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DOCUMENTATION OF ICEBERG GROUNDINGS

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SUMMARY

The study provides a comprehensive documentation of iceberg groundings off Canada's east coast. Sophisticated criteria to identify and verify grounding events have been developed. A data base containing iceberg tracking data and related information has been compiled. The data base includes data on 2,728 icebergs tracked at well-site locations by drill-rig radars, 868 icebergs tracked by shore-based radars off Newfoundland and Labrador and in Baffin Bay, 40 icebergs tracked by satellite in Baffin Bay and the Labrador Sea for periods up to 309 days, and about 65,000 iceberg sightings reported by the International Ice Patrol (United States Coast Guard).

The frequency of iceberg groundings near the shore-based radar stations was much higher than that of icebergs grounded near the well-sites which are generally located in deeper water. The frequency of groundings at the well-sites varied from 0 to 18.8% with a mean value of 4.5%. Near the shore-based radar stations the mean frequency of grounding was 19.9% for the Saglek area and 16.4% for the Strait of Belle Isle. For a specific site the frequency of groundings varied widely from year to year.

Of the 40 icebergs tracked by satellite telemetry, only three were never grounded. The grounding durations were up to 100% of the tracking time with an average value of 47%. About half of the icebergs tracked by well-site and shore-based radars were grounded for periods of longer

than two days. The longest grounding duration was 31 days for the well-site data, and 295 days for icebergs tracked by satellite.

About 75% of the grounded icebergs had masses in the range one to 20 million tonnes. The largest iceberg grounded in the Labrador Sea had a mass of 25 million tonnes while a grounded iceberg in Baffin Bay was reported to have a mass of 54 million tonnes.

Since the identified grounding events took place during times and at places where icebergs were tracked, the grounding data provided in this report are valid only at these places and during these periods of time.

Very few grounding events could be identified in the Grand Banks area owing to the lack of adequate iceberg tracking data for this area.

RÉSUMÉ

Une étude d'ensemble sur l'échouage des icebergs sur la côte est du Canada est présentée. Des critères sophistiqués sont élaborés pour identifier et vérifier, à partir des trajectoires, l'occurrence de l'échouage. Un ensemble de données concernant les trajectoires des icebergs et autres informations pertinentes a été constitué: la banque de données comprend les trajectoires de 2,728 icebergs repérés par des radars montés à bord de plateformes de forage offshore, de 868 icebergs repérés par des radars terrestres sur la côte de Terre-Neuve, du Labrador et de la baie de Baffin, et enfin de 40 icebergs suivis par satellite depuis la baie de Baffin et de la mer du Labrador sur des périodes allant jusqu'à 309 jours. La banque de données comprend aussi des données ponctuelles sur environ 65,000 icebergs repérés par l'International Ice Patrol (Garde Côtiére, des États-Unis).

L'échouage des icebergs est beaucoup plus fréquent près des radars terrestres que près des puits de forage qui sont généralement situés dans des eaux plus profondes. Dans ce dernier cas, la fréquence moyenne des échouages près des puits varie entre 0 et 18.8%, la moyenne étant de 4.5%. Près des stations terrestres, la fréquence moyenne s'établit à 19.9% dans la région de Saglek et de 16.4% dans le détroit de Belle Isle. Pour un site donné, la fréquence d'échouage varie beaucoup d'année en année.

Des 40 icebergs repérés par satellite, seulement trois ne se sont échoués à aucun moment. Dans certains

cas, les icebergs sont restés immobilisés durant toute la durée du repérage mais la durée moyenne d'échouage était de 47% du temps de repérage. Environ la moitié des icebergs suivis par radar terrestre ou offshore sont restés échoués pour des périodes de plus de deux jours; la durée d'échouage la plus longue s'établissant à 31 jours pour lesicebergs repérés par radar offshore et à 295 jours pour les icebergs repérés par radar terrestre.

Environ 75% des icebergs échoués ont une masse comprise entre une et 20 millions de tonnes. Le plus gros iceberg échoué en mer du Labrador fait 25 millions de tonnes alors qu'un iceberg échoué de 54 millions de tonnes a été repéré dans la baie de Baffin.

Comme les événements d'échouage identifiés font forcément partie de la durée du trajet qui a été enregistrée, les données d'échouage fournies ne s'appliquent qu'aux endroits et aux intervalles de temps où elles ont été observées.

Très peu d'échouages ont été identifiés dans la région des Grands Bancs (au large de Terre-Neuve) en raison du petit nombre de trajectoires disponibles dans ce secteur.

INTRODUCTION

The objective of this study is to provide information to establish a data base containing the positions of iceberg groundings and associated information for the Grand Banks, Labrador Sea and Baffin Bay regions of eastern Canada. This data base is needed for the planning and design of drilling activities and production systems, including pipelines and other seabed installations. The grounding events were identified in this study through extensive analyses of iceberg tracks logged by drill rig radars and shore-based radars, and satellite telemetry. Information on iceberg groundings was obtained from International Ice Patrol records and repair records of submarine cables.

Very limited information is available on the frequency of iceberg groundings. Only two published studies have been carried out to identify groundings, these analyzed iceberg tracking data at some well-sites off Labrador (Barrie et al. 1981; Lynas et al. 1984). Using a simple grounding criterion, these references report the percentage of iceberg groundings at well-sites for a period of 12 hours or more, which ranged from 0.5% to 8.3%. The average grounding frequency for Makkovik Bank during the drilling seasons from 1973 to 1981 was reported to be 3.39%. It was pointed out that this was a conservative number and that several other groundings could have been identified had a more refined criterion been used (Lynas et al. 1984).

Analysis of long-term satellite tracking of two sets

of icebergs by the International Ice Patrol (Robe et al. 1979; Robe 1982) indicated that icebergs grounded frequently and for long periods of time during their drift. For the first set of icebergs tracked from Baffin Bay to the Labrador Sea, it was reported that grounding occurred frequently, occupying nearly 40% of the observed time (Robe et al. 1979). For the second set of icebergs, tracked along the west coast of Greenland, it was reported that icebergs were grounded for 63% of the tracking time (Robe 1982).

METHODS

The study presents a comprehensive approach to identifying and documenting iceberg grounding, using all the known and available sources for obtaining icebery tracking data and employing criteria to determine grounding conditions. This involved extensive search, correspondence, and data-handling efforts.

DATA SOURCES

A list of the data sources is presented below

a) Icebergs tracked by drill-rig radar: a total of 2,728 icebergs were tracked during drilling operations from 1973 to 1982.

b) Icebergs tracked by shore-based radar: a total of 292 icebergs were tracked by a Memorial University team during the years 1972 to 1974 in the Saglek Bay area; Fenco Newfoundland Limited tracked 106 icebergs during the period 1979 to 1981 and the Canadian Coast Guard tracked 169 icebergs during the period 1982-1983 in the Strait of Belle Isle; and a total of 301 icebergs were tracked by Arctic Sciences Ltd. for Petro-Canada during the period July to October, 1978, in Baffin Bay.

c) Icebergs tracked by satellite telemetry: eight icebergs were tracked by satellite telemetry by the International Ice Patrol (IIP) in the Baffin Bay and Labrador Sea area; two were tracked during the period February to August 1977, while six were tracked during the period of January to September 1978; and a total of 32 icebergs were tracked for Petro-Canada during the Eastern Arctic Marine Environmental Studies (EAMES) ice studies in Baffin Bay, during the period from August 1978 to December 1980.

d) International Ice Patrol records: a total of about 65,000 records of iceberg positions as reported by IIP

reconnaissance flights, IIP vessels throughout the east coast area, and by other ships in the Grand Banks area, during the years 1960 to 1982.

e) Repair records of submarine cables: a total of 25 cable breakages took place as a result of iceberg impact, documented by Teleglobe Canada during the period 1960 to 1982.

f) Other sources: a survey of 421 icebergs in the Davis Strait and Baffin Bay areas between 63°N and 75°N for the Arctic Petroleum Operators Association was carried out by Marine Exploration Limited (Marex) from the vessel Hans Egede, during the period July to October, 1972.

CRITERIA FOR IDENTIFYING ICEBERG GROUNDING EVENTS

A drifting iceberg will run aground (be grounded) when water depth becomes less than iceberg draft and usually takes place when the iceberg drifts into shallower water. The iceberg also may become grounded if it rolls towards a position of greater draft. The iceberg may be grounded during periods of low tide if its draft is very close to the water depth. A grounded iceberg will start to move again when it refloats, which may take place during high tide, if its draft is reduced (by melting, rolling, or tilting), or if environmental forces (such as wind, current) push it into deeper waters.

Grounded icebergs, by definition, remain stationary for a period of time. Analysis of the time history of iceberg velocity alone may not yield conclusive verification of iceberg grounding. Some changes in environmental conditions may temporarily slow, or stop, a drifting iceberg for some period of time and give a false impression that the iceberg has grounded. On the other hand, a grounded iceberg may seem to be moving or, conversely, a drifting iceberg may seem to have a zero speed because of inaccuracies introduced by the radar, or the observer or both. Therefore, in addition to iceberg velocity, the following factors, whenever available, must be considered for verification of iceberg grounding events:

- visual verification of the grounding;
- iceberg draft versus water depth; and
- environmental conditions.

Because the accuracy of the positions reported for icebergs depends on the source, the resolution of the equipment, the period between measurements, and the availability of other relevant information, **different criteria will be set for each data set.** The following subsections outline the proposed grounding criteria for each data source.

Icebergs Tracked by Drill-Rig Radars

Data from drill-rig radars at well-sites are the major source of iceberg grounding information.

Usually iceberg positions (range and bearing) are given at an interval of about one hour; however, this time interval may vary from half an hour for close icebergs to several hours for a grounded iceberg. Appendix 1 gives the errors introduced by radar system or operator problems which may be involved in interpreting these data. Table A.1 presents estimates of errors in range and bearing for iceberg positions introduced by such inaccuracies.

To study the quality of tracking data and to establish criteria for identifying grounded icebergs, the following diagrams were plotted and analysed for a random sample of 100 icebergs tracked at different well-sites during different seasons:

- time history of speed magnitude
- time history of speed direction
- iceberg drift trajectory.

In addition, listings of the range, bearing, velocity, and direction of these icebergs were also analysed. Appendix 2 presents trajectory plots, time histories, and listings for four of these icebergs. Significant fluctuations in iceberg speed and direction during a very short period were observed. As explained in Appendix 1, most of these fluctuations were introduced by range and bearing errors, since icebergs usually take more than one hour to respond to any changes in environmental forces (in-house research at Fenco Newfoundland Ltd.).

Based on the sample of 100 icebergs, and after careful review by geologists and oceanographers from the Bedford Institute of Oceanography, the minimum requirements to identify positive and probable grounded icebergs were established and are presented in Figure 1. An iceberg was considered to be stationary during a certain period if the variations in range and bearing data during this period were within the possible tracking error, and the iceberg appeared to 'move' around a certain location. Thus, icebergs with low velocities but with steady movement in a given direction could be identified as non-stationary. More conditions had to be satisfied for shorter durations of little or no iceberg movement (within radar accuracy).

The following paragraphs describe the procedure followed to identify positive or probable groundings for all icebergs tracked near well-sites. A 'Grounding Analysis Form' was designed to compile available information on each iceberg suspected to have run aground according to the grounding criteria (see Figure 1). A sample of the 'Grounding Analysis Form' is given in Appendix 3.

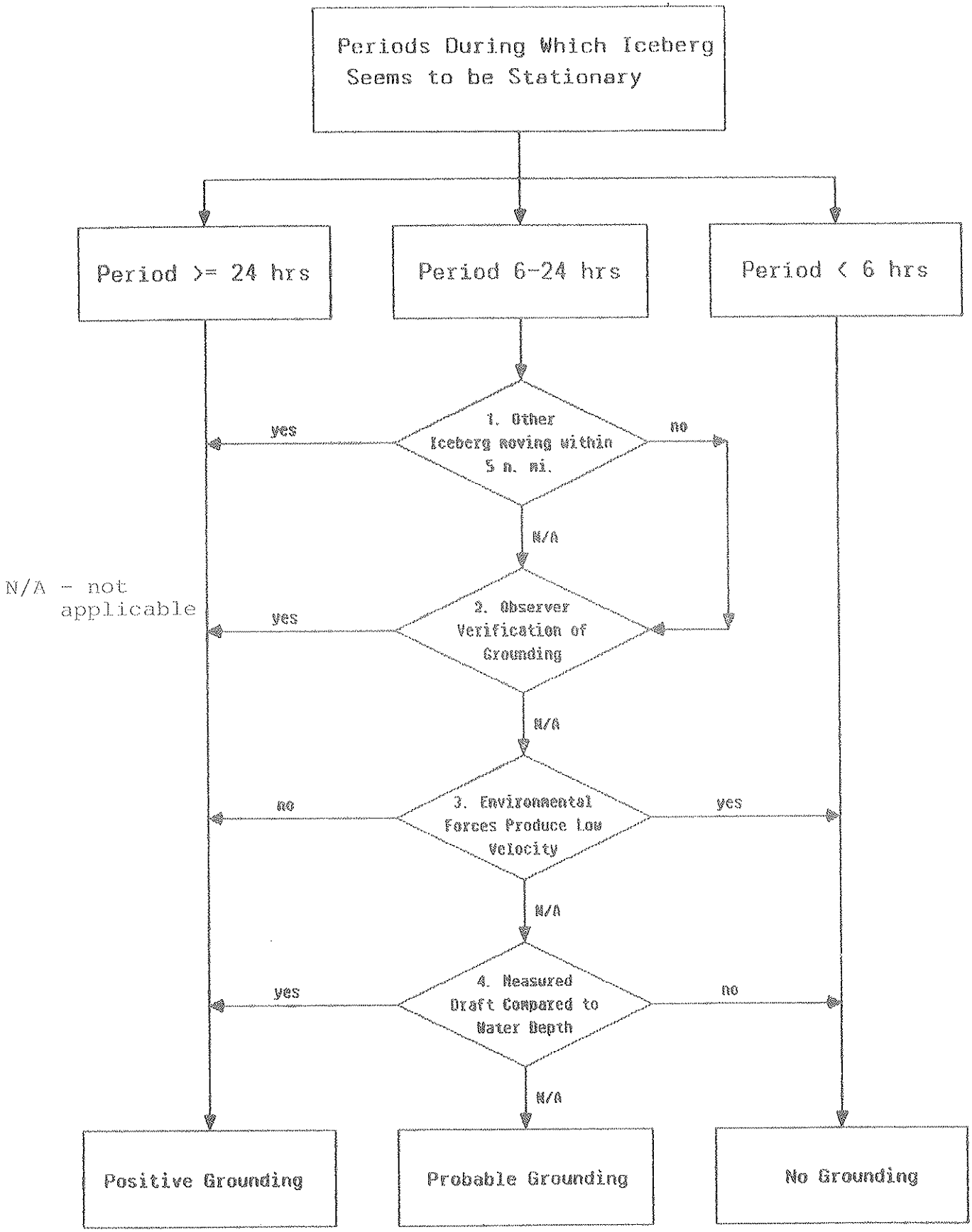


Fig. 1 Grounding Criteria for Iceberg Tracked by Drill-Rig or Shore-Based Radar

The first step was to screen all the tracking data (such as that shown in Appendix 2) to identify icebergs that may have been grounded. Icebergs with consecutively low velocities were identified as potentially grounded and were subjected to further analysis. Icebergs identified as stationary for a period of six hours or more were subjected to detailed analysis using the grounding criteria. Well-site reports and observers logs were examined to determine whether grounding had been verified by ice observers or supply vessel personnel, by considering constant bearings to known landmarks (when in sight or radar range of the coast), current, wind conditions, and movement of other icebergs in the vicinity. Changes in ocean currents, winds, waves, or tides may temporarily slow or stop a drifting iceberg and give a false impression that the iceberg has grounded. Therefore, iceberg tracking data and plots were checked to determine if there were other icebergs moving in the vicinity of the iceberg under consideration (within five nautical miles). When iceberg draft measurements were available, they were compared to water depth information obtained from hydrographic and navigation charts to confirm grounding events.

Based on the above analysis and the grounding criteria, a stationary iceberg was identified to be either positively grounded or probably grounded (see Figure 1).

Icebergs Tracked by Shore-Based Radars

The criteria followed for this data base were essentially the same as those applied for the well-site data. However, no information on environmental data or

iceberg size was available. Some of the probable groundings could have been confirmed had more information been available.

Icebergs Tracked by Satellite Telemetry

In the data sets compiled by the IIP and Petro-Canada, iceberg positions (latitude and longitude to the nearest 0.01 degree) are given at time intervals varying from about 2 to 18 hours. The expected error in computing iceberg velocity would be less than 0.1 m sec^{-1} (0.2 knots). The grounding criterion for this data set was based on the velocity time history, because no other information was available. An iceberg was considered positively grounded if it maintained a zero or very low velocity ($\leq$0.05 m sec^{-1}) for at least 24 hours. Probable grounding was assigned to an iceberg that maintained zero or very low velocity for a period of 12 to 23 hours.

Iceberg Positions Recorded by the International Ice Patrol

The records compiled by the IIP contain about 65,000 iceberg positions, as reported by the IIP reconniassance flights, by IIP vessels, and by other ships. The positions of observed icebergs are given in terms of longitude and latitude to the nearest minute, at time intervals varying from one to several days. The accuracy of these positions depends on the accuracy of the navigation system used and distance and time from a reference point. For these records the locations are expected to be correct within two

nautical miles (naut. mi), therefore, the expected error in iceberg speed is about 0.05 m sec^{-1} (0.1 knots).

Any iceberg that had been sighted previously (given the same target number) and that maintained the same position (within ±2 naut. mi) for a period of at least two days, was considered to be positively grounded. Probable grounding was assigned to any iceberg that fulfilled these conditions for one day.

IDENTIFIED ICEBERG GROUNDING EVENTS

The following subsections present iceberg groundings determined for each data set which meet the criteria outlined in the previous Section.

Grounding near Well-Sites

A total of 2,728 iceberg tracking records were analyzed to identify iceberg groundings. Of these, 123 icebergs were considered to have positively grounded (4.5%) and 48 to have probably grounded (1.8%). Table 1 presents a listing of well-site information (location, period of drilling, water depth) and the number of iceberg groundings near each site. Figure 2 shows the location of the drilling well-site.

Tables 2 and 3 present information on positively grounded and probably grounded icebergs respectively and include location and duration of groundings, and iceberg dimensions when available. Some icebergs were grounded more than once during the tracking period but the duration and location of groundings in Table 3 are given only for the longest grounding period and a summary of data on icebergs that were grounded more than once is presented in Table 4.

TABLE 1

Summary of well-site data and iceberg groundings from drill-rig radars

Identification of well-site	Latitude (North)	Longitude (West)	Drilling Period Year	Start	Stop	Well-site water depth (m)	No. of icebergs tracked	No. of icebergs positively grounded	No. of icebergs probably grounded
Leif E-38 RE	54°17'29.87"	55°05'52.17"	1973	25-Jul.	01-Aug.	168	11	0	0
Leif M-48	54°17'45.92"	55°07'20.17"	1973	01-Aug.	29-Aug.	165	32	0	1
Bjarni H-81	55°30'29.35"	57°45'05.52"	1973	29-Aug.	14-Oct.	139	24	2	0
Bonavista C-99	49°08'06.48"	51°14'27.85"	1974	26-June	04-Oct.	329	184	0	0
Gudrid H-55	54°54'20.06"	55°52'31.04"	1974	14-Jul.	03-Oct.	299	222	6	1
Bjarni H-81 RE	55°30'29.35"	57°45'05.52"	1974	03-Oct.	25-Oct.	139	10	0	0
Bonavista C-99 RE	49°08'06.48"	51°14'27.85"	1975	31-May	11-Aug.	329	36	0	0
Freydis B-87	53°56'13.39"	54°42'39.75"	1975	02-Jul.	08-Aug.	179	27	0	2
Snorri J-90	57°19'44.52"	59°57'44.37"	1975	28-Jul.	10-Oct.	141	50	3	4
Karlsefni A-13	58°52'15.03"	61°46'42.8 "	1975	10-Aug.	25-Sept	175	25	0	1
Indian Harbour M-52	54°21'51.34"	54°23'51.81"	1975	21-Aug.	23-Oct.	198	11	0	0
Cabot G-91	59°50'20.11"	61°45'04.00"	1976	31-Jul.	29-Aug.	181	151	3	0
Karlsefni A-13 RE	58°52'15.03"	61°46'42.08"	1976	12-Sept.	25-Oct.	175	26	2	0
Indian Harbour M-52 RE	54°21'51.34"	54°23'51.81"	1976	05-Sept.	06-Nov.	198	11	0	0
Snorri J-90 RE	57°19'44.52"	59°57'44.37"	1976	30-Aug.	08-Sept	141	13	2	0
Herjolf M-92	55°31'53.30"	57°44'52.53"	1976	28-Aug.	23-Nov.	139	26	2	0
Verrazano L-77	52°26'37.67"	54°11'51.14"	1976	01-Sept.	29-Sept	183	2	0	0
Skolp E-07	58°26'24.71"	61°46'09.05"	1978	22-Jul.	30-Sept	167	55	4	3
Hopedale E-33	55°52'24.34"	58°50'52.45"	1978	09-Aug.	01-Oct.	550	68	1	0
Hare Bay E-21	51°10'22.18"	51°04'27.09"	1979	14-Jun.	18-Oct.	239	8	0	0
Gilbert F-53	58°52'26.82"	62°08'23.04"	1979	28-Aug.	15-Oct.	183	21	4	1
Roberval K-92	54°51'35.53"	55°44'35.76"	1979	04-Jul.	03-Oct.	269	145	2	1
Tyrk P-100	55°29'49.62"	58°13'50.71"	1979	18-Jul.	22-Oct.	117	168	9	0
Bjarni O-82	55°31'48.22"	57°42'37.70"	1979	29-Jul.	22-Oct.	144	100	8	3
Roberval C-02	54°51'07.90"	55°46'04.51"	1980	07-Jul.	14-Sept	276	30	2	0
Gilbert F-53 RE	58°52'26.82"	62°08'23.04"	1980	20-Jul.	12-Sept	183	52	6	3
North Leif I-05	54°24'38.95"	55°15'10.57"	1980	14-Sept.	27-Sept	144	3	0	0
Bjarni O-82 RE	55°31'48.22"	57°42'37.70"	1980	15-Sept.	17-Oct.	144	8	2	1
Hekja O-71 RE	62°10'51.76"	62°59'46.78"	1980	21-Jul.	13-Oct.	351	44	0	0
Ogmund E-72	57°31'29.68"	60°25'37.78"	1980	16-Aug.	08-Oct.	156	32	6	0
South Labrador N-79	55°48'45.22"	58°26'32.83"	1980	26-Jul.	18-Oct.	500	117	3	2
Bjarni O-82 RE	55°31'48.22"	57°34'37.70"	1981	25-Jun.	31-Jul.	144	383	22	10
Rut H-11	59°10'16.47"	62°16'47.15"	1981	14-Jul.	27-Sept	124	193	24	6
North Bjarni F-06	55°35'29.34"	57°45'49.40"	1981	01-Aug.	06-Oct.	150	57	3	1
Roberval K-92 RE	54°51'35.53"	55°44'35.76"	1982	01-Jul.	08-Jul.	269	67	0	3
Corte-Real P-85 RE	56°04'49.01"	58°12'08.48"	1982	09-Jul.	14-Oct.	438	76	1	0
Rut H-11 RE	59°10'16.47"	62°16'47.15"	1982	24-Jul.	12-Oct.	124	106	5	3
Raleigh N-19	62°17'57.16"	62°32'57.30"	1982	16-Jul.	15-Oct.	339	134	1	2
Total no. of icebergs							2,728	123	48
Percent							100	4.5	1.8

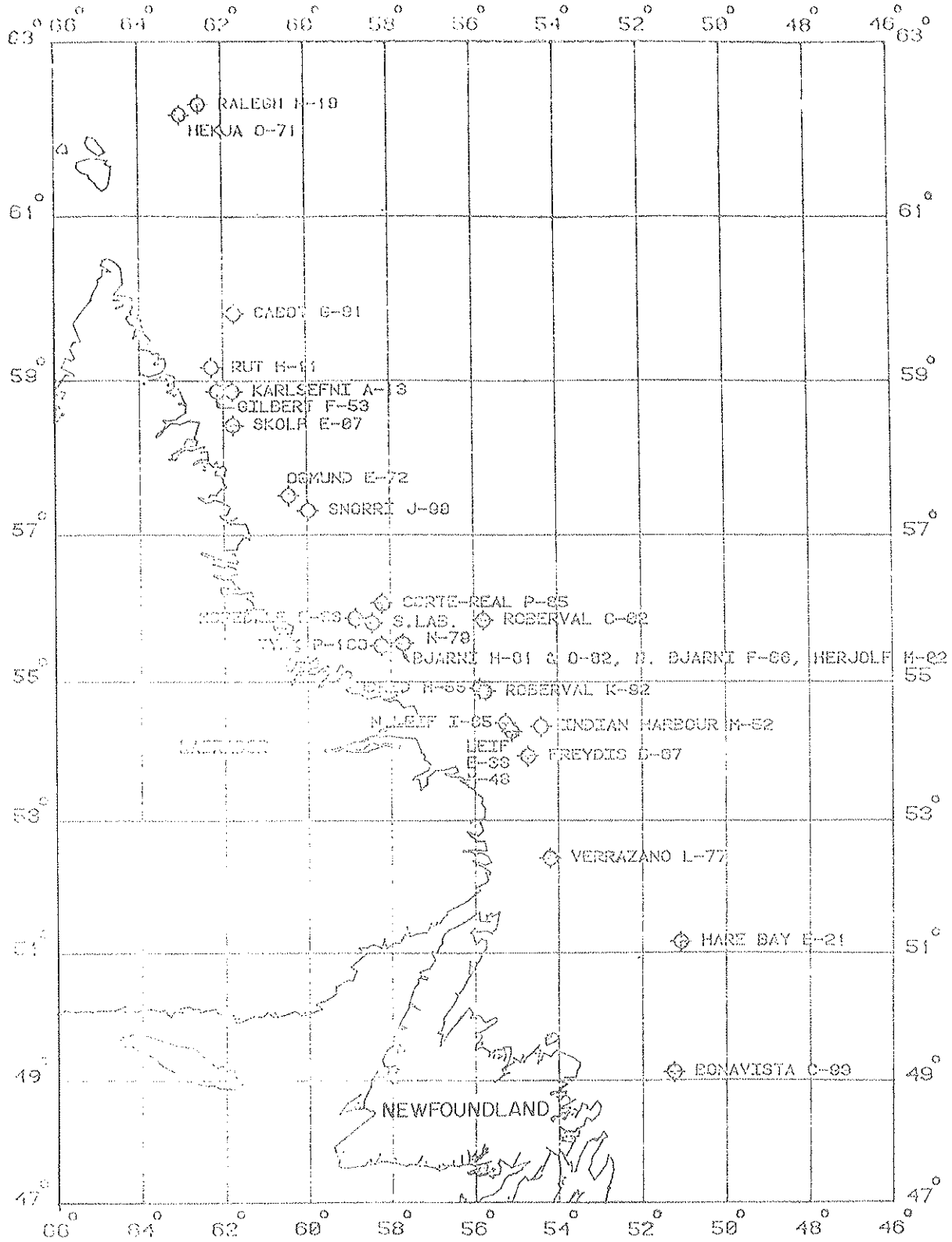


Figure 2 Well-sites offshore Newfoundland and Labrador, 1973-1982.

