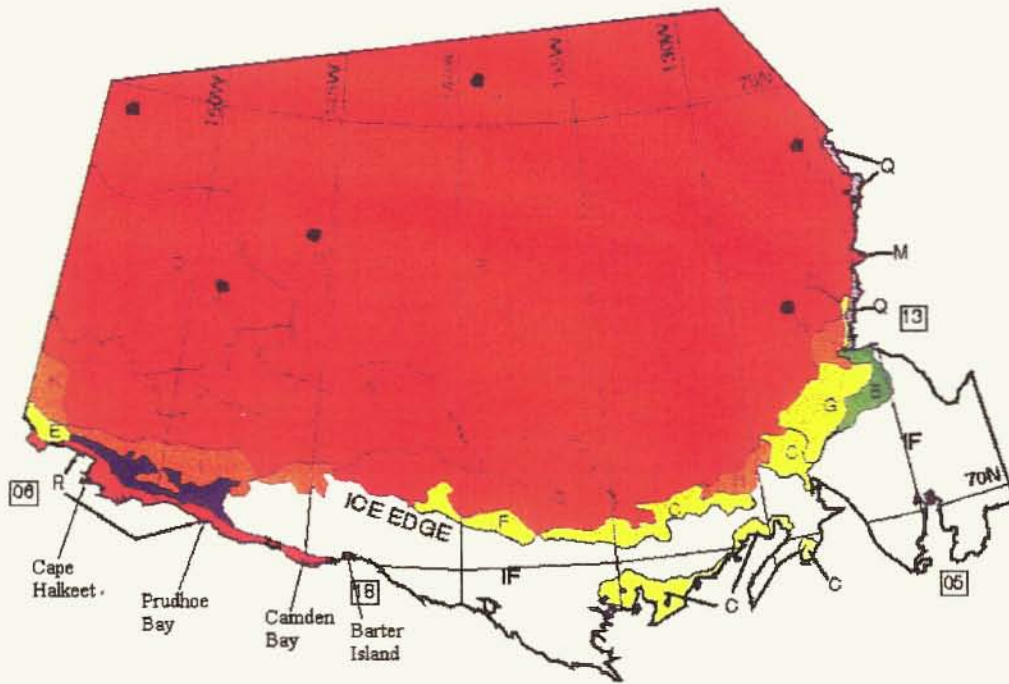
Appendix IV. Ice map for October 3, 2001. Map taken from www.natice.noaa.gov.



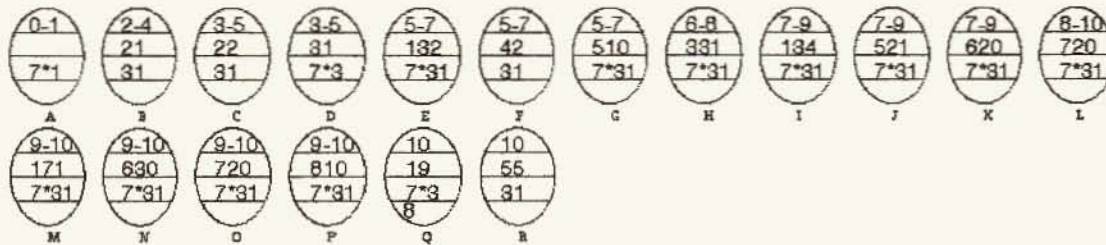
ICE ANALYSIS
BEAUFORT
NATIONAL/NAVAL ICE CENTER
 ANALYSIS WEEK: 01-05 OCT 2001
 DATA SOURCES DATE
 RADARSAT 29 SEP - 1 OCT

ANALYST: CHRISTOPHER SZORC
 UNCLASSIFIED

Appendix V. Ice map for October 10, 2001. Map taken from www.natice.noaa.gov.