TABLE 2

Summary of positively grounded icebergs from drill-rig radar data

Iceberg identification	Year	Grounding location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass (t x 10^6)
037 Bjarni H-81	1973	55°39.1'	58°14.8'	190	141	-	82	90b	10
040 Bjarni H-81	1973	55°40.5'	58°14.6'	87	93	-	69	80b	3
006 Gudrid H-55	1974	54°53.1'	56°17.7'	52	360	-	54	150b	20
010 Gudrid H-55	1974	54°58.2'	56°20.7'	54	-	-	-	-	-
011 Gudrid H-55	1974	54°56.8'	56°24.4'	26	-	-	-	-	-
012 Gudrid H-55	1974	54°41.4'	55°40.5'	78	-	-	-	-	-
122 Gudrid H-55	1974	54°55.0'	56°18.6'	142	400	-	45	155	7.5
150 Gudrid H-55	1974	54°46.9'	56°28.1'	201	216	-	66	120b	10
012 Snorri J-90	1975	57°09.3'	59°55.0'	48	177	144	61	140b	2.4
040 Snorri J-90	1975	57°22.8'	59°36.7'	27	180	105	85	115	4.5
046 Snorri J-90	1975	57°09.8'	60°37.0'	>24a	235	190	65	125	7.05
001 Cabot G-91	1976	60°02.2'	61°34.9'	45	-	-	-	-	-
002 Cabot G-91	1976	59°41.7'	61°17.6'	376	-	-	-	-	-
104 Cabot G-91	1976	59°41.9'	61°25.1'	109	-	-	-	-	-
007 Karlsefni A-13 RE	1976	59°02.8'	61°25.9'	460	230	180	85	120b	25
018 Karlsefni A-13 RE	1976	59°02.9'	61°43.5'	26	241	173	55	165	12
008 Snorri J-90RE	1976	57°08.0'	59°25.5'	15	-	-	-	-	-
012 Snorri J-90RE	1976	57°21.9'	59°35.2'	20	260	-	75	-	10
004 Herjolf H-92	1976	55°32.0'	57°13.4'	86	255	-	58	128	5.5
024 Herjolf H-92	1976	55°14.1'	57°44.1'	9	128	58	50b	80b	1.8
002 Skolp E-07	1978	58°36.4'	61°33.3'	103	256	253	94	107	7-7.5
006 Skolp E-07	1978	58°37.2'	61°12.6'	40	-	-	-	-	-
007 Skolp E-07	1978	58°36.1'	61°10.8'	34	-	-	-	-	-
017 Skolp E-07	1978	58°25.5'	62°03.4'	9	200	-	28	120	5-6
043 Hopedale E-33	1978	55°47.7'	59°30.2'	35	-	-	-	-	-
001 Gilbert F-53	1979	58°55.7'	62°02.9'	91	122	117	46	90b	2
008 Gilbert F-53	1979	58°47.9'	62°29.6'	29	-	-	-	-	-
009 Gilbert F-53	1979	58°40.9'	62°33.1'	114	-	-	-	-	-
014 Gilbert F-53	1979	58°46.5'	62°26.5'	17	-	-	-	-	-
040 Roberval K-92	1979	54°51.6'	56°20.2'	238	132	-	58	150b	1.8
093 Roberval K-92	1979	54°55.8'	55°23.5'	7	220	-	52	110b	3.5
001 Tyrk P-100	1979	55°39.7'	58°10.8'	21	-	-	-	-	-
006 Tyrk P-100	1979	55°34.6'	57°56.1'	12	64	-	12	50b	0.14
011 Tyrk P-100	1979	55°28.7'	58°10.0'	27	148	-	42	88b	1.4
012 Tyrk P-100	1979	55°25.1'	57°56.5'	343	138	-	48	85b	1.0
014 Tyrk P-100	1979	55°27.6'	58°09.2'	37	87	-	35	65b	1.0
042 Tyrk P-100	1979	55°35.3'	57°51.7'	19	-	-	-	-	-

TABLE 2 (cont'd)

Iceberg identification	Year	Grounding location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass (t x 10^6)
051 Tyrk P-100	1979	55°36.8'	57°56.5'	30	–	–	–	–	–
052 Tyrk P-100	1979	55°36.0'	57°55.7'	38	–	–	–	–	–
114 Tyrk P-100	1979	55°31.1'	57°47.7'	101	–	–	–	–	–
002 Bjarni 0-82	1979	55°29.8'	57°17.0'	8	121	–	49	80b	1.3
007 Bjarni 0-82	1979	55°36.9'	57°46.3'	176	188	–	62	105b	12.25
016 Bjarni 0-82	1979	55°44.4'	57°33.7'	9	–	–	–	–	–
025 Bjarni 0-82	1979	55°35.1'	57°50.4'	6	–	–	–	–	–
034 Bjarni 0-82	1979	55°43.8'	57°32.6'	24	201	–	62	110b	3.8
038 Bjarni 0-82	1979	55°41.4'	57°37.0'	96	218	–	51	156b	10
047 Bjarni 0-82	1979	55°33.5'	57°38.7'	23	125	–	34	80b	1.15
101 Bjarni 0-82	1979	55°38.3'	58°03.9'	116	173	–	85	100b	7.5
007 Roberval C-02	1980	55°07.5'	56°22.9'	7	118	53	53	173	0.94
025 Roberval C-02	1980	54°36.8'	56°24.6'	60	–	–	–	–	–
005 Gilbert F-53RE	1980	58°46.6'	62°23.8'	44	257	206	62	157b	3.0
009 Gilbert F-53RE	1980	58°38.4'	62°17.2'	164	–	–	–	–	–
014 Gilbert F-53RE	1980	58°37.7'	62°03.9'	68	–	–	–	–	–
019 Gilbert F-53RE	1980	58°37.6'	62°07.1'	34	–	–	–	–	–
030 Gilbert F-53RE	1980	58°37.5'	62°07.4'	121	98	77	26	82	0.170
033 Gilbert F-53RE	1980	58°58.6'	61°49.4'	162	175	123	63	130	.24
001 Bjarni 0-82RE	1980	55°42.0'	57°55.2'	138	146	142	65	115	1.9
002 Bjarni 0-82RE	1980	55°31.7'	57°49.3'	139	257	114	57	110	1.5
007 Ogmund E-72	1980	57°12.8'	60°45.8'	26	–	–	–	–	–
010 Ogmund E-72	1980	57°17.2'	60°43.6'	106	–	–	–	–	–
013 Ogmund E-72	1980	57°25.7'	61°08.5'	112	–	–	–	–	–
017 Ogmund E-72	1980	57°29.8'	60°30.5'	32	–	–	–	–	–
021 Ogmund E-72	1980	57°23.8'	61°08.3'	17	–	–	–	–	–
028 Ogmund E-72	1980	57°34.8'	61°24.2'	18	–	–	–	–	–
072 South Labrador N-79	1980	55°38.2'	58°10.9'	35	–	–	–	–	–
101 South Labrador N-79	1980	55°42.5'	58°05.0'	152	–	–	–	–	–
109 South Labrador N-79	1980	55°32.6'	57°58.5'	84	–	–	–	–	–
006 Bjarni 0-82RE	1981	55°23.3'	57°55.3'	19	–	–	–	–	–
016 Bjarni 0-82RE	1981	55°21.3'	57°56.3'	169	–	–	–	–	–
020 Bjarni 0-82RE	1981	55°43.9'	57°47.6'	59	–	–	–	–	–
022 Bjarni 0-82RE	1981	55°29.5'	57°58.3'	101	–	–	–	–	–
023 Bjarni 0-82RE	1981	55°32.1'	58°04.8'	58	–	–	–	–	–
024 Bjarni 0-82RE	1981	55°33.3'	58°03.5'	54	–	–	–	–	–
040 Bjarni 0-82RE	1981	55°39.8'	58°02.9'	32	–	–	–	–	–
061 Bjarni 0-82RE	1981	55°32.4'	58°04.8'	27	–	–	–	–	–

TABLE 2 (cont'd)

Iceberg identification	Year	Grounding Location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass ($t \times 10^6$)
106 Bjarni 0-82RE	1981	55°29.5'	55°58.2'	65	-	-	-	-	-
142 Bjarni 0-82RE	1981	55°31.5'	58°04.8'	40	-	-	-	-	-
269 Bjarni 0-82RE	1981	55°44.1'	55°35.6'	182	-	-	-	-	-
273 Bjarni 0-82RE	1981	55°28.8'	57°58.1'	22	-	-	-	-	-
276 Bjarni 0-82RE	1981	55°31.6'	58°04.7'	30	-	-	-	-	-
290 Bjarni 0-82RE	1981	55°45.1'	57°54.5'	65	-	-	-	-	-
335 Bjarni 0-82RE	1981	55°18.2'	57°12.5'	217	-	-	-	-	-
343 Bjarni 0-82RE	1981	55°34.5'	58°01.4'	8	-	-	-	-	-
355 Bjarni 0-82RE	1981	55°32.9'	58°01.6'	13	-	-	-	-	-
356 Bjarni 0-82RE	1981	55°41.5'	57°57.9'	374	-	-	-	-	-
371 Bjarni 0-82RE	1981	55°18.3'	57°27.7'	9	-	-	-	-	-
377 Bjarni 0-82RE	1981	55°21.8'	57°50.5'	9	-	-	-	-	-
386 Bjarni 0-82RE	1981	55°15.5'	57°17.6'	7	-	-	-	-	-
006 Rut H-11	1981	59°09.0'	62°08.8'	51	-	-	-	-	-
007 Rut H-11	1981	59°29.8'	62°34.6'	63	223	169	75	164b	2.8
008 Rut H-11	1981	59°06.1'	62°15.9'	656	201	154	68	149b	2.5
009 Rut H-11	1981	59°11.0'	61°50.9'	735	174	119	32	155	2.0
010 Rut H-11	1981	59°18.3'	61°52.0'	54	268	210	36	146	5.8
012 Rut H-11	1981	59°08.7'	62°16.0'	610	147	102	47	103b	0.85
032 Rut H-11	1981	59°10.3'	61°38.1'	13	-	-	-	-	-
065 Rut H-11	1981	59°13.4'	62°07.4'	199	207	145	58	127b	-
078 Rut H-11	1981	59°09.8'	61°37.9'	80	-	-	-	-	3.1
083 Rut H-11	1981	59°06.5'	62°16.8'	29	-	-	-	-	-
085 Rut H-11	1981	58°59.0'	62°59.0'	110	-	-	-	-	-
086 Rut H-11	1981	59°06.4'	63°02.2'	123	-	-	-	-	-
091 Rut H-11	1981	59°21.3'	62°33.5'	32	-	-	-	-	-
107 Rut H-11	1981	58°51.4'	62°40.6'	61	-	-	-	-	-
111 Rut H-11	1981	59°25.3'	62°07.3'	85	-	-	-	-	-
138 Rut H-11	1981	59°18.0'	61°35.9'	25	-	-	-	-	-
141 Rut H-11	1981	59°22.0'	62°50.1'	35	-	-	-	-	-
151 Rut H-11	1981	59°17.2'	62°40.7'	32	111	90	25	68	0.460
158 Rut H-11	1981	58°54.4'	62°31.9'	40	72	45	26	78	0.250
161 Rut H-11	1981	59°08.1'	63°06.0'	38	-	-	-	-	-
163 Rut H-11	1981	58°56.4'	62°54.6'	36	-	-	-	-	-
180 Rut H-11	1981	59°14.9'	62°31.1'	7	153	111	-	78	5.4
188 Rut H-11	1981	58°53.1'	62°53.3'	8	-	-	31	-	-
200 Rut H-11	1981	59°29.9'	62°23.6'	54	-	-	-	-	-
001 North Bjarni F-06	1981	55°24.4'	57°32.2'	329	-	-	-	-	-

TABLE 2 (cont'd)

Iceberg identification	Year	Grounding Location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass (t x 10^6)
007 North Bjarni F-06	1981	55°25.1'	57°59.6'	38	-	-	-	-	-
010 North Bjarni F-06	1981	55°44.6'	57°32.3'	25	77	55	16	110	0.220
066 Corte Real P-85RE	1982	56°17.4'	58°16.1'	48	158	141	28	81b	0.880
059 Rut H-11	1982	59°01.7'	61°47.3'	120	198	152	59	130b	3.160
069 Rut H-11	1982	59°03.2'	63°01.7'	99	-	-	-	-	-
072 Rut H-11	1982	58°55.4'	62°52.5'	86	-	-	-	-	-
089 Rut H-11	1982	59°59.2'	61°44.2'	102	-	-	-	-	-
091 Rut H-11	1982	59°21.8'	62°14.5'	93	230	183	57	125b	4.3
108 Ralegh N-19	1982	62°37.1'	63°00.8'	46	-	-	-	-	-

a - Investigated by supply vessel
b - Estimated from El-Tahan and El-Tahan 1982

TABLE 3

Summary of probably grounded icebergs from drill-rig radar

Iceberg identification	Year	Grounding location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass ($t \times 10^6$)
017 Leif H-48	1973	54°29.7'	55°10.2'	9	145	-	72	100b	1.5
124 Gudrid H-55	1974	55°07.2'	56°02.9'	10	130	-	60	90	2
013 Freydis B-87	1975	54°00.2'	54°46.2'	7	-	-	-	-	-
014 Freydis B-87	1975	53°57.1'	54°18.5'	6	-	-	-	-	-
001 Snorri J-90	1975	57°21.5'	60°26.2'	20	50	-	18	45b	0.15
008 Snorri J-90	1975	57°15.0'	59°56.2'	6	66	-	23	50b	0.3
013 Snorri J-90	1975	57°18.6'	59°33.6'	7	-	-	-	-	-
014 Snorri J-90	1975	57°30.7'	60°13.0'	14	-	-	-	-	-
016 Karlsefni A-13	1975	59°01.9'	61°56.5'	10	175	-	54	100b	2.0
005 Skolp E-07	1978	58°39.6'	61°19.7'	9	-	-	-	-	-
026 Skolp E-07	1978	58°19.2'	61°28.9'	7	-	-	-	-	-
044 Skolp E-07	1978	58°42.4'	61°21.5'	22	193	162	50	152	2.2
007 Gilbert F-53	1979	59°10.6'	62°13.7'	7	224	181	70	130b	5
045 Roberval K-92	1979	54°42.2'	55°32.1'	7	145	-	27	85b	1.2
039 Bjarni O-82	1979	55°23.7'	57°15.3'	6	193	-	40	105	5.5
049 Bjarni O-82	1979	55°14.1'	57°31.5'	6	-	-	-	-	-
071 Bjarni O-82	1979	55°27.4'	57°58.2'	19	-	-	-	-	-
025 Gilbert F-53	1980	58°55.4'	62°47.2'	8	-	-	-	-	-
029 Gilbert F-53	1980	58°38.9'	62°08.4'	22	-	-	-	-	-
051 Gilbert F-53	1980	59°05.5'	62°34.2'	9	-	-	-	-	-
005 Bjarni O-82RE	1980	55°39.3'	57°51.5'	10	98	77	26	82	0.17
102 South Labrador N-79	1980	55°42 3'	58°11.3'	8	-	-	-	-	-
107 South Labrador N-79	1980	55°35.6'	58°00.2'	6	-	-	-	-	-
104 Bjarni O-82RE	1981	55°39.8'	58°03.0'	11	-	-	-	-	-
105 Bjarni O-82RE	1981	55°32.9'	58°04.8'	21	-	-	-	-	-
110 Bjarni O-82RE	1981	55°40.9'	58°08.9'	8	-	-	-	-	-
140 Bjarni O-82RE	1981	55°44.0'	57°46.9'	7	-	-	-	-	-
216 Bjarni O-82RE	1981	55°38.8'	58°02.6'	22	-	-	-	-	-
217 Bjarni O-82RE	1981	55°40.6'	58°09.3'	17	-	-	-	-	-
224 Bjarni O-82RE	1981	55°19.2'	57°25.3'	8	-	-	-	-	-
288 Bjarni O-82RE	1981	55°34.7'	58°01.2'	23	-	-	-	-	-

TABLE 3 (cont'd)

Iceberg Identification	Year	Grounding location		Grounding duration (hours)	Iceberg parameters				
		Latitude	Longitude		Length (m)	Width (m)	Height (m)	Draft (m)	Mass ($t \times 10^6$)
295 Bjarni O-82RE	1981	55°18.4'	57°47.6'	22	-	-	-	-	-
391 Bjarni O-82RE	1981	55°20.7'	57°46.2'	12	192	148	41	114	2.1
011 Rut H-11	1981	59°04.1'	62°42.7'	10	-	-	-	-	-
015 Rut H-11	1981	59°09.8'	62°19.5'	8	-	-	-	-	-
087 Rut H-11	1981	58°55.1'	62°50.1'	22	-	-	-	-	-
117 Rut H-11	1981	59°23.1'	61°47.5'	6	-	-	-	-	-
137 Rut H-11	1981	59°30.1'	62°17.8'	18	-	-	-	-	-
148 Rut H-11	1981	59°19.5'	61°51.1'	14	254	123	35	86b	3.2
011 North Bjarni F-06	1981	55°35.9'	58°22.5'	9	-	-	-	-	-
051 Roberval K-92RE	1982	54°53.4'	55°55.0'	23	-	-	-	-	-
054 Roberval K-92RE	1982	54°34.7'	55°40.2'	8	-	-	-	-	-
055 Roberval K-92RE	1982	54°34.4'	55°38.0'	23	-	-	-	-	-
009 Rut H-11	1982	59°16.5'	62°13.3'	18	-	-	-	-	-
010 Rut H-11	1982	59°16.0'	62°00.1'	19	-	-	-	-	-
073 Rut H-11	1982	59°20.3'	61°37.5'	9	-	-	-	-	-
056 Ralegh N-19	1982	62°25.9'	62°45.1'	6	-	-	-	-	-
111 Ralegh N-19	1982	62°12.2'	63°18.3'	6	-	-	-	-	-

b - Estimated from El-Tahan and El-Tahan 1982

TABLE 4

Summary of icebergs grounded more than once

YEAR	WELLSITE	BERG NO.	LATITUDE	LONGITUDE	TRACKING PERIOD	WATER DEPTH (M)	GROUNDING DURATION (HOURS)			ICEBERG PARAMETERS (METERS)					COMMENTS
							1	2	3	Length	Width	Height	Draft	Mass	
1975	Karlsefni A-13	012	58°52'15.03"	61°46'42.8"	Aug.01-Aug.10	175	10	7		175	N/A	54	100b	2×10^6	
1976	Cabot G-91	001	59°50'20.11"	61°45'4.00"	July 30-Aug.23	181	45			-	-	-	-	-	Grounded many times over tracking period right up to August 23
1976	Karlsefni A-13	007	58°52'15.03"	61°46'42.48	Sept.15-Oct. 16	175	460	12		230	180	85	120b	25×10^6	
1978	Skolp E-07	002	58°26'24.71"	61°46'9.05"	July 22-Aug. 21	166	103			256	253	94	107	7.5×10^6	Berg has a number of other 'greater than 24 hours' grounding periods up to Aug. 19
1978	Skolp E-07	007	58°26'24.71"	61°46'9.05"	July 23-29	166	34	17		-	-	-	-	-	
1979	Gilbert F-53	008	58°52'26.82"	62°08'23.04	Aug. 27-Sept.1	183	29	15		-	-	-	-	-	Observer has verified both grounding periods
1979	Tyrk P-100	006	55°29'49.62"	58°13'50.71	July 20-22	118	12	5		64	-	12	50b	$.14 \times 10^6$	
1979	Tyrk P-100	012	55°29'49.62"	58°13'50.71	July 21-Aug.19	118	21	285	343	138	-	48	85	1×10^6	Observer has verified grounding on Aug. 2, 3 and 18.
1979	Bjarni O-82	038	55°31'48.22"	51°42'37.70	Aug. 7-26	140	55	96		218	-	51	156b	10×10^6	Grounded many times over the tracking perid Aug. 15 to 19
1980	Bjarni O-82	002	55°31'48.22"	57°42'37.70	Sept. 15-23	140	17	139		257	114	57	110	1.5×10^6	Grounded several times over the tracking period.
1980	Gilbert F-53	009	58°52'26.82"	62°08'23.04	July 17-27	170	164			-	-	-	-	-	Grounded many times over tracking period July 24 to 27
1980	Gilbert F-53	030	58°52'26.82"	62°08'23.04	July 29-Aug.16	170	110	121	37	98	77	26	26	$.17 \times 10^6$	Berg grounded for a fourth period for about 6 hours
1980	Gilbert F-53	033	58°52'26.82"	62°08'23.04	Aug. 2-Sept.1	170	7			175	123	63	130	2.4×10^6	
1980	Bjarni O-82	002	55°31'48.22"	57°42'22"	Sept. 15-23	140	17	139		257	114	57	110	1.5×10^6	
1981	Bjarni O-82	335	55°31'48.22"	57°42'22"	July 9-23	140	217	217		-	-	-	-	-	
1981	Bjarni O-82	755	55°31'48.22"	57°42'22"	July 12-14	140	13	32		-	-	-	-	-	
1981	Rut H-11	010	59°10'16.67"	62°16'47.15	July 14-Aug.28	128	54			268	210	36	95	5.8×10^6	Berg continued scouring and grounding in the same vicinity for more than 36 days
1982	Rut H-11	091	59°10'16.67"	62°16'47.15	Oct. 1-08	128	93	32		230	183	57	125b	4.3×10^6	

b - Estimated draft from El-Tahan and El-Tahan 1982

Grounding near Shore-Based Radar Sites

A total of 868 icebergs were tracked by five shore-based radars during the periods 1972-1974 and 1978-1983. The radar tracking stations were located as follows:

- Saglek, Labrador, during the summers of 1972, 1973 and 1974;

- Point Amour, Labrador, on the Strait of Belle Isle, from 1979 to 1981;

- Cape Norman, Newfoundland, on the Strait of Belle Isle, during 1982 and 1983;

- Hope Monument, Devon Island, overlooking Baffin Bay and Lancaster Sound, during the period of July to October, 1978; and

- Cape Fanshawe, Bylot Island, overlooking Baffin Bay and the approach to Lancaster Sound, during the period of July to October, 1978.

Figures 3 and 4 show the location of shore-based experiments and the range of coverage. It should be noted that no information was available on the dimensions of any of the icebergs.

Table 5 presents a summary of identified iceberg groundings off Saglek whereas Table 6 presents all the grounding data for the same location. About 20% of the

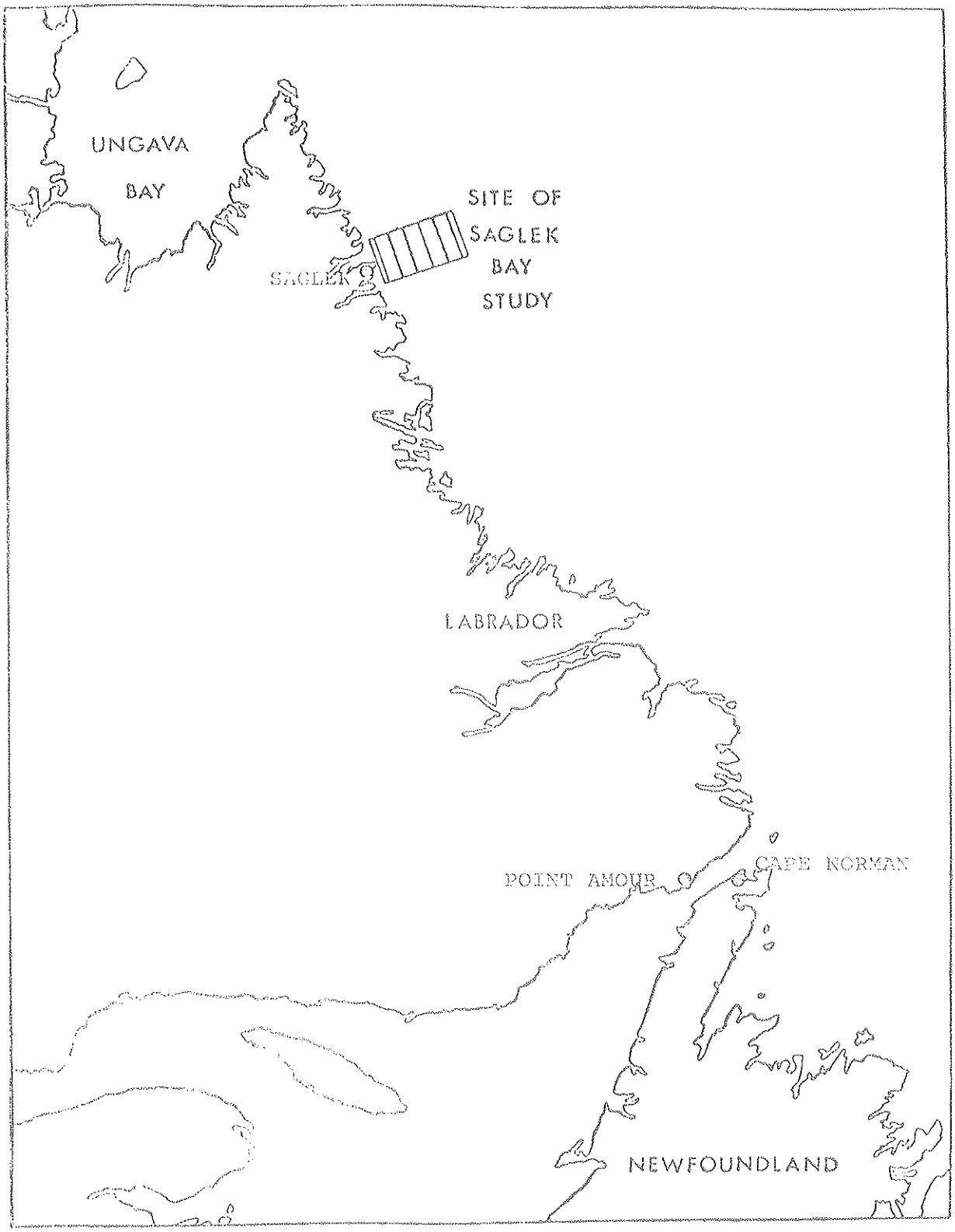


Figure 3 Locations of shore-based radars at Saglek and the Strait of Belle Isle.

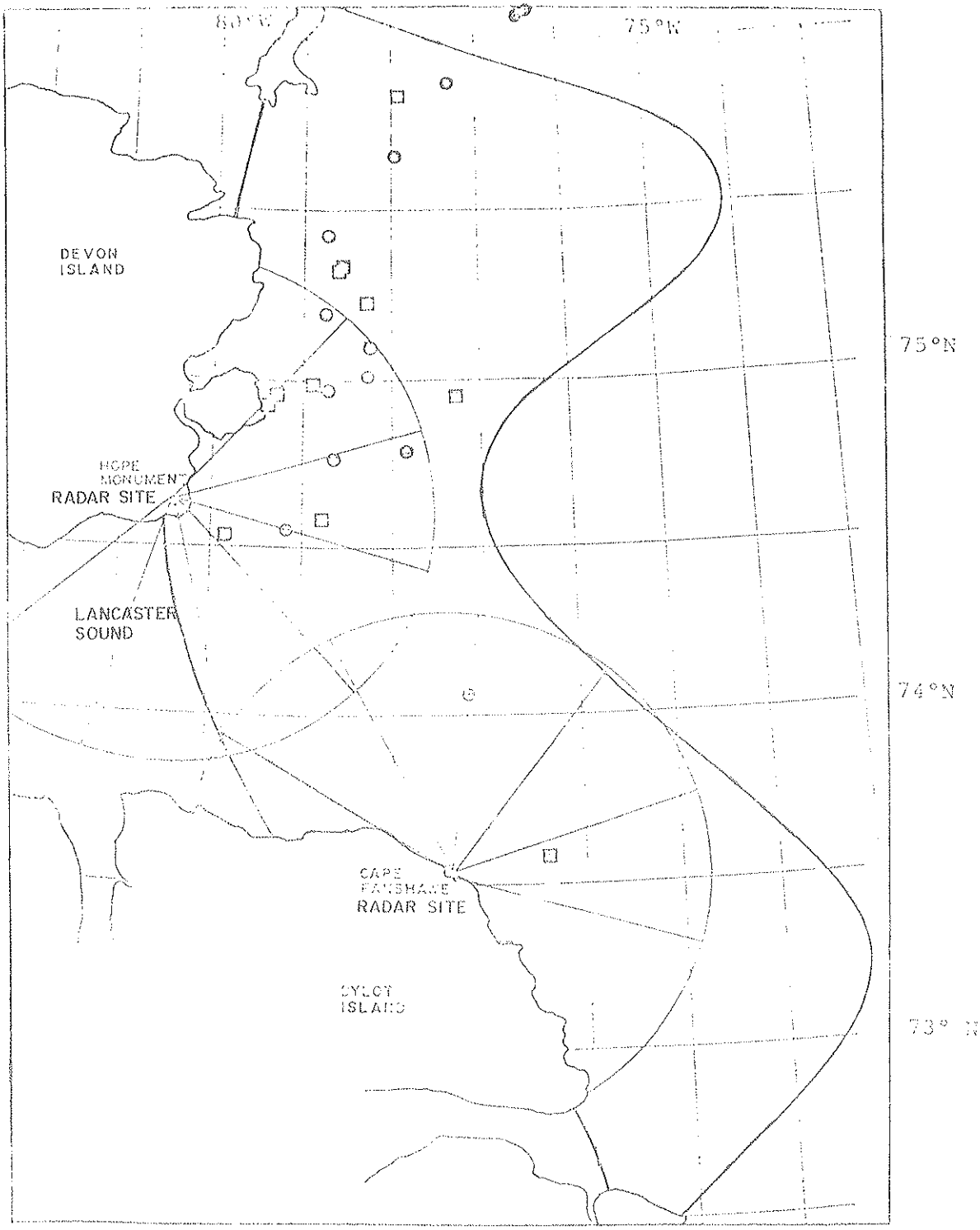


Figure 4 The Hope Monument and Cape Fanshawe radar stations and range.

(Pissot, 1980)

TABLE 5

Summary of iceberg groundings from shore-based radar at Saglek, Northern Labrador

Year	Total no. of icebergs	Positively grounded icebergs		Probably grounded icebergs	
		Total	Percent	Total	Percent
1972	104	5	4.8	3	2.9
1973	109	27	24.8	9	8.3
1974	79	26	32.9	8	10.1
TOTAL	292	58	19.9	20	6.8

tracked icebergs were identified as positively grounded and 6.8% as probably grounded. These values are about four times greater than those for icebergs tracked by the drill-rig radars. Similar results were obtained for the icebergs tracked in the Strait of Belle Isle as presented in Tables 7 (summary for Point Amour and Cape Norman radar), 8, and 9 (all grounding data). The large number of groundings is reasonable since water depths near the Labrador coast and in the Strait of Belle Isle are shallower than those at the drilling sites (compare Table 1 with Tables 6, 8, and 9).

This was not the case for the icebergs tracked in Baffin Bay and entrance to Lancaster Sound by the shore-

TABLE 6

Iceberg grounding events from the shore-based radar at Saglek

Year	Iceberg no.	Grounding location		Water depth (m)	Duration (hrs.)	Iceberg grounding	
		Latitude North	Longitude West			Positive	Probable
1972	7J	58°38.3'	62°23.7'	150	8		X
	7K	58°58.7'	62°24.1'	130	39	X	
	7L	58°17.5'	62°14.3'	175	12		X
	7Q	58°23.2'	62°10.9'	200	172	X	
	8B	58°57.6'	61°58.7'	130	182	X	
	11N	58°51.7'	61°20.9'	170	16		X
	12C	58°11.5'	62°11.1'	95	68	X	
	21C	58°27.0'	61°01.0'	130	26	X	
1973	30C	58°27.5'	61°31.8'	150	46	X	
	30A	58°25.2'	61°38.2'	200	42	X	
	30D	58°33.4'	62°09.2'	150	252	X	
	30F	58°25.7'	62°01.1'	200	206	X	
	30H	58°49.0'	62°11.9'	160	12		X
	30I	58°34.3'	62°30.4'	115	234	X	
	30K	58°33.8'	61°57.4'	150	44	X	
	30L	59°03.1'	63°04.7'	65	21		X
	30M	58°28.4'	61°50.9'	170	3		X
	30N	58°36.0'	62°48.7'	50	27	X	
	30O	58°21.7'	62°12.7'	100	142	X	
	30P	58°36.7'	62°58.5'	100	218	X	
	30S	58°40.8'	63°27.8'	200	24	X	
	30W	58°55.8'	62°58.3'	100	11		X
	1C	58°38.0'	62°59.7'	100	84	X	
	1D	58°24.5'	62°00.6'	200	196	X	
	2A	58°09.9'	62°21.2'	100	352	X	
	4B	58°30.0'	62°24.4'	150	87	X	
	5A	58°30.5'	62°36.3'	100	34	X	
	5B	58°33.3'	62°54.0'	40	149	X	
	5C	58°36.8'	62°23.5'	150	38	X	
	6A	58°30.8'	62°39.3'	31	20		X
	7A	58°10.4'	62°14.2'	155	118	X	
	9F	58°15.3'	62°04.1'	170	38	X	
	13C	58°19.2'	62°25.9'	100	36	X	
	13F	59°12.9'	62°08.2'	140	18		X
	14C	58°56.0'	62°58.0'	100	114	X	
	15A	58°42.9'	62°41.4'	150	144	X	
	15B	58°18.1'	62°22.9'	200	8		X
	16C	58°42.2'	62°54.7'	100	74	X	

TABLE 6 (cont'd)

Year	Iceberg no.	Grounding location		Water depth (m)	Duration (hrs.)	Iceberg grounding	
		Latitude North	Longitude West			Positive	Probable
	17A	58°26.3'	62°07.2'	140	22		X
	18B	59°08.4'	63°30.5'	100	72	X	
	19A	58°07.3'	62°15.3'	100	166	X	
	19F	58°12.5'	61°57.0'	140	52	X	
	22A	58°39.3'	62°44.7'	100	68	X	
	24C	58°34.9'	62°35.6'	100	22		X
1974	26A	58°53.7'	62°54.2'	145	52	X	
	26B	58°42.3'	62°40.9'	100	34	X	
	26C	58°40.2'	62°43.7'	170	22		X
	26G	58°23.1'	62°10.5'	200	72	X	
	26L	58°25.7'	62°21.2'	100	137	X	
	26M	58°24.9'	62°23.5'	100	220	X	
	26N	58°25.2'	62°25.3'	90	118	X	
	26P	58°22.4'	62°18.4'	35	38	X	
	26Q	58°07.7'	62°02.5'	90	42	X	
	26R	58°13.0'	62°17.1'	150	270	X	
	26S	58°18.3'	62°10.9'	150	176	X	
	26X	58°43.3'	61°31.9'	190	3		X
	26A1	58°22.4'	62°10.7'	200	28	X	
	26A4	58°22.8'	62°11.6'	200	64	X	
	26A9	59°02.8'	63°10.7'	-	42	X	
	26B1	58°22.5'	62°11.3'	200	258	X	
	27F	58°38.2'	62°43.6'	100	46	X	
	27K	58°23.5'	62°12.3'	200	22		X
	27N	58°55.8'	62°56.8'	110	38	X	
	28A1	58°50.9'	62°21.3'	170	14		X
	28B	58°38.6'	62°42.1'	100	18		X
	28D	58°22.1'	62°18.8'	120	51	X	
	28L	58°06.8'	61°56.7'	110	58	X	
	30A	58°35.8'	61°33.9'	155	44	X	
	31A	58°43.9'	62°39.6'	110	58	X	
	31C	58°12.7'	62°12.7'	150	62	X	
	31D	58°50.4'	62°50.4'	115	110	X	
	1B	58°18.0'	62°11.1'	100	30	X	
	2D	58°14.6'	62°24.7'	75	28	X	
	4B	58°41.6'	62°42.2'	175	40	X	
	4E	58°12.2'	62°15.8'	100	24	X	
	4F	58°32.7'	62°13.5'	200	10		X
	4G	58°53.7'	62°53.2'	100	16		X
	4H	58°30.6'	61°20.7'	135	22		X

TABLE 7

Summary of iceberg groundings in Strait of Belle Isle from radars at Point Amour, Labrador and Cape Norman, Newfoundland

Year	Total icebergs	Positively grounded icebergs		Probably grounded icebergs	
		Total	Percent	Total	Percent
1979	3	2	67.0	0	0
1980	26	8	30.0	1	3.8
1981	77	11	14.3	1	1.3
1982	130	27	20.8	13	10.0
1983	39	0	0	0	0
Total	275	48	16.4	15	5.1

based radar stations at Hope Monument and Cape Fanshawe. In this area, the sea floor slopes down quickly from the coast and water depths reach more than 500 metres only a few kilometres from the shore. Of 301 icebergs, 41 were found to be stationary for periods up to 49 hours, although most of these were stationary for periods of less than 12 hours (Table 10). Since information was not available on iceberg size or draft, and water depth in most cases was more than 500 metres, it seems unlikely that the icebergs had run aground. The maximum draft measured for icebergs off Labrador and off Hibernia is about 230 m, and drafts

TABLE 3

Grounding events from the shore-based radar at Point Amour, Southern Labrador

Year	Iceberg no.	Grounding location		Water depth (m)	Duration (hrs.)	Iceberg grounding	
		Latitude North	Longitude West			Positive	Probable
1979	001	51°24.0'	57°00.5'	92	60	X	
	001	51°24.3'	56°59.7'	92	34	X	
	002	51°26.9'	56°56.0'	95	98	X	
1980	005	51°26.3'	56°47.2'	55	60	X	
	007	51°27.5	56°53.4'	55	7		X
	008	51°24.6	56°57.4'	51	49	X	
	008	51°24.3	56°57.6'	55	60	X	
	009	51°25.9	56°48.6'	55	66	X	
	3-2	51°29.6	56°35.7'	60	16		X
	3-2	51°29.2	56°36.1'	60	46	X	
	3-2	51°26.7	56°44.8'	60	18		X
	3-3	51°27.8	56°52.7'	30	16		X
	4-1	51°26.8	56°45.1'	60	69	X	
	5-2	51°31.7	56°37.3'	60	87	X	
1981	25-1	51°26.2'	56°50.8'	60	74	X	
	26-1	51°24.2'	56°55.3'	60	267	X	
	26-3	51°26.3'	56°49.2'	60	60	X	
	26-4	51°24.5'	56°59.4'	60	312	X	
	009	51°20.9'	56°42.8'	15-30	23	X	
	027	51°19.6'	56°46.9'	30	7		X
	037	51°28.3'	56°56.5'	15	43	X	
	057	51°25.6'	56°56.9'	15-30	94	X	
	058	51°28.2'	56°54.8'	30-45	103	X	
	073	51°28.2'	56°56.8'	15	102	X	
	075	51°32.0'	56°32.2'	40	28	X	
	077	51°30.1'	56°43.0'	60-75	41	X	

TABLE 9

Grounding events from the shore-based radar at Cape Norman, Newfoundland

Year	Iceberg no.	Grounding location		Water depth (m)	Duration (hrs.)	Iceberg grounding	
		Latitude North	Longitude West			Positive	Probable
1982	001	51°37.7'	56°02.4'	64	599	X	
	005	51°44.0'	55°52.7'	64	11	X	
	016	51°35.6'	56°08.3'	64	18	X	
	017	51°46.0'	55°46.9'	55	8		X
	020	51°44.4'	55°52.6'	70	8		X
	043	51°43.2'	55°49.9'	53	47	X	
	048	51°38.7'	56°00.1'	64	56	X	
	050	51°36.1'	56°06.9'	66	13	X	
	053	51°44.1'	56°00.5'	92	6		X
	054	51°36.9'	56°04.7'	66	55	X	
	056	51°44.6'	55°47.9'	49	12	X	
	057	51°47.3'	55°42.7'	53	9		X
	061	51°40.9'	55°35.3'	53	19	X	
	062	51°47.8'	55°42.1'	57	107	X	
	063	51°38.5'	55°46.1'	24	10		X
	067	51°41.7'	55°50.2'	42	112	X	
	069	51°52.5'	55°41.2'	73	11	X	
	075	51°49.1'	56°03.7'	55	6		X
	076	51°44.9'	55°49.4'	55	27	X	
	087	51°38.9'	56°00.5'	62	12	X	
	090	51°36.5'	56°05.7'	66	30	X	
	092	51°38.2'	55°45.7'	35	47	X	
	094	51°37.6'	55°42.6'	35	22	X	
	095	51°36.5'	56°05.7'	66	29	X	
	097	51°37.6'	55°42.8'	35	11	X	
	099	51°45.6'	56°03.5'	90	9		X
	103	51°52.0'	55°54.8'	92	8		X
	106	51°38.9'	55°52.5'	26	30	X	
	107	51°40.4'	55°54.4'	55	16	X	
	108	51°40.4'	55°54.3'	55	88	X	
	109	51°46.1'	56°07.4'	73	33	X	
	110	51°55.0'	55°50.4'	124	10		X
	113	51°44.1'	55°48.9'	55	15	X	
	115	51°38.8'	55°50.9'	22	12	X	
	116	51°44.5'	55°48.0'	48	15	X	
	122	51°47.6'	56°06.4'	37	13	X	
	123	51°45.1'	56°08.9'	92	7		X
	129	51°42.8'	55°50.3'	51	9		X
	130	51°40.0'	55°51.5'	37	9		X

TABLE 10

Information on stationary icebergs tracked by shore-based radar in eastern Lancaster Sound and Baffin Bay east of Devon Island during the period of July to October, 1973.

Iceberg no.	Position		Water depth (a) (m)	Duration of no movement (hrs.)
	Latitude North	Longitude West		
1056	74.360	81.841	695	31
1044	74.32	78.233	653	11
2001	74.281	82.898	585	12
2017	74.153	82.262	704	49
2021	74.091	81.493	693	7
3116	74.746	78.537	315	25
3065	74.203	81.159	695	9
3071	74.411	78.843	640	6
3071	74.417	78.755	640	7
3072	74.415	78.616	640	20
3026	74.449	78.649	611	11
3026	74.443	78.669	611	7
4101	73.999	79.797	776	8
4019	74.737	78.174	353	8
4115	74.348	81.296	695	8
4028	75.034	78.941	201	7
4010	74.451	79.048	613	10
4010	74.380	79.263	668	7
5073	74.196	81.105	677	8
5046	74.319	80.315	680	20
6014	74.314	80.845	686	9
6065	74.791	79.540	148	7
7044	74.795	79.463	148	7
7046	74.822	79.367	146	8
7045	74.794	79.562	146	16
8091	74.805	78.576	146	9
9020	74.276	80.481	677	9
9011	74.318	80.555	677	9
9019	74.301	80.589	677	8
9019	74.309	80.527	677	13
9019	74.309	80.491	677	9
9059	74.204	80.724	677	7
9059	74.198	80.767	677	8
9023	74.594	79.100	457	7
16	74.342	79.543	653	8
7	74.491	79.626	408	10
1522	74.678	79.236	201	9
1605	74.182	80.003	721	25
1613	74.177	80.051	721	37
1574	74.091	81.112	721	7
1583	74.098	80.724	721	7

a - Estimated from Navigation Charts

may be greater than this nearer to the iceberg sources but are not expected to be in the order of 500 m.

Grounding of Icebergs Tracked by Satellite Telemetry

Two sets of data are available for icebergs tracked by satellite telemetry off Canada's east coast. The first set was studied by the International Ice Patrol. Two icebergs were tracked during the period of February to August, 1977, while six icebergs were tracked during the period of January to September, 1978. Most of these were tracked from latitudes of 68° to 70°N, and varied from about 71° to 51°N when tracking stopped. Table 11 presents a summary of the tracking data. Table 12 presents a summary of grounding events for the eight icebergs. The probable groundings usually occurred very close to the locations of positive grounding. All the icebergs, except No. 77-0160, were grounded for periods ranging from 14 to 176 days. This means that the icebergs were grounded for 12% to 86% of the tracking time (see Table 11). The grounding time of iceberg No. 77-0160 was short (0.2%).

Robe et al (1979) presented a detailed account of the movement and grounding of all the icebergs tracked in 1978 except iceberg No. 78-1550. Appendix 4 presents the drift trajectories of the icebergs which grounded, the grounding locations and durations. The criteria which they used to identify 'firm' and 'intermittent' groundings were not reported in the paper. However, it seems that firm grounding was assigned to icebergs with a long stationary period.

TABLE 11

Summary of data on icebergs tracked by satellite for IIP in Baffin Bay and the Labrador Sea, 1977 to 1978.

Iceberg no.	Tracking Dates		Tracking period (days)	Location (Latitude °N)		Grounding period (days)	Period grounded (%)
	Start	End		At start	At end		
77-0156	26 Feb 77	18 Jul 77	142	69.14	68.84	23.5	16.2
77-0160	25 Feb 77	26 Aug 77	182	68.06	63.15	0.5	0.2
78-0050	30 Jan 78	25 Jul 78	176	68.47	52.37	90	51.1
78-0066	08 Feb 78	01 Sept 78	205	62.92	57.64	176	85.9
78-0156	30 Jan 78	22 Aug 78	205	68.50	57.90	72	35.1
78-1344	30 Jan 78	20 Jun 78	141	67.28	51.43	14.5	10.3
78-1372	01 Feb 78	17 Jul 78	166	70.88	71.35	46.6	28.1
78-1550	25 Feb 78	25 Jul 78	150	64.15	63.19	18.4	12.3

The second set of satellite tracking data was obtained during the Petro-Canada EAMES ice studies in Baffin Bay. A total of 32 icebergs were tracked from latitude 78°N to 70°N near Smith Sound, through Western Baffin Bay during the period of August 1978 to December 1980. Table 13 presents a summary of the tracking data while Table 14 presents data on grounding events for each iceberg. Figures 5 and 6 show the drift trajectories of the icebergs for the years 1978 and 1979, respectively. Of the 32 icebergs studied, only three were never grounded.

TABLE 12

Details of grounding data for icebergs tracked by satellite telemetry in Baffin Bay and the Labrador Sea, 1977 to 1978.