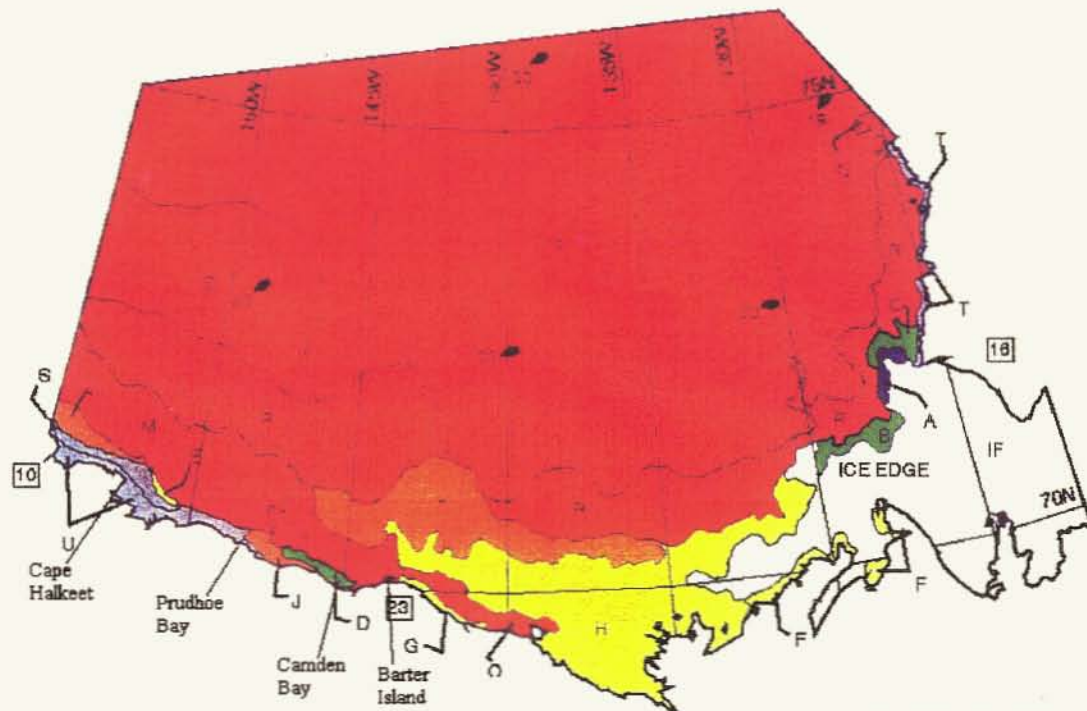


IF = SEA ICE FREE

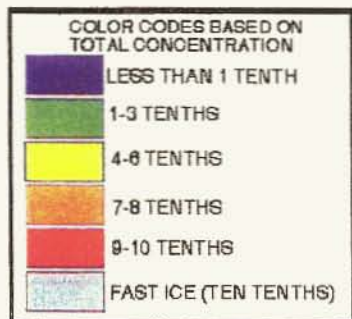
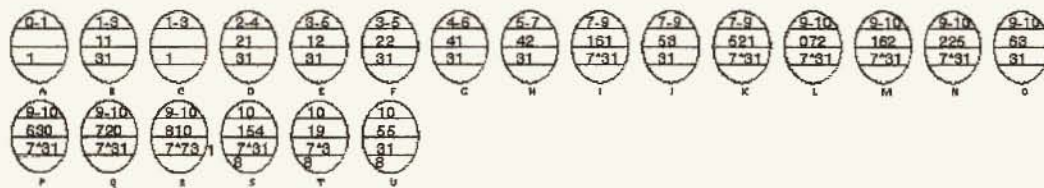


ICE ANALYSIS	
BEAUFORT	
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ANALYSIS WEEK: 08-12 OCT 2001	
DATA SOURCES	DATE
RADARSAT	6-9 OCT
ESTIMATED	9 OCT
ANALYST: CHRISTOPHER SZORC	
UNCLASSIFIED	

Appendix VI. Ice map for October 17, 2001. Map taken from www.natice.noaa.gov.



IF = SEA ICE FREE



**ICE ANALYSIS
BEAUFORT**
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 ANALYSIS WEEK: 15-19 OCT 2001
 DATA SOURCES: RADARSAT DATE: 14-16 OCT
 ANALYST: CHRISTOPHER SZORC
 UNCLASSIFIED