Iceberg no.	Position		Duration Hours	Water depth(a) (m)	Grounding	
	Latitude North (deg)	Longitude West (deg)			Positive	Probable
77-0156	68.16	55.23	20	112		X
	68.20	55.04	169	112	X	
	68.18	55.20	18	112		X
	68.17	55.13	13	112		X
	68.94	54.68	317	102	X	
	68.78	54.17	13	97		X
77-0160	64.04	62.23	13	183		X
78-0066	62.98	62.86	423	183	X	
	62.72	62.98	1384	221	X	
	62.49	63.54	1404	165	X	
	62.36	63.85	629	121	X	
	62.11	64.81	22	201		X
	62.28	64.96	350	201	X	
78-0050	64.12	61.86	2107	155	X	
	63.17	62.84	18	155		X
	63.18	62.95	20	180		X
	63.16	62.94	13	180		X
78-0156	58.67	60.75	1720	200	X	
78-1344	64.37	60.88	16	247		X
	64.11	60.97	15	285		X
	56.59	58.53	212	250	X	
	56.25	59.00	106	300	X	
78-1372	70.58	55.51	513	68	X	
	70.43	55.28	496	73	X	
	70.55	54.84	28	97		X
	70.49	56.37	55	135		X
78-1550	64.15	62.08	20	190		
	64.00	62.07	81	190	X	
	64.10	61.91	23	190		X
	64.13	61.80	22	190		X
	63.19	62.99	255	180	X	

a = Estimated from navigation charts

TABLE 13

Summary of satellite tracking and grounding data for icebergs tracked for Petro-Canada in western Baffin Bay, 1978 to 1980.

Iceberg no.	Tracking dates		Tracking period (days)	Grounding period (days)	Period grounded (%)
	Start	End			
78-1162	26 Aug 78	17 Dec 78	114	67.0	58.8
78-1163	31 Aug 78	22 Dec 78	114	66.8	58.6
78-1223	12 Sept 78	17 Dec 78	97	59.0	60.8
78-1241	04 Sept 78	31 Dec 78	119	4.3	3.6
78-1264	20 Sept 78	21 Dec 78	93	62.0	66.7
78-1401	20 Sept 78	31 Dec 78	103	46.2	44.9
78-1413	03 Sept 78	31 Dec 78	119	86.0	72.3
78-1446	03 Sept 78	11 Oct 78	38	5.0	13.2
78-1454	26 Sept 78	21 Dec 78	117	77.0	65.8
78-1462	20 Sept 78	22 Dec 78	93	76.0	81.7
79-1162	16 Jul 79	12 Dec 79	150	70.6	47.1
79-1163	14 Jul 79	01 Dec 79	141	138.3	98.1
79-1223	14 Jul 79	31 Dec 79	171	117.5	68.7
79-1241	01 Jan 79	05 Nov 79	309	295.5	95.6
79-1264	12 Jul 79	21 Nov 79	133	133.0	100
79-1401	12 Jul 79	31 Dec 79	173	118.6	68.5
79-1413	12 Jul 79	27 Nov 79	107	28.8	26.9
79-1446	13 Jul 79	22 Nov 79	101	32.0	31.6
79-1454	16 Jul 79	20 Nov 79	96	33.0	34.4
79-1462	12 Jul 79	07 Dec 79	148	105.5	71.3
79-1986	08 Sept 79	24 Nov 79	77	1.2	1.5
79-1987	13 Aug 79	17 Sept 79	35	8.8	25.1
79-1988	12 Aug 79	12 Nov 79	92	9.7	10.5
79-1989	12 Aug 79	29 Oct 79	78	nil	0
79-1990	12 Aug 79	15 Oct 79	64	nil	0
79-1991	08 Sept 79	25 Nov 79	78	47.8	61.3
79-1992	13 Aug 79	01 Sept 79	19	2.9	15.3
79-1993	08 Sept 79	16 Sept 79	8	1.5	18.8
79-1994	09 Sept 79	08 Oct 79	29	8.1	27.9
79-1995	09 Sept 79	13 Nov 79	65	nil	0
80-1993	20 Jun 80	09 Sept 80	81	4.2	5.2
80-1994	04 Dec 80	31 Dec 80	28	0.7	2.5

TABLE 14

Details of grounding data for icebergs tracked by satellite telemetry in western Baffin Bay, 1978 to 1980.

Iceberg no.	Date month-year	Position		Duration		Water depth (a) (m)	Grounded	
		Latitude North (°)	Longitude West (°)	(hrs.)	(days)		Positive	Probable
78-1162	09-1978	73.20	75.01	15		179		X
	09-1978	73.00	75.62	152	(6)	183	X	
	09-1978	74.23	80.25	33	(1)	719	X	
	12-1978	72.02	72.99	1408	(58)	730	X	
78-1163	08-1978	75.02	77.79	22		270		X
	09-1978	72.90	73.71	21		817		X
	09-1978	72.99	73.90	15		866		X
	10-1978	73.08	75.42	40		547	X	
	11-1978	71.74	72.31	1262	(52)	994	X	
	12-1978	71.78	72.30	242	(10)	994	X	
78-1223	11-1978	71.52	70.70	1419	(59)	1277	X	
78-1241	09-1978	75.24	77.93	72	(3)	328	X	
	12-1978	69.67	66.06	30	(1)	97	X	
78-1264	12-1978	70.65	68.24	1499	(62)	58	X	
78-1401	09-1978	74.93	79.36	25	(1)	73	X	
	09-1978	74.94	79.28	15		73		X
	12-1978	71.15	69.58	1069	(44)	91	X	
78-1413	09-1978	71.34	70.91	65	(2)	57	X	
	12-1978	71.30	71.10	2025	(84)	55	X	
78-1446	09-1978	75.30	77.86	31	(1)	387	X	
	10-1978	70.75	67.84	98	(4)	77	X	
78-1454	10-1978	70.71	69.60	25	(1)	68	X	
	12-1978	70.70	69.04	1826	(76)	64	X	
78-1462	12-1978	72.54	75.19	1825	(76)	73	X	
79-1162	08-1979	71.98	73.05	445	(18)	146	X	
	08-1979	72.01	72.96	83	(3)	146	X	
	10-1979	70.18	66.50	117	(4)	91	X	
	12-1979	67.29	63.21	1050	(43)	37	X	
79-1163	11-1979	71.77	72.21	3320	138)	183	X	
79-1223	07-1979	71.50	70.74	334	(13)	139	X	
	08-1979	71.56	70.86	108	(4)	139	X	
	08-1979	71.50	70.68	112	(4)	139	X	
	08-1979	71.52	70.73	34	(1)	139	X	
	09-1979	71.48	70.04	543	(22)	146	X	
	09-1979	70.15	66.92	16		84		X
	12-1979	68.49	67.00	1672	(69)	69	X	
79-1241	07-1979	68.44	64.84	4815	(200)	133	X	
	07-1979	68.44	64.92	123	(5)	133	X	

TABLE 14 (cont'd)

Iceberg no.	Date month-year	Position		Duration		Water depth (a) (m)	Grounded	
		Latitude North (°)	Longitude West (°)	(hrs.)	(days)		Positive	Probable
79-1241	10-1979	68.43	64.87	2155	(89)	133	X	
79-1264	11-1979	70.61	68.50	3253	(135)	175	X	
79-1401	08-1979	71.17	69.73	676	(28)	93	X	
	08-1979	71.15	69.68	161	(6)	93	X	
	09-1979	69.52	65.95	23		47		X
	12-1979	68.55	67.34	1877	(78)	0-73	X	
79-1413	08-1979	71.25	71.10	1058	(44)	55	X	
	09-1979	71.27	71.09	113	(4)	55	X	
	09-1979	70.86	69.95	189	(7)	55	X	
	09-1979	70.85	69.86	41	(1)	55	X	
	10-1979	70.86	69.93	585	(24)	55	X	
79-1446	08-1979	70.69	67.97	745	(31)	68	X	
	08-1979	70.56	67.75	45	(1)	68	X	
79-1454	08-1979	70.70	69.03	764	(31)	91	X	
79-1462	07-1979	72.60	76.02	106	(4)	91	X	
	07-1979	72.61	76.42	99	(4)	91	X	
	08-1979	72.17	77.06	49	(2)		X	
	12-1979	72.25	78.07	2278	(94)	90	X	
79-1986	11-1979	73.49	76.82	29	(1)	265	X	
79-1987	09-1979	73.24	76.37	210	(8)	183	X	
79-1988	08-1979	73.70	78.58	233	(9)	275	X	
79-1991	09-1979	76.18	76.36	393	(16)	212	X	
	10-1979	75.86	76.89	755	(31)	201	X	
79-1992	08-1979	73.69	78.62	36	(1)	183	X	
	08-1979	73.68	78.68	33	(1)	183	X	
79-1993	09-1979	75.59	77.96	37	(1)	183	X	
79-1994	09-1979	75.87	76.62	27	(1)	255	X	
	10-1979	75.53	82.97	167	(7)	220	X	
80-1993	06-1980	73.34	75.31	15		183		X
	07-1980	73.00	75.30	66	(2)	183	X	
80-1994	12-1980	70.35	64.16	16		400		X

a = Estimated from navigation charts

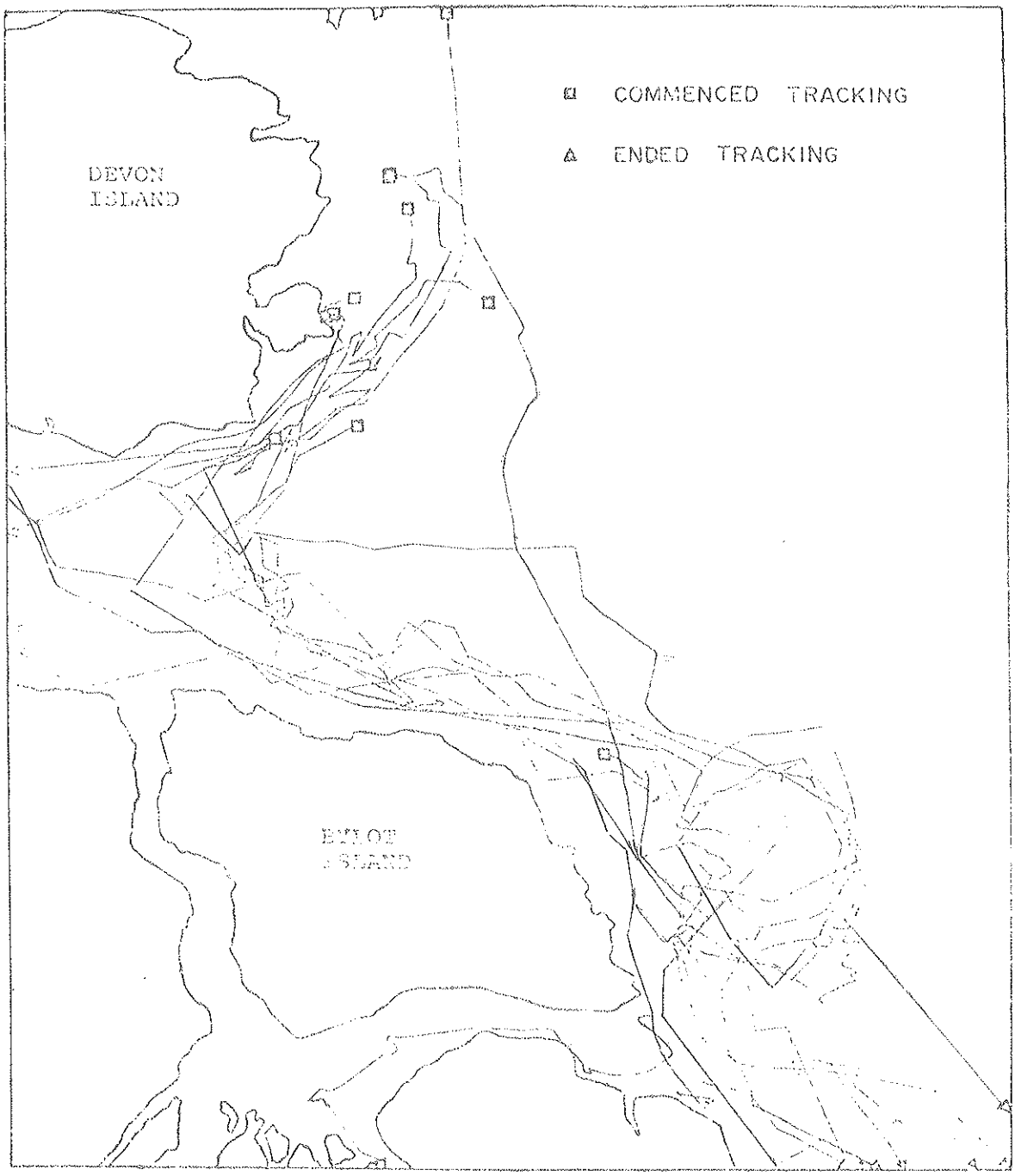


Figure 5 Trajectories of iceberg drifts from satellite - tracked data, 1978 (Fissel, 1980)

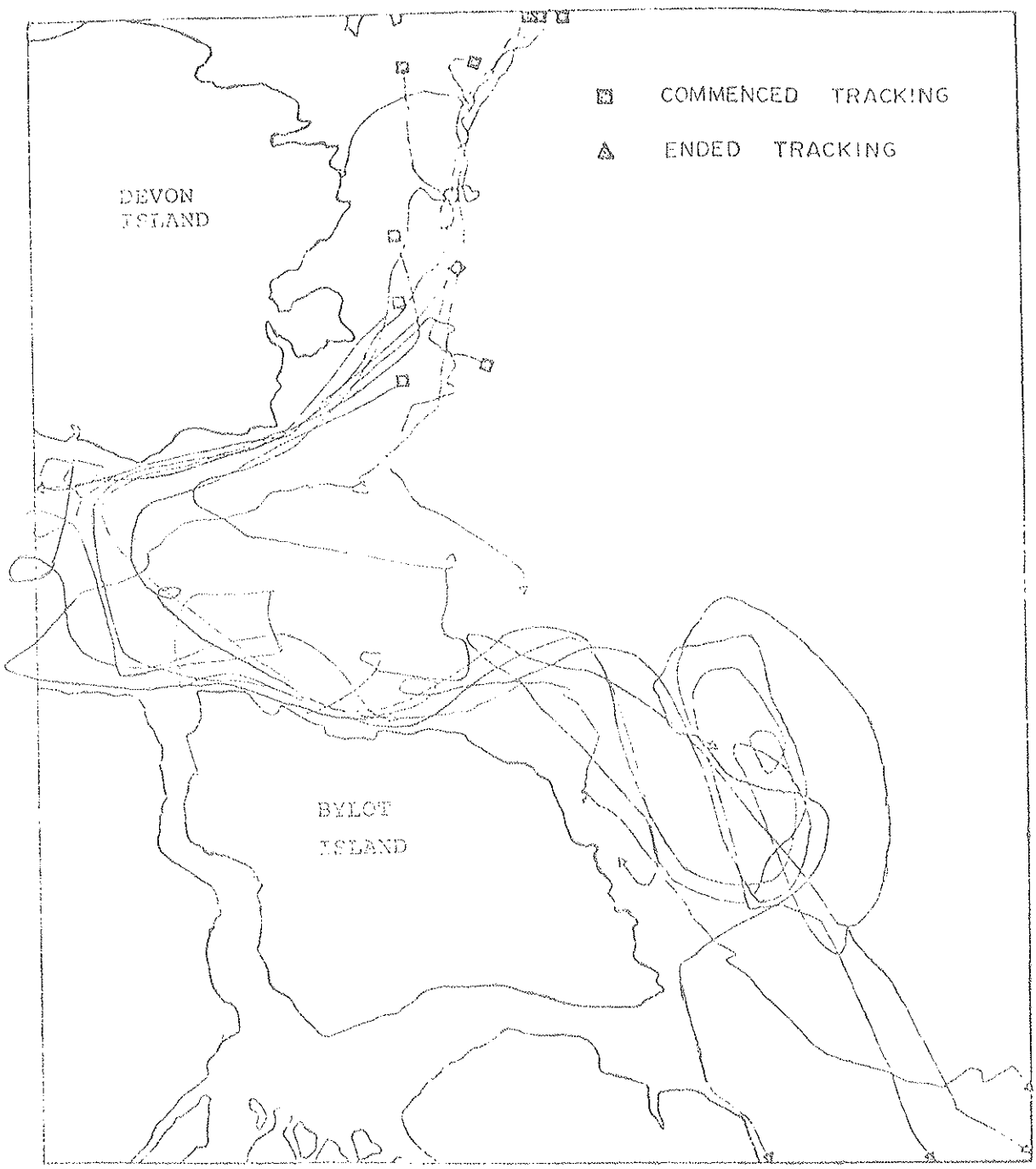


Figure 6 Trajectories of iceberg drifts from satellite - tracked data, 1979 (Fissel, 1980)

Icebergs were grounded for 0% to 100% of the total tracking time. About 45% of the icebergs were grounded for more than half of the tracking period. It should be noted that the water depth values provided in Table 14 are unreliable because they were obtained from the depth soundings in navigation charts. This unreliability may explain the fact that iceberg No. 78-1223 remained stationary for 59 days in an area where water depth is indicated as 1227 metres. The position of these icebergs is reported to be accurate within 0.5 to 2.5 km. This could introduce significant errors in water depth estimates since a slight offset in the position could result in extreme water depth due to certain seafloor features. Availability of a detailed bathymetric chart for the study area should provide better estimates of water depths at the locations of grounding.

Groundings Identified from International Ice Patrol Records

This data set contains about 65,000 records of iceberg positions as reported by the International Ice Patrol's flights and vessels and by other ships, during the years 1960 to 1982. Each sighting record includes date of sighting, iceberg position, size code, source of sighting report, and a "resight" identification code. The latter is used when an iceberg has been reidentified by shape or location and the iceberg is assigned the same number as for the first sighting. Reidentification is possible if a few icebergs are scattered in a wide area, if sequential flights are close enough in time, or if suites of icebergs

move together in a recognizable pattern. For large numbers of icebergs in close proximity, a "resight" is more questionable, and grounded icebergs might not be identified. For this reason, the actual number of groundings off Newfoundland and on the Grand Banks is expected to have been much higher than the number of grounding events extracted from the IIP records.

Of the 65,000 sightings, several hundred icebergs were identified again in the same location. Ten of these were identified as positively grounded and five as probably grounded and Table 15 presents the date, location of grounding, and water depth for each iceberg.

Breaks in Submarine Cables caused by Iceberg Groundings

There are eight submarine communication cable systems starting from, or terminating at Canada's eastern seaboard. Table 16 presents information on these cable systems including when the system was laid and whether it is still in service. Table 17 presents the dates, locations, and water depths of 25 cable crushes caused by iceberg impact. This information was provided by Teleglobe Canada. Cable breaks were identified as caused by iceberg impact by the repair crew, according to the mode of failure of the cable and the marks on the ocean bed that distinguish iceberg impact from other causes of cable damage (e.g., due to fishing gear and ship anchors).

All 25 iceberg impacts affected only three of the cable systems: ICECAN, TAT, and BMEWS. Cable breaks

TABLE 15

Summary of iceberg grounding events from International Ice Patrol data.

Iceberg no.	Date	Position		Water depth (m)	Grounded	
		Latitude North (°)	Longitude West (°)		Positive	Probable
592	13 May 1975	47.58	49.05	146		X
	14 May 1975	47.57	49.08			
748	27 May 1975	47.36	52.40	110	X	
	30 May 1975	47.36	52.40			
251	02 May 1977	48.41	52.56	238	X	
	03 May 1977	48.39	53.01			
	04 May 1977	48.39	53.00			
	05 May 1977	48.39	53.00			
504	27 Apr 1978	46.54	52.56	196	X	
	03 Jun 1978	46.55	52.56			
	08 Jun 1978	46.56	52.55			
	09 Jun 1978	46.54	52.56			
745	13 Jun 1978	47.45	52.45	157	X	
	15 Jun 1978	47.45	52.42			
748	13 Jun 1978	48.08	52.53	194	X	
	15 Jun 1978	48.08	52.52			
764	13 Jun 1978	48.32	53.02	275	X	
	15 Jun 1978	48.29	53.00			
329	14 Jun 1979	46.55	52.49	176		X
	15 Jun 1979	46.55	52.49			
392	20 Jun 1979	46.38	53.05	146	X	
	23 Jun 1979	46.38	53.05			
339	23 Jun 1979	46.34	52.32	68		X
	23 Jun 1979	46.30	52.28			
	24 Jun 1979	46.32	52.32			
397	23 Jun 1979	46.20	53.10	154		X
	24 Jun 1979	46.20	53.10			
480	10 Jul 1979	46.35	53.46	110	X	
	12 Jul 1979	46.35	53.46			
	15 Jul 1979	46.32	53.35			
	18 Jul 1979	46.36	53.37			
	21 Jul 1979	46.38	53.43			
505	15 Jul 1979	47.42	52.34	154	X	
	18 Jul 1979	47.42	52.37			
172	21 Jun 1980	49.15	53.22	146		X
	22 Jun 1980	49.16	53.23			
547	18 Aug 1982	47.18	52.50	168	X	
	31 Jul 1982	47.11	52.48			
	09 Aug 1982	47.11	52.48			
Total					10	5

TABLE 16

Information on submarine telephone cables

Cable	Name	Cable terminals	Date system laid	Date system taken out	Owner
TAT-1	First Trans-Atlantic Telephone Cable	Clarenville, Nfld. and Oban, Scotland	1956	1978	AT & T
TAT-2	Second Trans-Atlantic Telephone cable	Clarenville, Nfld. and Penmarch, France	1959	1981	AT & T
BMEWS	Ballistic Missile Early Warning-System	Corner Brook, Nfld. and Thule, Greenland	1960	1975	U.S. Air Force
CANTAT-1	Canadian Trans-Atlantic 1 Cable	Corner Brook, Nfld. and Oban, Scotland	1961	in service	Teleglobe Canada
ICECAN	Iceland-Canada cable	Corner Brook, Nfld. and Frederiksdal, Iceland	1962	in service	Teleglobe Canada
CANTAT-B	Canadian Trans-Atlantic B cable	Corner Brook, Nfld. and Grosses Roches, Quebec	1961	1975	Teleglobe Canada
CANBER	Canada-Bermuda cable	Mill Village, N.S. and Devonshire, Bermuda	1970	in service	Teleglobe Canada
CANTAT-2	Canadian Trans-Atlantic 2 cable	Beaver Harbour, N.S. and Widemouth, England	1974	in service	Teleglobe Canada

TABLE 17

Submarine communications cable crushes or breaks caused by iceberg impact

NO.	Date	Location Latitude (N)	Location Longitude (W)	Water depth (m)	Cable
1	03 Oct. 1960	66°25'35"	61°07'36"	421 a	BMEWS EAST
2	23 Mar. 1961	48°34'00"	52°49'00"	59	TAT-2 E-W
3	16 Jan. 1963	59°58'57"	44°42'01"	86	ICECAN SOUTH
4	23 Jan. 1963	59°56'15"	44°42'46"	106	ICECAN SOUTH
5	07 Feb. 1963	59°43'18"	44°45'24"	143	ICECAN SOUTH
6	11 Feb. 1963	59°56'45"	44°41'24"	106	ICECAN SOUTH
7	11 Feb. 1863	59°38'40"	44°50'34"	137	ICECAN SOUTH
8	30 Sept. 1963	59°57'08"	44°41'42"	77	ICECAN SOUTH
9	03 Oct. 1963	59°39'31"	44°51'08"	139	ICECAN SOUTH
10	21 Feb. 1965	59°56'32"	44°31'20"	208	ICECAN SOUTH
11	30 Jul. 1965	76°08'30"	69°53'20"	199	BMEWS WEST
12	29 Oct. 1965	76°19'06"	69°59'40"	185	BMEWS WEST
13	28 Nov. 1966	76°09'54"	69°53'36"	236	BMEWS WEST
14	12 Aug. 1968	59°37'30"	44°24'20"	154	ICECAN SOUTH
15	07 Sept. 1968	76°11'55"	69°59'18"	201	BMEWS WEST
16	06 Oct. 1968	76°12'04"	69°56'42"	212	BMEWS WEST
17	12 Sept. 1969	59°38'36"	44°29'45"	157	ICECAN SOUTH
18	20 Feb. 1970	59°35'55"	44°30'15"	150	ICECAN SOUTH
19	Jun. 1970	59°35'55"	44°30'15"	150	ICECAN SOUTH
20	12 Nov. 1970	76°10'39"	69°58'18"	243-397	BMEWS WEST
21	14 Jul. 1974	48.31'00"	52°49'00"	183	TAT-2 E-W
22	23 Sept. 1976	59°37'33"	44°29'36"	156	ICECAN SOUTH
23	29 Jan. 1978	b		165	ICECAN SOUTH
24	29 Oct. 1981	59°37'30"	44°29'25"	155	ICECAN SOUTH
25	04 Sept. 1982	59°37'42"	44°28'36"	155	ICECAN SOUTH

a - On the bathymetric chart this location is shown as having a water depth of less than 180 meters.

b - Near Frederiksdal, southern tip of Greenland

occurred at four different areas: off Frederiksdal on the southern tip of Greenland (a); off Greenland's west coast around Kap Atholl (b); off Exeter Bay on the west coast of Baffin Island (c); and off Trinity Bay on the east coast of Newfoundland (d) (Figure 7). Table 18 presents the number of iceberg impacts for each of these areas in each year.

The iceberg groundings do not seem to have a regular frequency. For example, the ICECAN cable system was laid in 1962 and suffered seven iceberg impacts in 1963; one each in 1965, 1968, 1969, 1976, 1978, 1981, and 1982; and two in 1970. No correlation could be found between iceberg impacts on the cables and the severity of the iceberg season. For example, in 1972, when record numbers of icebergs were recorded off eastern Newfoundland there were no reports of iceberg impacts on any cable.

Out of the 25 cable crushes, 23 took place north of 59°N while only two breaks were reported off Newfoundland's east coast. In a given year all these iceberg impacts occurred during the season of high iceberg concentration in each area. The large number of cable breaks north of 59°N is consistent with the fact that the number of icebergs that cross latitude 60°N is about eight times higher than the number of icebergs that reach Newfoundland waters. The above analysis is based on a very limited number of grounding events and, therefore, should be considered as general observation. No conclusive findings can be reported because of insufficient data.

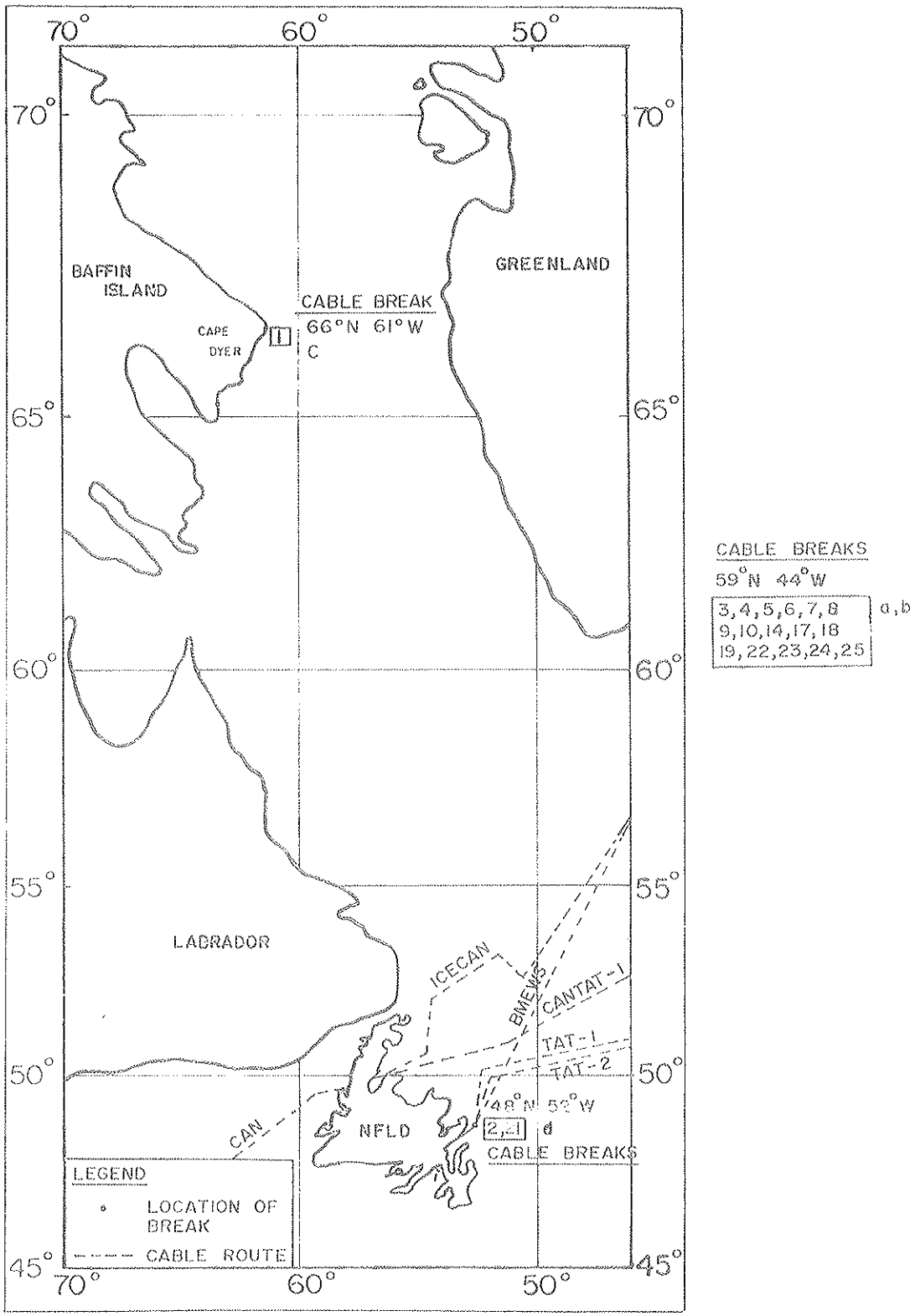


Fig. 7 Submarine cable routes and breaks caused by iceberg impact off Canada's East Coast

TABLE 13

Summary of data for cable crushes by iceberg impact

Year	No. of impacts	No. in area (a)	No. in area (b)	No. in area (c)	No. in area (d)
1960	1			1	
1961	1				1
1963	7	7			
1965	3	1	2		
1966	1		1		
1968	3	1	2		
1969	1	1			
1970	3	2	1		
1974	1				1
1976	1	1			
1978	1	1			
1981	1	1			
1982	1	1			
Total	25	16	6	1	2

a - Off Frederiksdal on the southern tip of Greenland.

b - Off Greenland's west coast near Kap Atholl.

c - On the east coast of Baffin Island (66°25'35"N; 61°07'36"W).

d - Off Trinity Bay, Newfoundland.

Groundings from Other Sources

A survey of icebergs in the Davis Strait and Baffin Bay area (between 63°N to 75°N) was carried out for the Arctic Petroleum Operators Association (APOA) from July to October, 1972 (Marex 1972). During the survey, measurements were made of 421 icebergs from the vessel Hans Egede. Of these 13 (3.1%) were reported to be positively grounded and 16 (3.8%) were probably grounded. Table 19 presents the date, grounding position, and iceberg parameters. The largest iceberg identified as grounded was 380 m long, 88 m above the water level, and had an estimated mass of 53.9 million tonnes. No information was provided on the criteria used to identify grounding events or to select the surveyed icebergs.

TABLE 19
Summary of iceberg groundings for the APOA iceberg survey
in Baffin Bay and Davis Strait, 1972

Date (1972)	Iceberg no.	Grounding position		Iceberg type	Length (m)	Height (m)	Mass (t x 10^6)	Grounded	
		Latitude (North)	Longitude (West)					Positive	Possible
20 July	A78	71°30'	55°14'	PI-DD	62.8	22.1	0.2	X	
20 July	A79	71°30'	55°14'	Dome	33.5	8.7	0.3	X	
20 July	A80	71°30'	55°14'	Dome	27.0	7.9	0.23	X	
20 July	A81	71°30'	55°14'	PI	11.3	5.5	0.005	X	
20 July	A82	71°30'	55°14'	Dome	37.2	10.2	0.041	X	
20 July	A83	71°30'	55°14'	Tab.	31.7	6.8	0.02	X	
20 July	A84	71°30'	55°14'	Tab.	80.8	17.1	0.4	X	
30 July	B26	73°25'	76°32'	Dome	181.4	90.0	9.60		X
31 July	B37	73°03'	75°37'	Dome	282.0	69.5	11.0		X
	B38	73°03'	75°37'	Dome	180.0	53.4	5.0		X
	B39	73°03'	75°37'	Dome	108.0	29.6	1.0		X
	B40	73°03'	75°37'	PI-DD	124.0	56.0	2.5		X
	B41	73°03'	75°37'	PI-DD	134.0	56.4	2.5		X
	B42	73°03'	75°37'	PI-DD	203.0	73.2	7.0		X
	B43	73°03'	75°37'	Tab.	88.4	19.6	0.6		X
11 Aug.	B104	73°51'	80°16'	Dome	71.7	17.7	0.27		X
	B105	73°51'	80°16'	Dome	146.0	32.0	2.0		X
22 Aug.	C16	71°20'	68°23'	Tab.	511.0	78.7	42.0		X
22 Sept	F26	64°32'	62°48'	Dome	389.0	80.0	38.5		X
23 Sept	F28	64°28'	63°00'	Dome	355.0	82.0	33.0		X
24 Sept	F41	63°59'	61°59'	Tab.	369.0	65.0	38.0	X	
	F42	64°01'	62°09'	PI-DD	218.0	75.0	7.0	X	
	F43	64°05'	62°28'	PI-DD	145.0	46.0	1.5		X
	F45	64°09'	62°45'	PI-DD	177.0	49.0	2.0	X	
	F46	64°09'	62°48'	PI-DD	147.0	59.5	3.0	X	
27 Sept	F62	63°47'	63°28'	Dome	209.0	38.0	2.0		X
	F63	63°46'	63°32'	PI-DD	114.0	34.0	0.8		X
04 Oct.	64	69°47'	65°32'	Tab.	380.0	88.0	53.9	X	
	65	69°47'	65°32'	Tab.	302.0	45.3	17.8	X	

PI = Pinnacled
Tab. = Tabular
DD = Dry Dock

ANALYSIS OF GROUNDING DATA

Frequency of Grounding

Drill-rig radar data

Figure 8 presents the yearly variation in the total number and average number of icebergs tracked by radar near well- sites off Newfoundland and Labrador and was derived from Table 3. The number of icebergs tracked by all the drill-rig radars varied from 67 in 1973 to 633 in 1981. The maximum number of icebergs tracked by one drill-rig radar was 383 icebergs (at the Bjarni O-82 RE well-site). These were tracked during 25 June to 31 July, 1981, a period of 37 days, for an average of about 11 new icebergs per day. The average number of icebergs within radar range of each well-site varied from 22 in 1973 to 211 in 1981. The variation in this number followed the general yearly variation in the number of icebergs that the IIP reported crossing latitude 48°N (Robe 1982).

The yearly variation in the number of positive and probable grounded icebergs as a percentage of the total number of icebergs tracked each year is presented in Figure 9. No correlation could be found between the total number of icebergs tracked each year and the number of grounded icebergs. As presented in Table 20, in 1974, only six icebergs were positively grounded from a total of 416 icebergs; whereas in 1979, 23 of 442 icebergs were grounded. Similarly, in 1982 only seven icebergs were grounded of 383 tracked, while 48 of 633 icebergs were grounded in 1981.

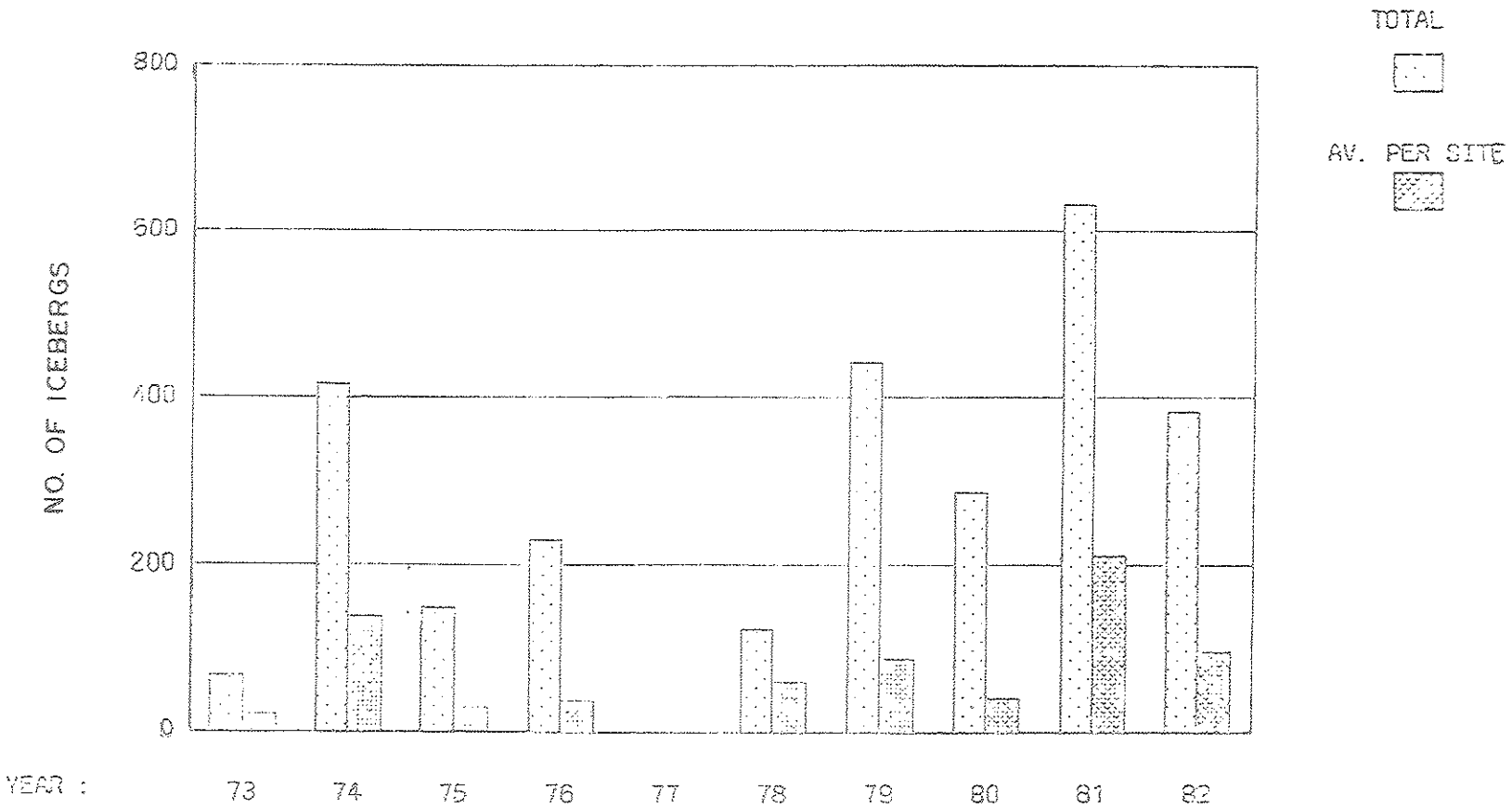


Figure 8 Yearly variation in number of icebergs tracked near well-sites.

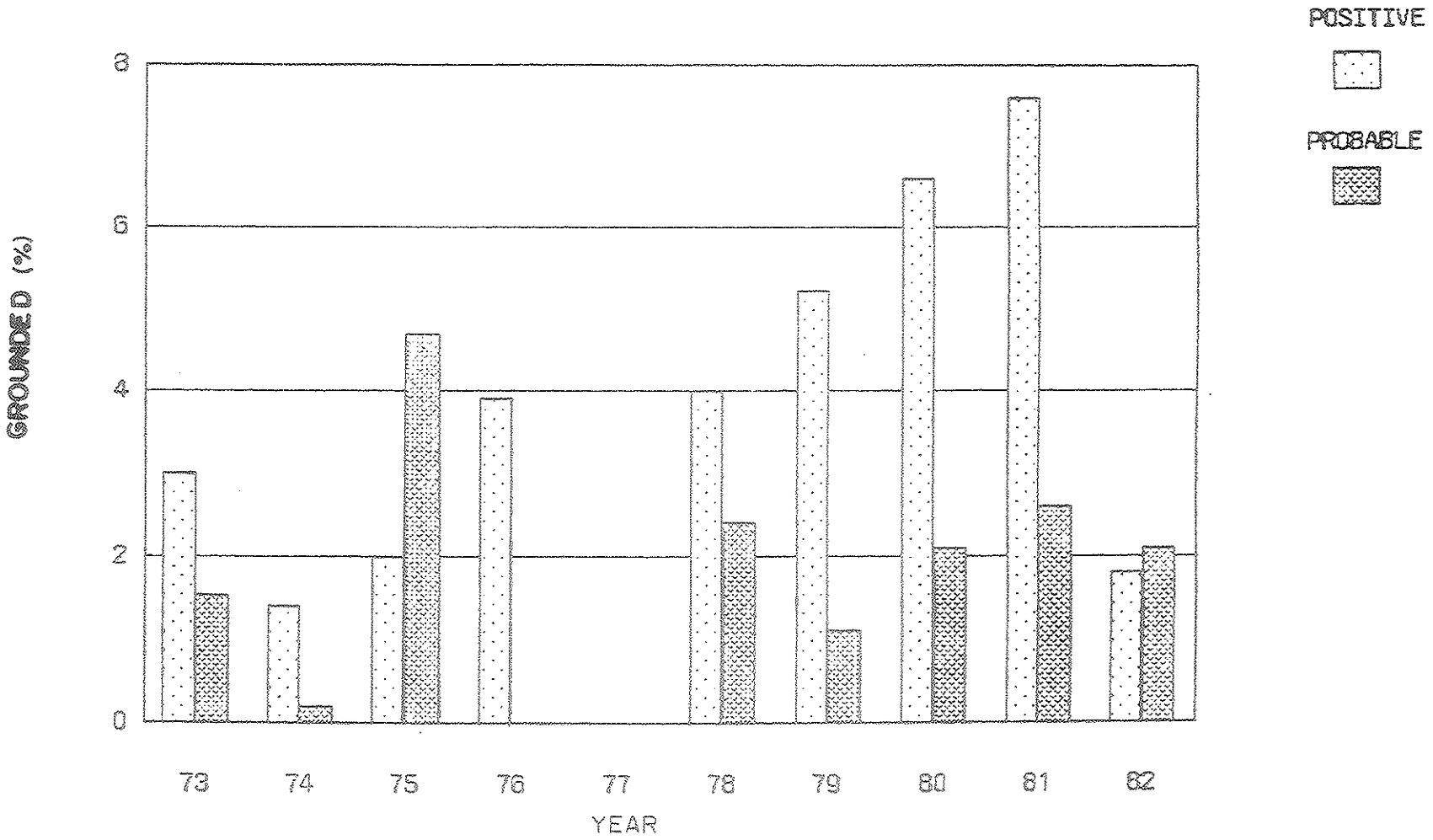


Figure 9 Grounded icebergs as a percentage of the total tracked each year.

TABLE 20

Yearly summary of grounding events for well-site data

Year	Number of icebergs tracked		Positive grounding		Probable grounding	
	Total	Mean per site	Total	Percent	Total	Percent
1973	67	22	2	3.0	1	1.5
1974	416	139	6	1.4	1	0.2
1975	149	30	3	2.0	7	4.7
1976	229	38	9	3.9	0	0
1978	123	61	5	4.0	3	2.4
1979	442	88	23	5.2	5	1.1
1980	286	41	19	6.6	6	2.1
1981	633	211	48	7.6	17	2.6
1982	383	96	7	1.8	8	2.1
Total	2,728	72	123	4.5	48	1.8

The grounded icebergs for any year varied from 1.4% to 7.6% of the total number of icebergs tracked.

For a given well-site, the frequency of grounding varies significantly from one year to another. For example, near the Rut well-site the frequency of grounding was 12.4% (24 of 193 icebergs) in 1981 but only 4.7% (5 of 106 icebergs) in 1982. However, at other sites, like Bjarni, less variation in the grounding frequency was observed (8.3% in 1973, 8% in 1979, and 5.7% in 1981). The

frequency of grounding at Bjarni in 1974 was excluded because only 10 icebergs were tracked. The highest grounding frequency was 18.8% (6 of 32 icebergs) at the Ogmond well-site in 1980.

Figure 10 shows the location and frequency of positive groundings near each well-site for all years. It is interesting to note that south of 54.5°N no grounding occurred. As expected the frequency of grounding is more influenced by site specifics rather than the total number of tracked icebergs at a certain location. The grounding frequency varied from 0 to 18.8% with mean value of 4.5%. Figure 11 shows the location and distribution of iceberg groundings for each well-site during the period 1973 to 1982. About 32% of the total groundings took place near the Bjarni and Herjolf well-sites during the five and one years of tracking respectively. The second highest frequency of groundings (23.6%) occurred near the Rut well-site during two drilling seasons. The remainder of the groundings were divided among the other well-sites, (see Figure 11).

Shore-based radar data

The frequency of positive grounding for icebergs tracked by the shore-based radar stations at Saglek and in the Strait of Belle Isle (see Tables 5 and 7), varied from 0 to 33% (excluding the 67% obtained from three tracked icebergs).

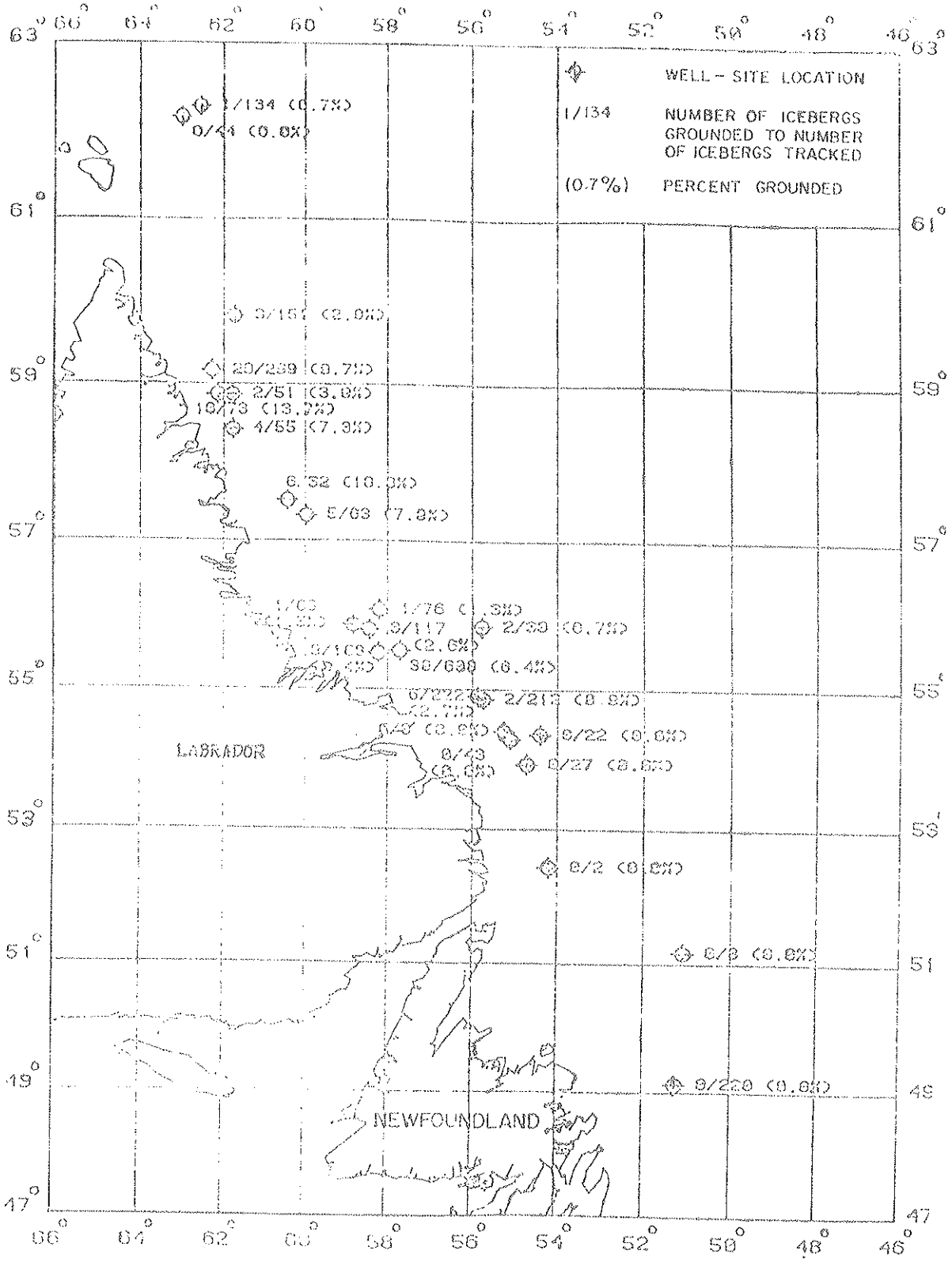


Figure 10 Percentage of iceberg groundings near well-sites

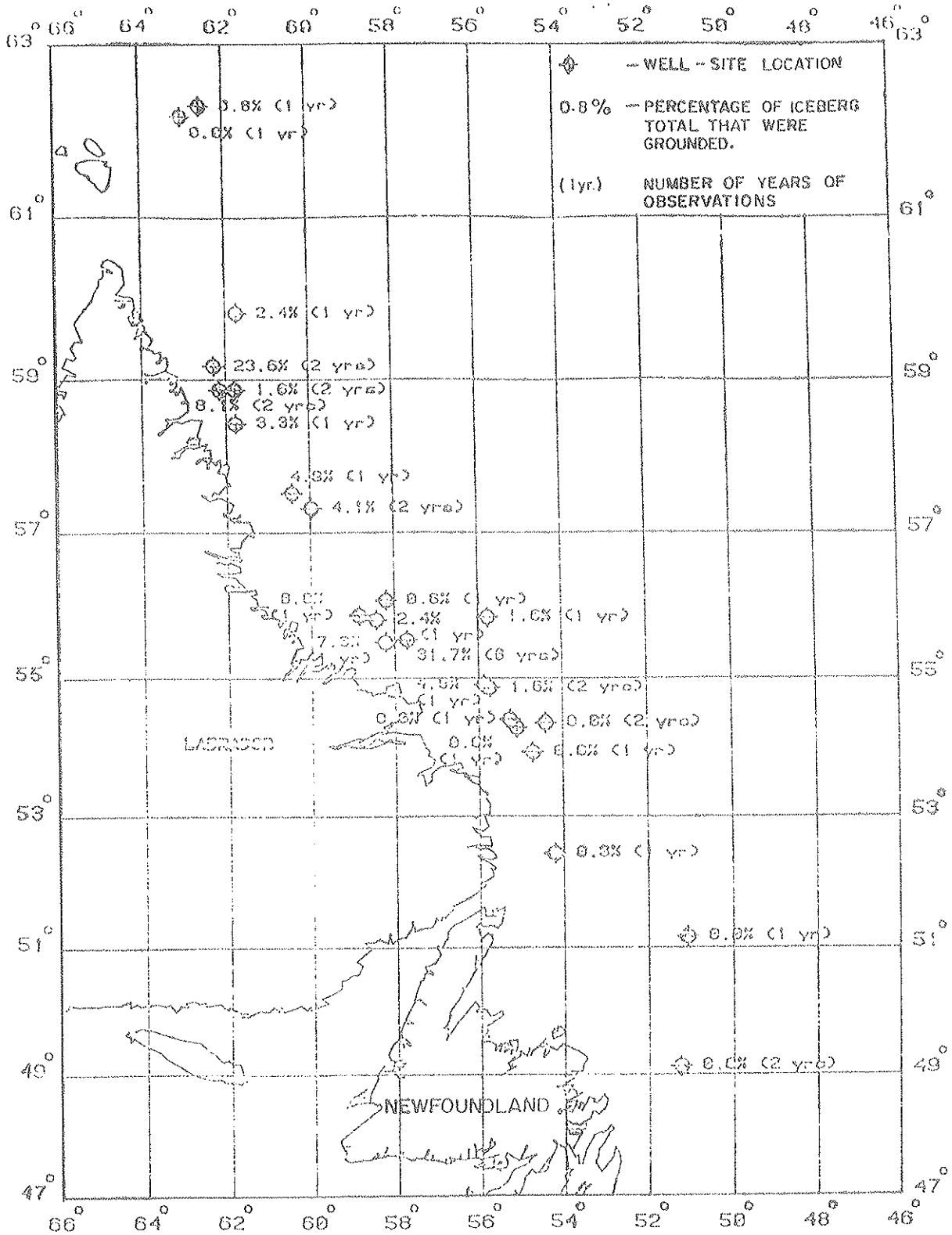


Figure 11 Distribution of iceberg groundings as a percentage of the total icebergs tracked.

The average is 19.9% for the Saglek area and 16.4% for the Strait of Belle Isle. The mean value of the frequency of groundings near the well-sites in the Saglek area of the Labrador Sea is 9.4% (45 of 478 icebergs). This figure is about twice the mean value for all the sites but it represents only one half of the mean value of grounding frequency of icebergs tracked by the Saglek radar station. The fact that the icebergs tracked by the Saglek radar station grounded more frequently than those tracked near the well-sites may be attributed to the difference in water depth.

Grounding Duration

Table 21 presents the frequency of occurrence of positive grounding duration for the drill-rig data, shore-based radar data, and for both data sets combined. Figure 12 is an exceedence diagram for the grounding duration for each data set showing that the distributions from the two data sources are very close for durations longer than one day. The percentage with a grounding duration of less than one day for icebergs tracked near the well-sites is higher than that for the icebergs tracked by the shore-based radars. The reason is that there was less information available for the icebergs tracked by shore-based radars than for those tracked by drill-rig radars to help verify positive groundings for durations less than one day. About half of the icebergs had a grounding duration of less than 48 hours and about 20% had a duration greater than five days. The longest grounding duration was 31 days near the Rut H-11 well-site in 1981.

TABLE 21

Distribution of positive grounding duration for icebergs tracked by drill-rig and shore-based radars

Grounding duration (days)	Frequency of occurence (%)		
	Drill-rig radars	Shore-based radars	Combined
1	26.8	14.2	21.5
1 - 2	26.8	28.3	27.8
2 - 3	14.1	17.9	16.0
3 - 4	7.4	10.3	8.9
4 - 5	8.9	7.5	8.4
5 - 6	4.5	1.9	3.3
6 - 7	2.2	2.8	2.5
7 - 8	2.2	2.8	2.5
8 - 9	1.5	1.9	1.7
9 - 10	1.5	2.8	2.0
10 - 11	0	1.9	0.8
11 - 12	0	1.9	0.8
12 - 13	0	0	0
13 - 14	0.8	0.9	0.8
14 - 15	0	0.9	0.4
15 - 20	1.5	0	0.8
20 - 25	6.8	0.9	0.4
25 - 30	1.5	0	0.4
30 - 35	0.8	0	0.4

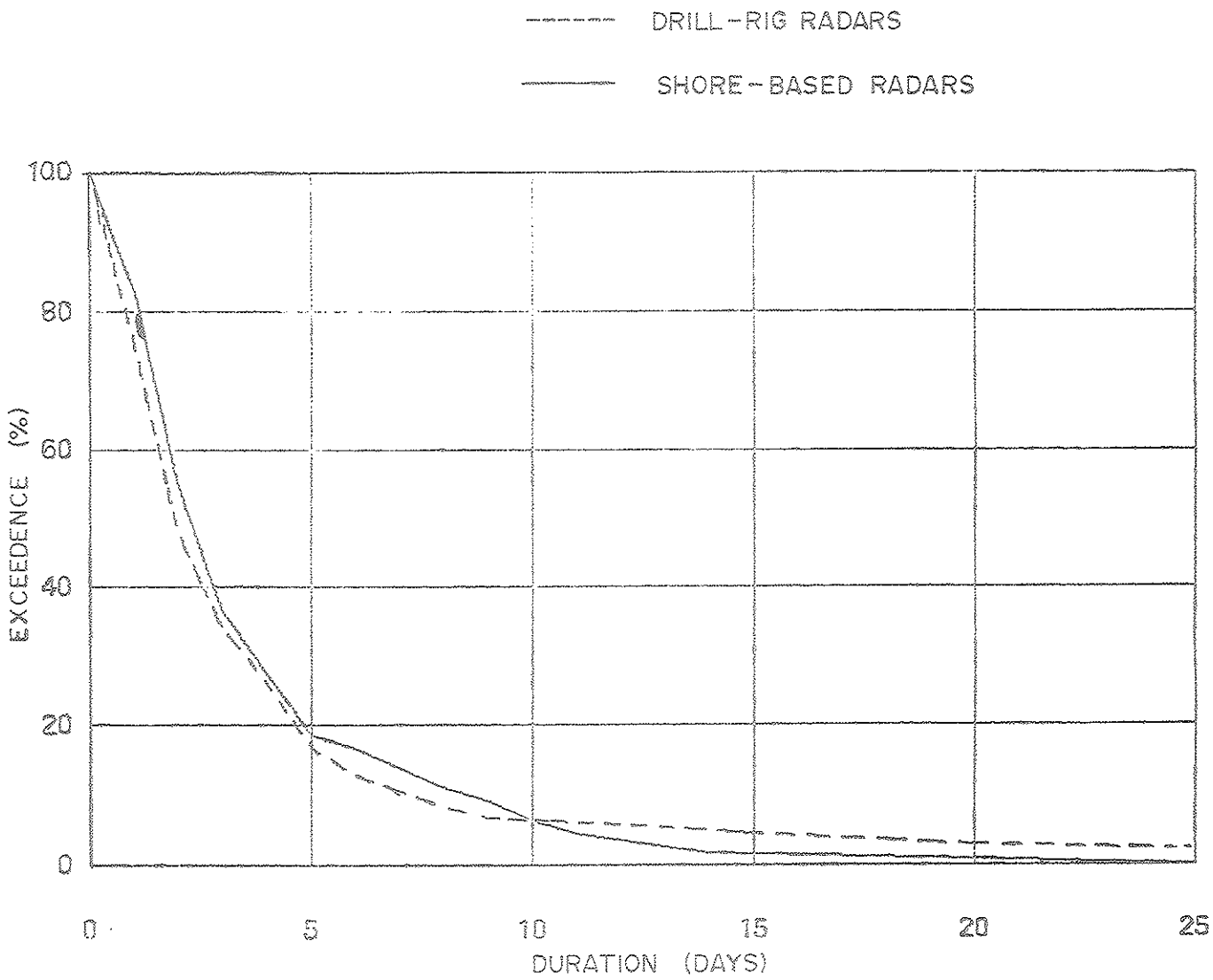


Figure 12 Exceedence diagram for positive grounding duration, all radar data

Figure 13 shows the frequency distribution diagram graphically for the combined data, for durations up to ten days.

The grounding duration of icebergs tracked by satellite telemetry ranged from 5 days to 295 days (see Tables 11 and 13). The icebergs were grounded from 3.6 to 100% of the tracking time. The 8 icebergs tracked for IIP from Baffin Bay to the Labrador Sea in 1977 and 1978 were grounded 32% of their tracking time; the 32 icebergs tracked in Baffin Bay for Petro-Canada from 1978 to 1980 were grounded 53% of their tracking time with an average value of 47% for all the icebergs.

Mass and Draft of Grounded Icebergs

Figure 14 presents the frequency distribution diagram for the mass of icebergs observed at all latitudes (49° to 75°N) off the east coast of Canada from 1971 to 1979. A logarithmic scale is used to represent the distribution of iceberg mass. This diagram was based on data compiled in-house (Fenco Newfoundland data base) on mass estimates for 756 icebergs. About 45% of the icebergs had masses in the range 0.5 to 5.0 million tonnes. The maximum mass was estimated at 54.0 million tonnes for an iceberg at 69°47'N.

Estimates of mass were available for 47 positively grounded icebergs tracked near well-sites (see Table 3). Figure 15 presents the frequency distribution diagram for those icebergs. The maximum mass of an iceberg grounded

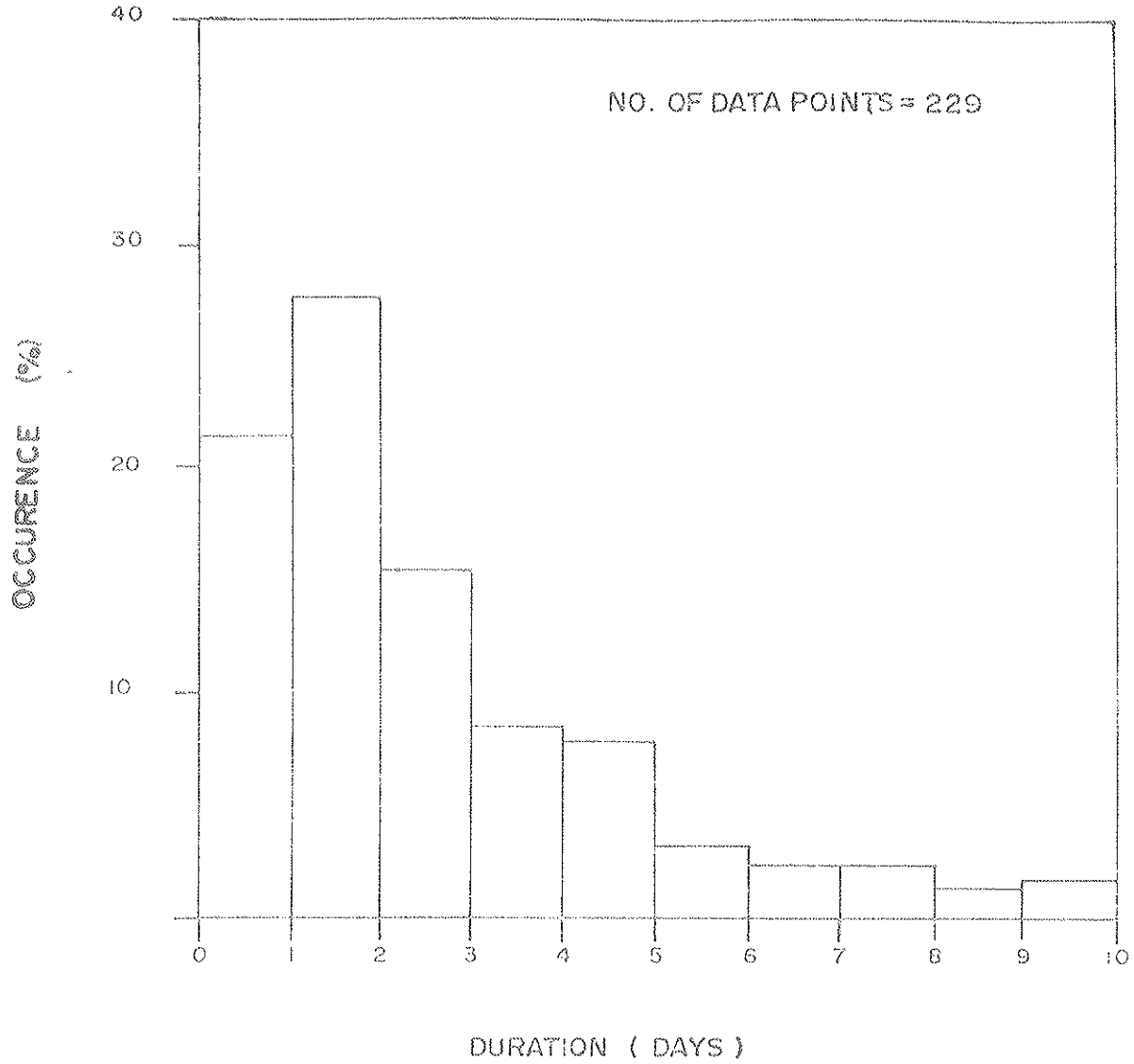


Figure 13 Distribution of duration of positive iceberg grounding for combined drill-rig and shore-based radar data sets.

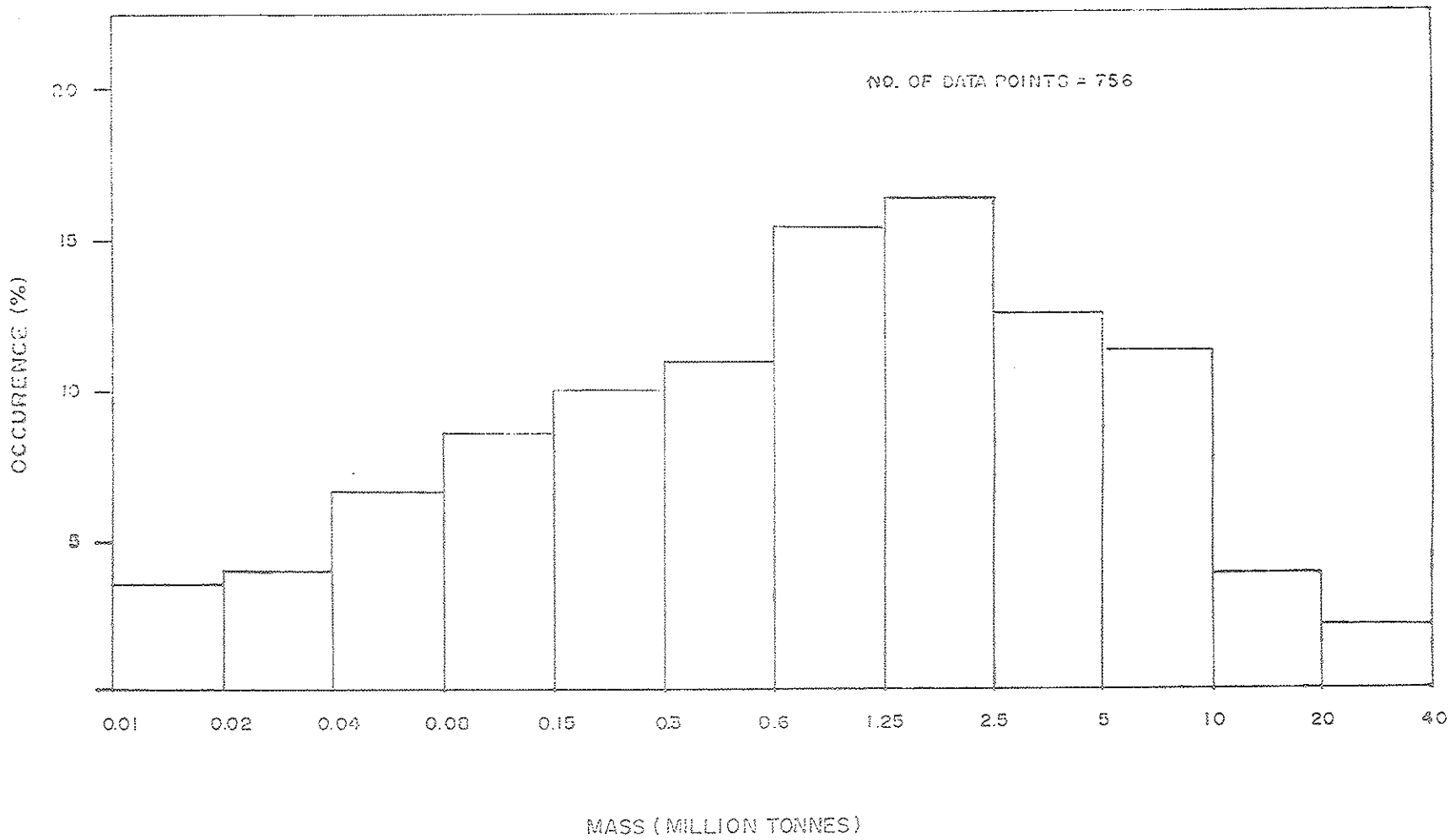


Figure 14 Distribution of iceberg mass between latitudes 49° and 75° N, from Fenco Newfoundland Limited data base of 756 icebergs.

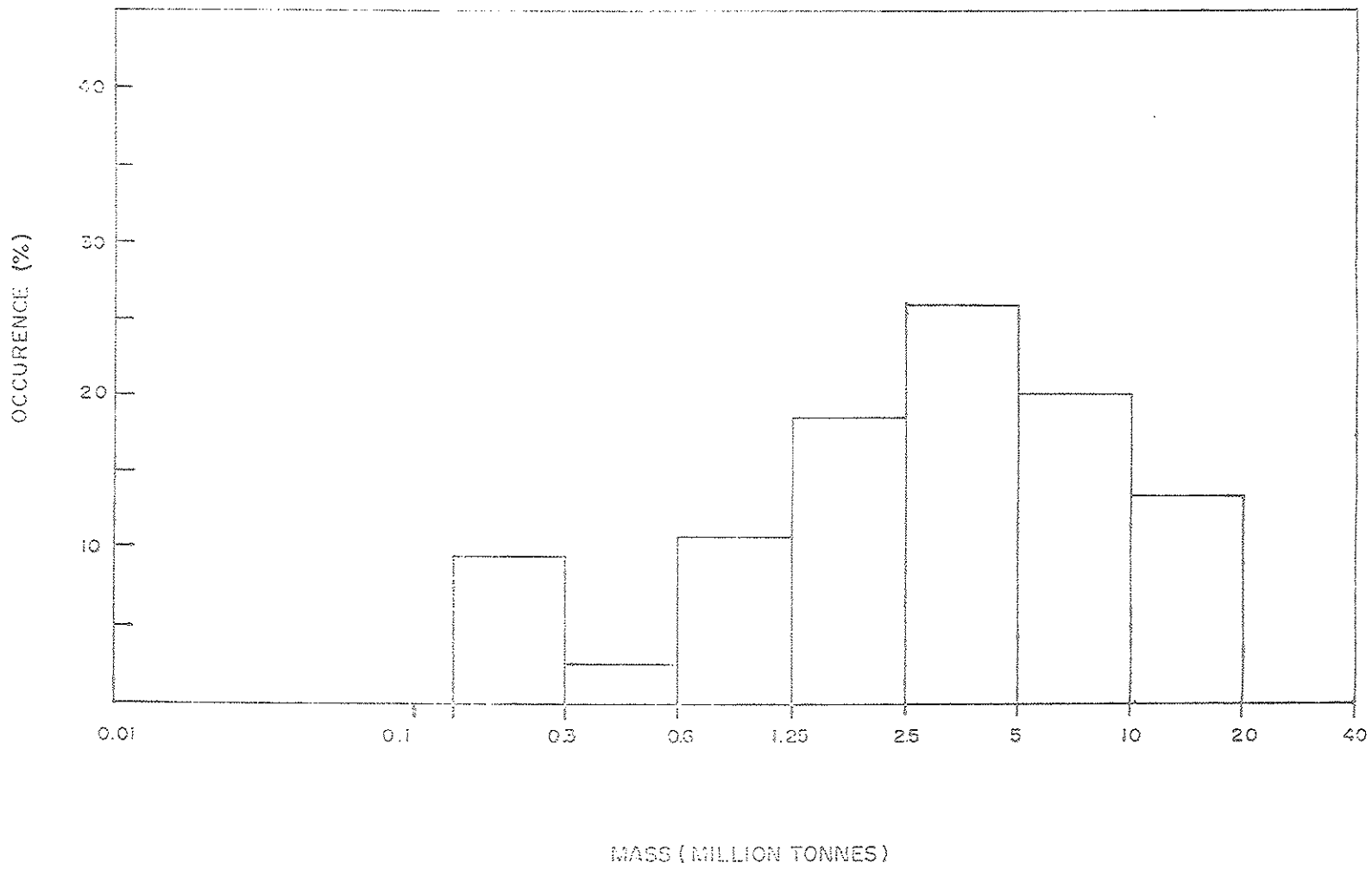


Figure 15 Distribution of the mass of 47 grounded icebergs by percentage of occurrence.

near the east coast well-sites was estimated to be 20 million tonnes. About 75% of the grounded icebergs had masses in the range 1-20 million tonnes. The maximum mass of a grounded iceberg ever reported was 53.9 million tonnes (see Table 19) for an iceberg at 69°47'N 65°32'W. Note that the modal value of iceberg mass has shifted from the 1.25 to 2.5 million tonne range for the 756 iceberg data base to 2.5 to 5 million tonnes for the 47 grounded icebergs. The reason for this shift is that smaller icebergs do not become grounded in the deeper water near the well-sites.

To investigate this point further, the distribution of drafts of the total iceberg population was compared to the distribution of drafts of the 47 grounded icebergs. Figure 16 presents the frequency distribution of the measured draft of 218 icebergs as compiled from reported measurements from 1973 to 1979 (Fenco data base). About 85% of the icebergs had drafts ranging from 50 to 150 m and the maximum measured draft was 230 m.

Figure 17 presents the frequency distribution of the measured draft of the grounded icebergs as obtained from Table 3. The maximum measured draft of a grounded iceberg was 165 m. About 57% of the icebergs had a draft in the range of 100-150 m. As observed in the discussion of mass distribution above, the modal value of the draft of the grounded icebergs has a value larger than that of the total iceberg population. As indicated earlier, this observation has a simple, logical explanation. The draft of a grounded iceberg is a function of water depth, and the water depth at these locations was greater than the modal value of the distribution of the drafts of the total iceberg population.

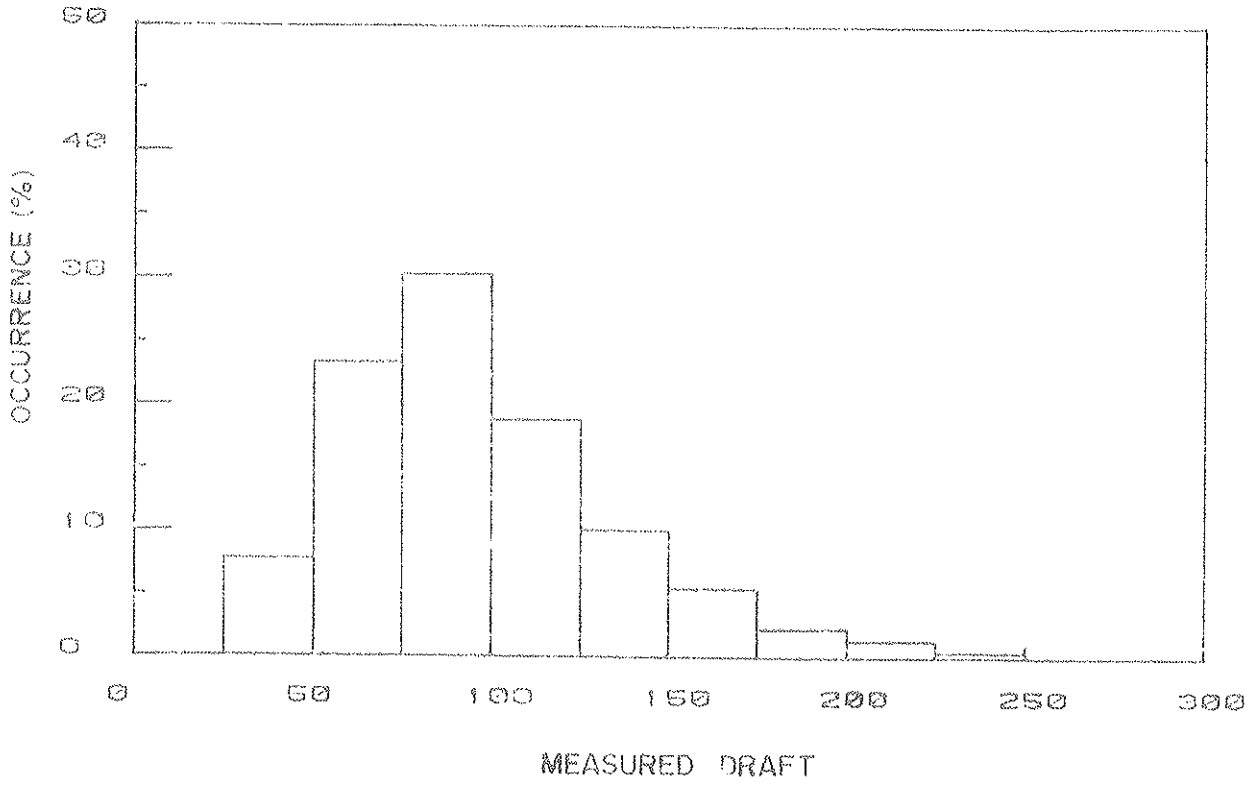


Figure 16 Distribution of measured draft for 218 icebergs from latitude 49° to 75°N, during the years 1973 to 1979.

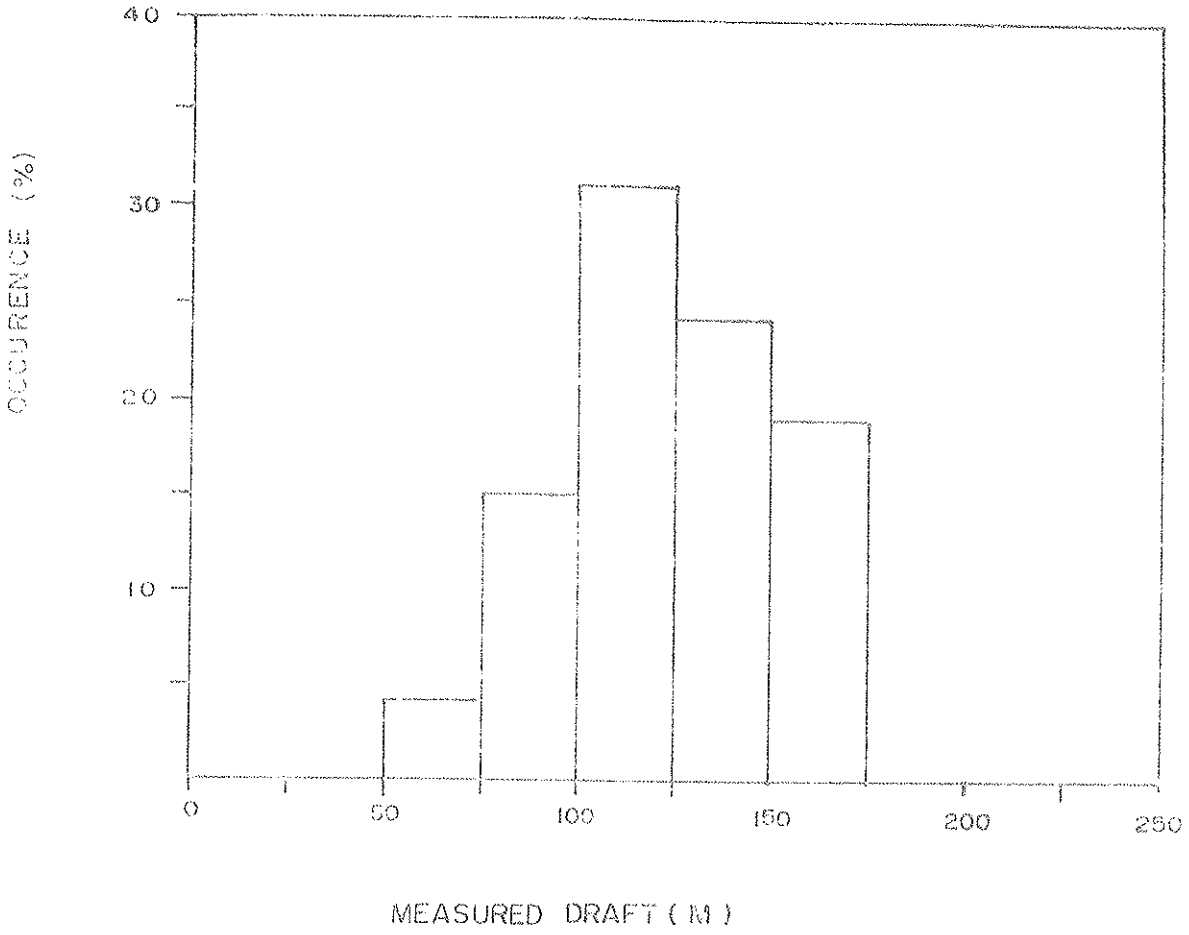


Figure 17 Distribution of measured draft of grounded icebergs by percentage of occurrence.

CONCLUDING REMARKS

The study presents a comprehensive documentation of iceberg grounding off Canada's east coast using all the available data up to 1982. The compiled data on iceberg grounding (date, position, duration, water depth, and iceberg parameters) are presented in table form in the report and the tracking data for each iceberg (date, position) have been stored on computer tape. For the most efficient use of these data, the files on tape should be used to establish a data base on iceberg groundings. Thus it would be easy to carry out analytical and correlational studies according to the specific needs of the individual researcher. This data base should be updated every two years as more data become available.

The grounding data have been analysed to provide information and statistics on grounding frequency and duration, and the mass and draft of grounded icebergs. Further analysis of the compiled grounding data are needed to correlate iceberg grounding frequency and duration with water depth and iceberg season severity at specific sites.

For icebergs that were grounded for long periods of time near the well-sites, historical records should be examined where available to establish possible correlations between the environmental data (wind, current and tide) and the 'release' of the iceberg. This information would provide a better understanding of the factors and mechanisms involved in 'setting a grounded iceberg free'. The trajectories of the icebergs that were grounded several

times near well-sites and tracked by satellite should be plotted on detailed hydrographic charts to study the correlation between bathymetry and scouring or grounding.

All identified positions of iceberg groundings should also be plotted on detailed bathymetric charts for each drilling site to provide a quick graphic reference for grounding locations.

The water depth values of the satellite-tracked icebergs were obtained from depth soundings on navigation charts and may be unreliable. Unrealistic water depths ($\geq$1000 m) were found at locations where icebergs were stationary for weeks. Therefore, these water depth values should be updated as detailed hydrographic charts for these locations become available.

The data provided in the grounding study can be used for validation of theoretical scour models. If scour marks can be identified using the positions and iceberg parameters provided in this study, then a correlation can be established between iceberg initial speed, mass, and scour length and depth. The grounding data also can be used to establish the age of the identified scour marks.

A very limited number of grounding events could be identified in the Grand Banks area because of the lack of adequate iceberg tracking data for this area. The criteria used to identify grounding from the IIP data was applied to any iceberg identified as a 'resight'. More grounding for this area may be identified using more refined criteria and non-resight icebergs. Due to the nature of the data and the coverage area this work is

expected to be very exhausting and time consuming. However, it is possible to identify groundings using non-resight icebergs with reasonable cost provided that the area of interest is limited to certain parts of the Grand Banks.

APPENDICES

Appendix 1

Possible errors in computing iceberg speeds from radars

Iceberg grounding or scouring events, as measured by shore-based or drill-rig radars, were determined by recording the sequential positions of the iceberg, and hence deriving the iceberg's average or changing speed and course. The iceberg can be assumed to be grounded during the periods for which the target's speed was nil or below a chosen threshold value. However, there are a number of errors to consider when evaluating observations of iceberg drift using a scanning radar system (whether standard marine or research sensor), whether introduced by the radar or the observer or both. They result in "speeds" within the range of that of a drifting iceberg for icebergs that were actually grounded or, conversely, yield zero speeds when an iceberg was drifting freely.

The accuracy of the radar is dependent upon a number of factors, as follows:

a) The make, model, age, tuning, general condition of the unit(s) and the various components, installation, and component matching can influence the resolution, repeatability, and general accuracy of a given radar system.

b) The predicted accuracy of the instrument, which is usually $\pm 1^{\circ}$ for the bearing, and about 1% to 1.5% of the maximum range scale being used for the range.

c) The correct centering and alignment of the display.

d) Gyro-stabilization of the unit. With no gyro-stabilization, there is a possibility that heading changes could cause errors in reading the target bearings if the observer had not compensated fully for any such changes, or if an observation inadvertently occurred while the vessel was in the process of a heading change.

e) The type of range display, whether analog or digital; since with an analog display, the observer must interpolate between range marks to estimate the range, while a digital display gives a direct reading.

f) The wavelength of the instrument, whether an X-band (≈3 cm wavelength) or S-band (≈10 cm wavelength) sensor was used. The S-band radar gives less detail than the X-band, but responds better in rain, snow, and fog conditions.

g) Fog, rain, snow, and heavy sea-state conditions reduce the effectiveness of radars, such that targets could be lost in drifter for some period of time or fade with increasing range.

h)) Movement of the radar mast since the last observation (normally due to a change of heading for a drilling vessel).

The observers may introduce errors into an observation in other ways which may be combined with the stated or other inherent inaccuracies with the particular radar system.

a) An iceberg may appear to change position in the radar display (and hence travel with some speed since the last observation) and the observer records a change in the target's range and/or bearing.

   Table A-1 shows how even small errors can produce apparent iceberg speeds similar to observed rates of iceberg drift. An error of only 0.1 naut. mi in range would give an iceberg an apparent speed of 0.1 knot over one hour, similar to frequently recorded rates of 0.5 knots (see Figure A-1).

b) When an iceberg drifts near to a drilling vessel, for example within 3 naut. mi, the observer makes observations more frequently than every hour or half-hour. During 15 minutes or less a target may move a short distance, but owing to the short time between the observations and the resolution of the radar, no movement is perceived and a zero speed results.

c) If an observer changes range scales between observations, positions the range or bearing marker differently, views the radar screen from a different angle, or adjusts the radar tuning, centering, alignment, or band, a difference in target position may be recorded even though the target may not have moved.

TABLE A-1

Examples of error in iceberg position owing to range and bearing errors at different radar range settings.

Target range (naut mi)	Bearing inaccuracy (degrees)	Bearing error (naut mi)	Range inaccuracy (%)	Range error (naut mi)	Combined error (naut mi)
Range setting of 24 naut mi					
2	1	0.03	1	.24	0.24
4	1	0.07	1	.24	0.25
6	1	0.10	1	.24	0.26
8	1	0.14	1	.24	0.28
10	1	0.17	1	.24	0.30
12	1	0.21	1	.24	0.32
16	1	0.28	1	.24	0.37
20	1	0.35	1	.24	0.42
24	1	0.42	1	.24	0.48
2	.5	0.02	1	.24	0.24
4	.5	0.03	1	.24	0.24
6	.5	0.05	1	.24	0.25
8	.5	0.07	1	.24	0.25
10	.5	0.09	1	.24	0.26
12	.5	0.10	1	.24	0.26
16	.5	0.14	1	.24	0.28
20	.5	0.17	1	.24	0.30
24	.5	0.21	1	.24	0.32
Range setting of 12 naut mi					
2	1	0.03	1	.12	0.12
4	1	0.07	1	.12	0.14
6	1	0.10	1	.12	0.16
8	1	0.14	1	.12	0.18
10	1	0.17	1	.12	0.21
12	1	0.21	1	.12	0.24
2	.5	0.02	1	.12	0.12
4	.5	0.03	1	.12	0.12
6	.5	0.05	1	.12	0.13
8	.5	0.07	1	.12	0.14
10	.5	0.09	1	.12	0.15
12	.5	0.10	1	.12	0.16
Range setting of 6 naut mi					
2	1	0.03	1	.06	0.07
4	1	0.07	1	.06	0.09
6	1	0.10	1	.06	0.12
2	.5	0.02	1	.06	0.06
4	.5	0.03	1	.06	0.07
6	.5	0.05	1	.06	0.08
Range setting of 3 naut mi					
2	1	0.03	1	.03	0.05
2	.5	0.02	1	.03	0.03

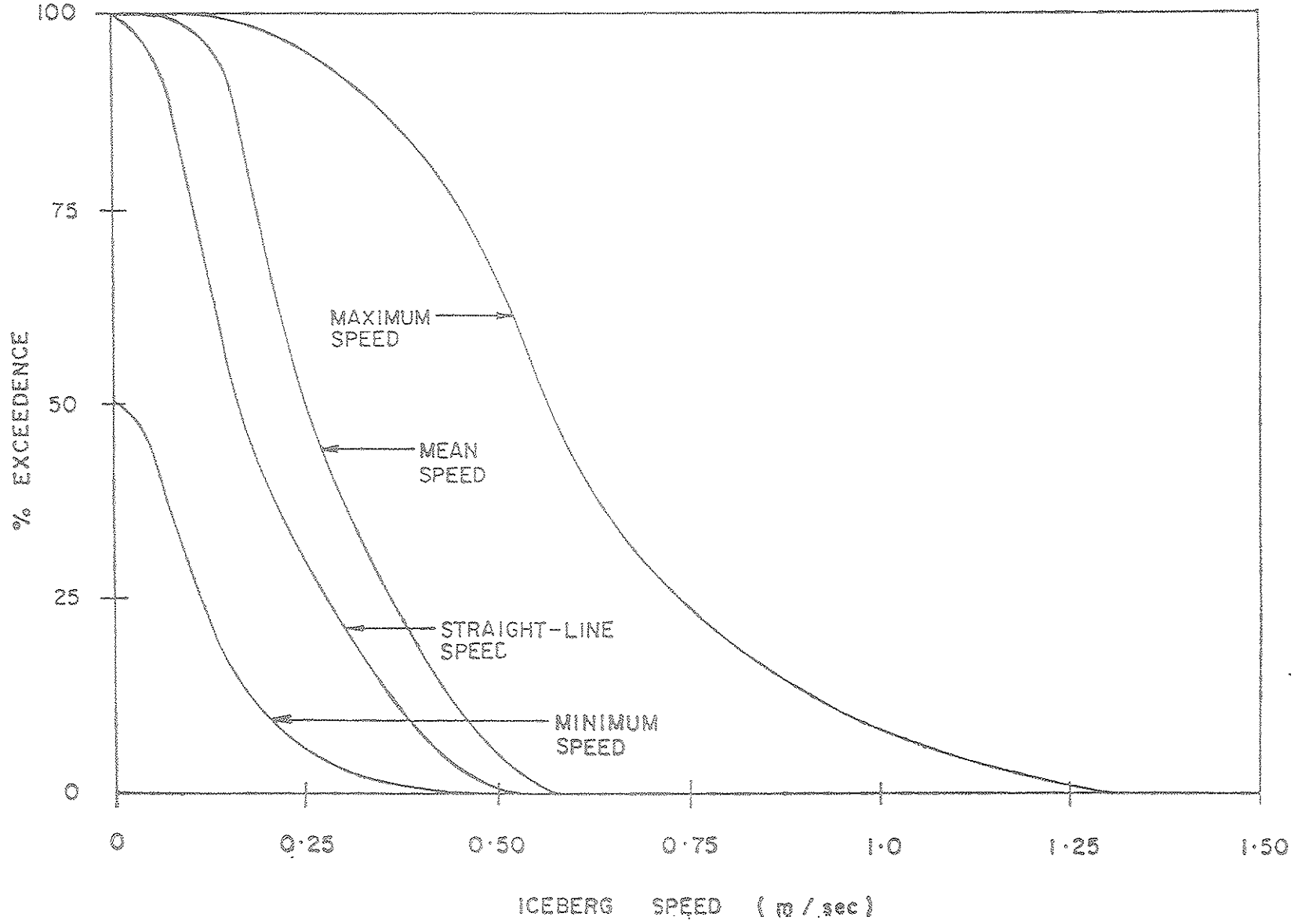


Fig. A-1. Drift speeds of 266 icebergs off Labrador (EL-Tahan et al. 1983).

Appendix 2

Samples of tracking data from drill-rig radars
for four icebergs

For each iceberg the following information is available, and examples are included in this appendix:

- computer listing of tracking data, location and velocity
    - location in range (naut mi) and bearing (degrees from true north) from the drill ship
    - speed (knots)
    - course (degrees from true north)
    - elapsed time (E.T.), cumulative total in hours from initial detection of target
    - elapsed distance (E.D.), cumulative total from initial detection of target in nautical miles;
- plot of iceberg trajectory; and
- graphs of direction vs time and speed vs time.

ICEBERGS: 1973

LOCATION: A Vessel, BJARNI H-81

BERG 037

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
30/08/73	0000	17.40	300.0	0.00	0.0	0.00	0.00
30/08/73	1330	17.20	300.0	0.01	120.0	13.50	0.20
30/08/73	1410	17.00	301.0	0.56	61.5	14.17	0.59
30/08/73	1500	17.10	300.0	0.36	227.2	15.13	0.94
30/08/73	1600	16.80	299.0	0.45	167.3	16.13	1.38
30/08/73	1710	16.90	298.0	0.30	225.4	17.27	1.73
30/08/73	1800	16.90	299.0	0.40	26.5	18.08	2.06
30/08/73	1900	17.20	298.5	0.33	269.8	19.13	2.40
30/08/73	2001	17.01	298.5	0.18	118.5	20.25	2.60
30/08/73	2110	16.10	298.5	0.10	298.5	21.25	2.70
30/08/73	2340	17.00	297.0	0.20	196.4	23.75	3.21
31/08/73	0130	17.00	298.0	0.19	27.5	25.50	3.54
31/08/73	0240	16.80	297.5	0.22	157.3	26.67	3.80
31/08/73	0501	16.80	299.5	0.28	26.5	29.02	4.45
31/08/73	0710	16.80	299.5	0.00	0.0	31.17	4.45
31/08/73	2230	16.90	296.5	0.06	213.8	46.50	5.45
01/09/73	0015	17.10	296.5	0.11	296.5	48.25	5.65
01/09/73	0101	16.90	296.5	0.26	116.5	49.02	5.85
01/09/73	0206	16.80	298.0	0.46	36.7	50.10	6.35
01/09/73	0313	16.80	297.5	0.15	207.7	51.22	6.51
01/09/73	0409	16.80	297.5	0.00	0.0	52.15	6.51
01/09/73	0505	16.80	297.5	0.00	0.0	53.05	6.51
01/09/73	0604	16.80	297.5	0.00	0.0	54.07	6.51
01/09/73	0703	16.80	297.5	0.00	0.0	55.05	6.51
01/09/73	0801	16.80	297.5	0.00	0.0	56.02	6.51
01/09/73	0905	16.80	297.5	0.00	0.0	57.08	6.51

ICEBERGS, 1973

LOCATION: A Vessel, BJARNI H-61

BERG 037 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
01/09/73	1000	18.80	297.5	0.00	0.0	58.00	6.51
01/09/73	1110	18.90	297.5	0.09	297.5	59.17	6.61
01/09/73	1203	19.00	297.5	0.11	297.5	60.05	6.71
01/09/73	1315	19.00	297.5	0.00	0.0	61.25	6.71
01/09/73	1430	18.80	297.5	0.16	117.5	62.50	6.91
01/09/73	1625	19.00	297.5	0.10	297.5	64.42	7.11
01/09/73	1730	19.00	297.5	0.00	0.0	65.50	7.11
01/09/73	1910	19.00	297.5	0.00	0.0	67.17	7.11
01/09/73	2210	18.80	298.5	0.13	59.2	70.17	7.30
02/09/73	0011	18.80	297.5	0.16	208.0	72.25	7.83
02/09/73	0100	19.00	298.0	0.35	337.3	73.00	8.05
02/09/73	0212	19.00	297.0	0.28	207.5	74.20	8.42
02/09/73	0314	18.80	296.0	0.37	58.7	75.23	8.80
02/09/73	0413	18.90	298.0	0.10	298.0	76.22	8.90
02/09/73	0509	18.90	298.0	0.00	0.0	77.15	8.90
02/09/73	0804	18.80	298.0	0.11	118.0	78.07	9.00
02/09/73	0705	18.90	296.5	0.19	357.0	79.08	9.20
02/09/73	0807	19.00	298.0	0.19	239.4	80.12	9.39
02/09/73	0916	19.00	298.0	0.00	0.0	81.27	9.39
02/09/73	1017	18.90	298.0	0.10	118.0	82.28	9.49
02/09/73	1107	18.80	298.0	0.12	118.0	83.12	9.59
02/09/73	1204	18.80	298.0	0.00	0.0	84.07	9.59
02/09/73	1315	18.80	297.5	0.14	207.7	85.25	9.75
02/09/73	1615	18.80	297.5	0.00	0.0	88.25	9.75
02/09/73	1715	18.80	297.5	0.00	0.0	89.25	9.75
03/09/73	0030	18.80	297.5	0.00	0.0	96.50	9.75

ICEBERGS, 1973

LOCATION: A Vessel: BJARNI H-61

BERG 637 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
03/09/73	0306	18.80	298.0	0.06	27.7	99.10	9.92
03/09/73	0735	18.80	297.5	0.04	207.7	103.58	10.08
03/09/73	0901	18.90	297.0	0.13	238.5	105.02	10.28
03/09/73	1008	18.90	297.0	0.00	0.0	106.13	10.28
03/09/73	1204	19.00	297.0	0.05	297.0	108.07	10.38
03/09/73	1257	19.00	297.0	0.00	0.0	108.95	10.38
03/09/73	1650	19.50	300.5	0.33	5.7	112.83	11.65
03/09/73	1953	18.70	297.0	0.46	174.3	115.92	13.07
03/09/73	2300	19.00	296.5	0.11	268.0	119.00	13.41
04/09/73	0112	18.70	297.5	0.20	69.4	121.20	13.85
04/09/73	0218	18.40	296.0	0.52	175.0	122.30	14.43
04/09/73	0556	16.20	293.0	0.67	136.9	125.63	16.60
04/09/73	0702	15.40	290.5	0.88	152.5	127.03	17.86
04/09/73	0816	14.60	287.5	0.91	153.5	128.27	18.98
04/09/73	0902	14.20	285.0	0.97	163.8	129.03	19.73
04/09/73	1005	13.40	281.0	1.19	153.3	130.08	20.98
04/09/73	1107	13.10	277.0	0.94	171.0	131.12	21.95
04/09/73	1325	12.50	269.0	0.82	164.5	133.42	23.83
04/09/73	1405	12.50	266.0	0.98	177.5	134.08	24.49
04/09/73	1500	12.50	264.0	0.48	175.0	135.00	24.92
04/09/73	1605	12.20	262.0	0.48	136.2	136.08	25.45
04/09/73	1710	12.20	260.0	0.39	171.0	137.17	25.87
04/09/73	1950	13.80	257.5	0.64	239.2	139.83	27.57
04/09/73	2053	14.00	257.5	0.18	257.5	140.92	27.77
04/09/73	2340	14.00	257.5	0.00	0.0	143.67	27.77
05/09/73	0103	14.20	257.0	0.17	225.6	145.05	28.01

ICEBERGS: 1973

LOCATION: A Vessel, BJARNI H-81

BERG 037 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
05/09/73	0200	14.20	257.0	0.00	0.0	146.00	28.01
05/09/73	0256	14.20	256.5	0.13	166.7	146.93	28.13
05/09/73	0400	14.20	256.5	0.00	0.0	148.00	28.13
05/09/73	0500	14.20	256.5	0.00	0.0	149.00	28.13
05/09/73	0600	14.20	256.5	0.00	0.0	150.00	28.13
05/09/73	0700	14.20	256.5	0.00	0.0	151.00	28.13
05/09/73	0800	14.20	256.5	0.00	0.0	152.00	28.13
05/09/73	0900	14.20	256.5	0.00	0.0	153.00	28.13
05/09/73	1000	14.20	256.5	0.00	0.0	154.00	28.13
05/09/73	1100	14.20	256.5	0.00	0.0	155.00	28.13
05/09/73	1200	14.20	256.5	0.00	0.0	156.00	28.13
06/09/73	0325	14.20	256.0	0.01	166.2	171.42	28.25
06/09/73	0700	14.20	256.0	0.00	0.0	175.00	28.25
06/09/73	0930	14.20	256.0	0.00	0.0	177.50	28.25
06/09/73	1400	14.20	256.0	0.00	0.0	182.00	28.25
06/09/73	1530	14.20	256.0	0.00	0.0	183.50	28.25
06/09/73	1700	14.20	256.0	0.00	0.0	185.00	28.25
06/09/73	2100	14.40	256.0	0.05	256.0	189.00	28.45
06/09/73	2200	14.40	256.0	0.00	0.0	190.00	28.45
07/09/73	0000	14.40	256.0	0.00	0.0	192.00	28.45
07/09/73	0515	14.40	260.0	0.19	348.0	197.25	29.46
07/09/73	0615	14.40	262.0	0.50	351.0	198.25	29.96
07/09/73	0800	14.60	265.0	0.45	336.7	200.00	30.75
07/09/73	0930	14.80	266.5	0.29	328.3	201.50	31.18
07/09/73	1030	15.50	267.0	0.71	277.4	202.50	31.69
07/09/73	1330	16.50	273.0	0.65	329.2	205.50	33.84

ICEBERGS, 1973

LOCATION: A Vessel, BJARNI H-61

BERG 037 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
07/09/73	1745	17.20	274.0	0.18	296.3	209.75	34.60
07/09/73	1920	17.40	275.0	0.23	331.0	211.33	34.96
08/09/73	0215	17.20	273.0	0.09	165.7	216.25	35.60
08/09/73	0945	17.00	273.0	0.03	92.0	225.75	35.80
08/09/73	1140	16.80	276.5	0.55	15.7	227.67	36.85
08/09/73	1930	17.20	275.0	0.08	227.7	235.50	37.45
08/09/73	2300	17.00	274.5	0.07	131.5	239.00	37.70
09/09/73	0230	16.50	275.0	0.05	38.0	242.50	37.88
09/09/73	0330	17.00	275.0	0.10	275.0	243.50	37.96
09/09/73	0600	16.90	274.0	0.12	165.8	246.00	38.29
10/09/73	0330	17.20	272.0	0.03	209.7	267.50	38.96
10/09/73	0615	17.00	272.0	0.04	92.0	272.25	39.16
10/09/73	1900	17.20	274.0	0.06	344.5	283.00	39.79
11/09/73	0100	17.20	274.0	0.00	0.0	289.00	39.79
11/09/73	1800	17.20	274.0	0.00	0.0	306.00	39.79
12/09/73	1730	19.60	274.0	0.10	274.0	329.50	42.19
13/09/73	0400	19.40	272.5	0.05	161.9	340.00	42.73
13/09/73	1020	19.40	276.0	0.19	4.2	346.33	43.92
13/09/73	1155	17.60	268.0	1.99	147.2	347.92	47.06
13/09/73	1215	17.40	268.0	0.60	88.0	348.25	47.26
13/09/73	1430	17.40	263.0	0.67	175.5	350.50	48.78
13/09/73	2200	16.40	261.0	0.15	112.5	358.00	49.94

ICEBERGS, 1973

LOCATION: A Vessel, BJARNI H-61

BERG 037 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
13/09/73	2315	15.60	260.0	0.53	105.6	359.25	50.61
14/09/73	0145	13.40	259.0	0.19	113.7	361.75	51.09
14/09/73	0300	15.00	256.0	0.36	112.1	363.00	51.57
14/09/73	0400	14.70	255.0	0.83	145.4	364.00	52.46
14/09/73	0600	14.20	252.5	0.40	125.3	366.00	53.21
14/09/73	0700	14.80	250.0	0.60	204.7	367.08	54.08
14/09/73	0815	14.60	249.5	0.11	159.7	368.25	54.21
14/09/73	1000	14.50	247.0	0.39	133.1	370.08	54.91
14/09/73	1400	13.20	239.0	0.59	119.1	374.00	57.24
14/09/73	1500	13.40	236.0	0.72	163.5	375.00	57.97
14/09/73	1800	14.60	228.0	0.76	173.5	378.00	60.26
15/09/73	0300	14.00	216.0	0.34	120.7	387.00	63.30
15/09/73	0400	14.20	213.0	0.76	139.7	388.00	64.07
15/09/73	0435	14.20	212.0	0.42	122.5	388.58	64.32
15/09/73	0515	14.60	212.0	0.60	212.0	389.25	64.72
15/09/73	0625	13.00	212.0	0.34	212.0	390.42	65.12
15/09/73	0705	15.20	211.5	0.36	178.4	391.08	65.36
15/09/73	0805	15.60	211.0	0.42	192.7	392.08	65.78
15/09/73	0915	16.00	210.0	0.42	175.9	393.25	66.26
15/09/73	1015	16.20	209.0	0.34	154.9	394.25	66.61
15/09/73	1115	16.30	209.0	0.10	209.0	395.25	66.71
15/09/73	1215	16.80	208.0	0.58	178.5	396.25	67.29
15/09/73	1715	19.00	203.0	0.54	170.1	401.25	69.98
15/09/73	1900	20.00	200.5	0.75	161.4	403.00	71.30
15/09/73	2200	21.50	197.0	0.65	158.5	406.00	73.26

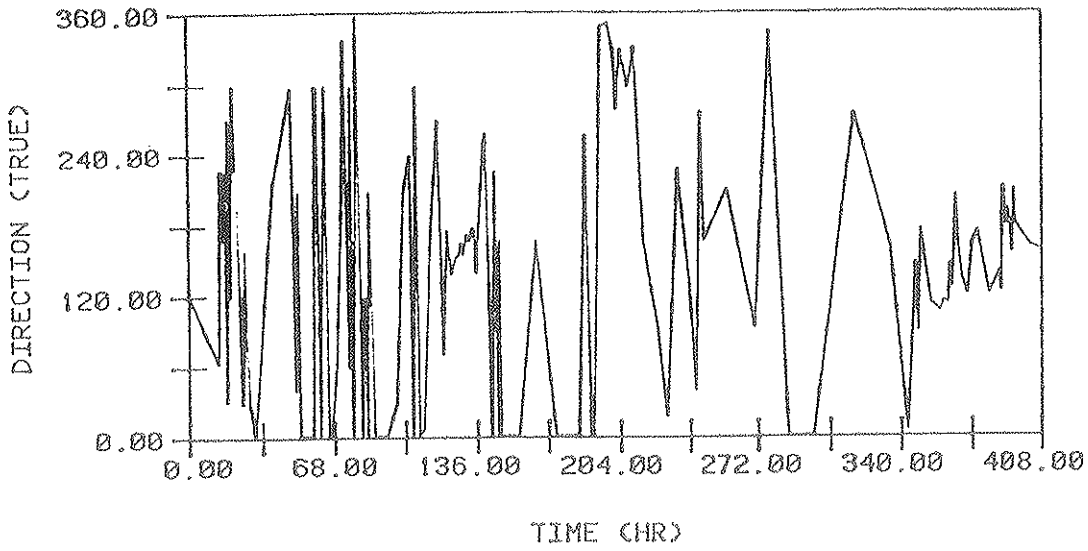
[illegible]

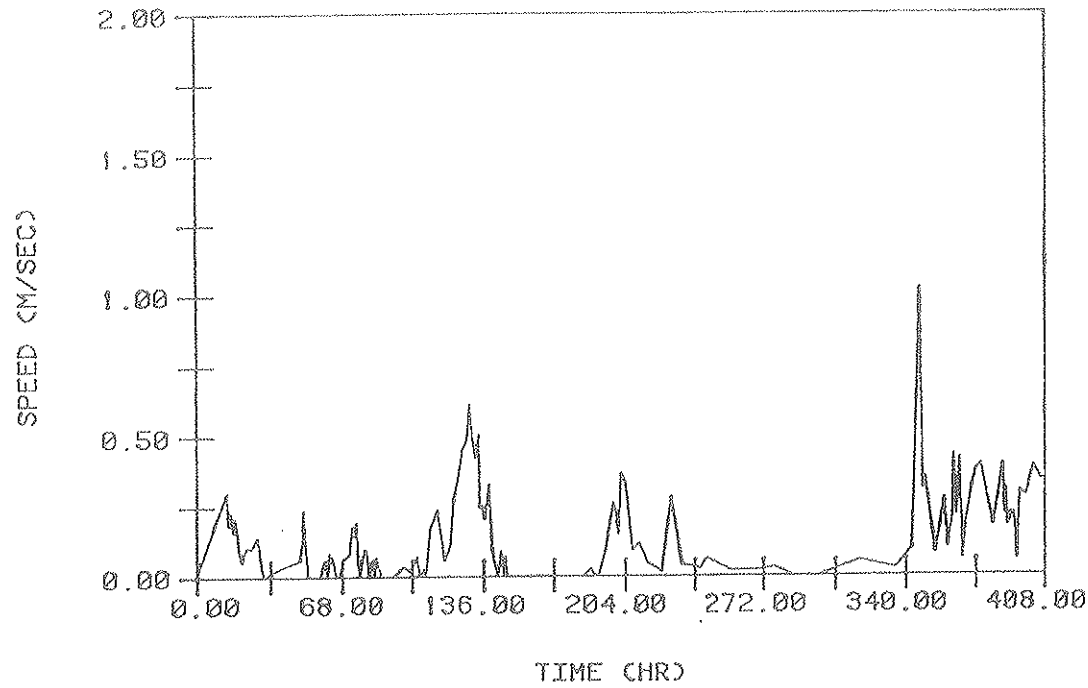
04/05/73 1605 12.20 262.0

SPEEDS (knots)

MIN.	MAX.	MEAN
0.00	1.99	0.26

TOTAL NO. OF OBSERVATIONS = 151





TIME HISTORY OF SPEED AND DIRECTION

BERG#037 BJARNI H-81 LABRADOR 1973

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
03/08/82	1438	18.00	110.0	0.00	0.0	0.00	0.00
03/08/82	1537	18.28	112.0	0.70	177.1	0.98	0.69
03/08/82	1648	18.35	111.0	0.30	21.3	2.07	1.01
03/08/82	1735	18.24	112.0	0.35	208.7	2.95	1.33
03/08/82	1825	18.25	112.0	0.01	112.0	3.78	1.34
03/08/82	1935	18.20	112.0	0.04	292.0	4.95	1.39
03/08/82	2140	17.89	112.0	0.15	292.0	7.03	1.70
03/08/82	2240	17.40	113.0	0.58	260.4	8.03	2.28
04/08/82	0010	17.28	114.0	0.22	225.1	9.53	2.61
04/08/82	0115	17.40	113.0	0.30	45.1	10.62	2.93
04/08/82	0225	17.30	113.0	0.09	293.0	11.78	3.03
04/08/82	0530	17.55	113.0	0.08	113.0	14.87	3.28
04/08/82	0730	17.50	113.0	0.02	293.0	16.87	3.33
04/08/82	0935	17.30	113.5	0.12	256.0	18.95	3.58
04/08/82	1030	17.35	113.0	0.17	41.5	19.87	3.74
04/08/82	1135	17.40	113.3	0.10	174.4	20.95	3.85
04/08/82	1230	17.30	114.0	0.26	228.9	21.87	4.08
04/08/82	1330	17.30	114.0	0.00	0.0	22.87	4.08
04/08/82	1450	17.30	114.0	0.00	0.0	24.20	4.08
04/08/82	1535	17.30	114.0	0.00	0.0	24.95	4.08
04/08/82	1745	17.30	113.0	0.14	23.5	27.12	4.38
04/08/82	1830	17.33	113.5	0.21	192.0	27.87	4.54
04/08/82	2130	17.40	113.0	0.06	48.0	30.87	4.70
04/08/82	2215	17.40	113.5	0.20	203.2	31.62	4.86
04/08/82	2315	17.40	113.5	0.00	0.0	32.62	4.86
05/08/82	0035	17.35	113.0	0.12	5.0	33.95	5.02
05/08/82	0130	17.48	113.0	0.14	113.0	34.87	5.15
05/08/82	0235	17.40	113.0	0.07	293.0	35.95	5.23

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
05/08/82	0445	17.41	113.5	0.07	199.5	38.12	5.38
05/08/82	0550	17.40	114.0	0.14	207.5	39.20	5.53
05/08/82	1140	17.38	113.0	0.05	19.7	45.03	5.83
05/08/82	1720	17.40	115.0	0.11	202.1	50.70	6.44
05/08/82	1820	17.50	116.0	0.32	187.3	51.70	6.76
05/08/82	1925	17.60	116.8	0.24	184.2	52.78	7.03
05/08/82	2210	17.62	118.5	0.19	205.5	55.53	7.55
05/08/82	2335	17.50	119.5	0.23	230.4	56.95	7.88
06/08/82	0030	17.60	119.0	0.20	62.4	57.87	8.06
06/08/82	0130	17.40	119.0	0.20	299.0	58.87	8.26
06/08/82	0230	17.40	119.5	0.15	209.2	59.87	8.41
06/08/82	0835	17.40	120.0	0.02	209.7	65.95	8.57
06/08/82	1333	17.40	120.0	0.00	0.0	70.92	8.57
06/08/82	1530	17.45	119.0	0.16	38.8	72.87	8.87
06/08/82	1930	17.50	119.5	0.04	191.1	76.87	9.03
06/08/82	2130	17.50	119.5	0.00	0.0	78.87	9.03
06/08/82	2300	17.50	119.5	0.00	0.0	80.37	9.03
07/08/82	0100	17.50	119.5	0.00	0.0	82.37	9.03
07/08/82	0200	17.50	119.5	0.00	0.0	83.37	9.03
07/08/82	0300	17.50	119.5	0.00	0.0	84.37	9.03
07/08/82	0500	17.50	119.5	0.00	0.0	86.37	9.03
07/08/82	0600	17.50	119.5	0.00	0.0	87.37	9.03
07/08/82	0700	17.50	119.5	0.00	0.0	88.37	9.03
07/08/82	0800	17.50	119.5	0.00	0.0	89.37	9.03
07/08/82	0900	17.50	119.5	0.00	0.0	90.37	9.03
07/08/82	1000	17.50	119.5	0.00	0.0	91.37	9.03
07/08/82	1100	17.50	119.5	0.00	0.0	92.37	9.03
07/08/82	1200	17.50	119.5	0.00	0.0	93.37	9.03

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
07/08/82	1300	17.50	119.5	0.00	0.0	94.37	9.03
07/08/82	1330	17.50	119.5	0.00	0.0	94.87	9.03
07/08/82	1600	17.50	119.5	0.00	0.0	96.37	9.03
07/08/82	1637	17.50	119.5	0.00	0.0	97.98	9.03
07/08/82	1735	17.45	119.5	0.05	299.5	98.95	9.08
07/08/82	1835	17.50	119.5	0.05	119.5	99.95	9.13
07/08/82	2100	17.45	119.5	0.02	299.5	102.37	9.18
07/08/82	2230	17.45	119.5	0.00	0.0	103.87	9.18
07/08/82	2330	17.50	119.5	0.05	119.5	104.87	9.23
08/08/82	0145	17.50	119.5	0.00	0.0	107.12	9.23
08/08/82	0225	17.50	119.5	0.00	0.0	107.78	9.23
08/08/82	0400	17.40	119.0	0.12	356.0	109.37	9.42
08/08/82	0500	17.40	119.5	0.15	209.2	110.37	9.57
08/08/82	0600	17.40	119.5	0.00	0.0	111.37	9.57
08/08/82	0700	17.50	119.5	0.10	119.5	112.37	9.67
08/08/82	0800	17.40	119.5	0.10	299.5	113.37	9.77
08/08/82	0835	17.40	119.5	0.00	0.0	113.95	9.77
08/08/82	1100	17.40	119.5	0.00	0.0	116.37	9.77
08/08/82	1200	17.40	119.5	0.00	0.0	117.37	9.77
08/08/82	1300	17.50	119.5	0.10	119.5	118.37	9.87
08/08/82	1400	17.40	119.5	0.10	299.5	119.37	9.97
08/08/82	1500	17.40	119.0	0.15	29.2	120.37	10.12
08/08/82	1645	17.50	119.5	0.10	176.0	122.12	10.30
08/08/82	1730	17.45	119.5	0.07	299.5	122.87	10.35
08/08/82	1930	17.50	119.0	0.08	47.4	124.87	10.51
08/08/82	2100	17.45	119.5	0.11	227.4	126.37	10.67
08/08/82	2200	17.50	119.5	0.05	119.5	127.37	10.72
08/08/82	2330	17.50	119.5	0.00	0.0	128.87	10.72

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
09/08/82	0130	17.43	119.0	0.08	4.6	130.87	10.89
09/08/82	0345	17.40	119.0	0.01	299.0	133.12	10.92
[illegible]	0505	17.40	119.0	0.00	0.0	134.45	10.92
09/08/82	0605	17.40	119.0	0.00	0.0	135.45	10.92
09/08/82	0705	17.40	119.0	0.00	0.0	136.45	10.92
09/08/82	0750	17.40	119.0	0.00	0.0	137.20	10.92
09/08/82	0910	17.40	119.0	0.00	0.0	138.53	10.92
09/08/82	1006	17.40	119.0	0.00	0.0	139.47	10.92
09/08/82	1102	17.40	119.0	0.00	0.0	140.40	10.92
10/08/82	1300	17.40	120.0	0.01	209.5	166.37	11.22
10/08/82	1400	17.40	120.0	0.00	0.0	167.37	11.22
10/08/82	1500	17.40	120.0	0.00	0.0	168.37	11.22
10/08/82	1600	17.40	119.5	0.15	29.7	169.37	11.38
10/08/82	1700	17.30	119.0	0.18	355.8	170.37	11.56
10/08/82	1800	17.35	119.0	0.05	119.0	171.37	11.61
10/08/82	1900	17.40	119.5	0.16	191.0	172.37	11.77
10/08/82	2000	17.40	119.5	0.00	0.0	173.37	11.77
10/08/82	2100	17.40	119.0	0.15	29.2	174.37	11.92
10/08/82	2220	17.40	119.0	0.00	0.0	175.70	11.92
10/08/82	2340	17.40	119.0	0.00	0.0	177.03	11.92
11/08/82	0040	17.40	120.5	0.46	209.7	178.03	12.37
11/08/82	0140	17.00	122.0	0.60	252.9	179.03	12.98
11/08/82	0230	16.75	123.0	0.46	252.8	179.87	13.36
11/08/82	0345	16.00	124.0	0.64	282.6	181.12	14.17
11/08/82	0440	15.60	124.0	0.44	304.0	182.03	14.57
11/08/82	0530	15.30	125.0	0.48	262.5	182.87	14.97
11/08/82	0607	15.50	125.5	0.39	159.1	183.48	15.21
11/08/82	0701	15.00	126.0	0.57	290.8	184.38	15.73

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE 1

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (des.T)	SPEED (knots)	COURSE (des.T)	E.T. (h)	E.D. (n.mi.)
11/08/82	0802	15.00	126.0	0.00	0.0	185.40	15.73
11/08/82	0905	15.10	126.0	0.10	126.0	186.45	15.83
11/08/82	1000	15.30	127.0	0.36	179.5	187.37	16.16
11/08/82	1100	15.50	128.0	0.34	180.8	188.37	16.49
11/08/82	1200	15.40	130.0	0.55	229.5	189.37	17.04
11/08/82	1300	15.40	132.0	0.54	221.0	190.37	17.58
11/08/82	1400	15.10	132.0	0.30	312.0	191.37	17.88
11/08/82	1500	14.50	135.0	0.98	261.2	192.37	18.86
11/08/82	1630	14.00	134.5	0.34	328.7	193.87	19.36
11/08/82	1730	13.80	135.0	0.23	283.5	194.87	19.61
11/08/82	1840	13.90	135.0	0.09	135.0	196.03	19.71
11/08/82	1930	13.90	135.0	0.00	0.0	196.87	19.71
11/08/82	2030	13.90	135.0	0.00	0.0	197.87	19.71
11/08/82	2130	13.90	135.0	0.00	0.0	198.87	19.71
11/08/82	2230	13.95	135.0	0.05	135.0	199.87	19.76
11/08/82	2330	14.00	135.0	0.05	135.0	200.87	19.81
12/08/82	0030	13.90	135.0	0.10	315.0	201.87	19.91
12/08/82	0130	13.90	135.0	0.00	0.0	202.87	19.91
12/08/82	0230	13.90	135.0	0.00	0.0	203.87	19.91
12/08/82	0330	13.80	135.0	0.10	315.0	204.87	20.01
12/08/82	0430	13.80	135.0	0.00	0.0	205.87	20.01
12/08/82	0500	13.80	135.0	0.00	0.0	206.37	20.01
12/08/82	0600	13.80	135.0	0.00	0.0	207.37	20.01
12/08/82	0700	13.80	135.0	0.00	0.0	208.37	20.01
12/08/82	0800	13.80	135.0	0.00	0.0	209.37	20.01
12/08/82	0905	13.80	135.0	0.00	0.0	210.45	20.01
12/08/82	2115	13.95	136.5	0.03	203.3	222.62	20.40
12/08/82	2315	14.00	136.5	0.03	136.5	224.62	20.45

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
13/08/82	0050	14.00	137.0	0.08	226.7	226.20	20.57
13/08/82	0230	14.00	136.5	0.07	46.7	227.87	20.70
13/08/82	0730	13.80	134.0	0.13	27.0	232.87	21.34
13/08/82	0802	13.80	134.0	0.00	0.0	233.40	21.34
13/08/82	0907	13.80	134.0	0.00	0.0	234.48	21.34
13/08/82	1003	13.80	134.0	0.00	0.0	235.42	21.34
13/08/82	1112	13.90	134.0	0.09	134.0	236.57	21.44
13/08/82	1200	13.80	134.0	0.12	314.0	237.37	21.54
13/08/82	1310	13.90	135.0	0.22	202.0	238.53	21.80
13/08/82	1400	13.90	134.0	0.29	44.5	239.37	22.04
13/08/82	1500	13.90	134.0	0.00	0.0	240.37	22.04
13/08/82	1600	13.90	135.0	0.24	224.5	241.37	22.28
13/08/82	1750	13.90	134.5	0.07	44.7	243.20	22.40
13/08/82	1930	13.90	135.0	0.07	224.7	244.87	22.52
13/08/82	2200	13.85	134.5	0.05	22.3	247.37	22.66
13/08/82	2330	13.80	135.0	0.09	247.3	248.87	22.79
14/08/82	0300	13.80	135.0	0.00	0.0	252.37	22.79
14/08/82	0400	13.80	135.0	0.00	0.0	253.37	22.79
14/08/82	0500	13.80	135.0	0.00	0.0	254.37	22.79
14/08/82	0600	13.80	135.0	0.00	0.0	255.37	22.79
14/08/82	0700	13.80	135.0	0.00	0.0	256.37	22.79
14/08/82	0800	13.80	135.0	0.00	0.0	257.37	22.79
14/08/82	0900	13.80	135.0	0.00	0.0	258.37	22.79
14/08/82	1000	13.80	135.0	0.00	0.0	259.37	22.79
14/08/82	1200	13.80	135.0	0.00	0.0	261.37	22.79
14/08/82	1400	13.80	135.0	0.00	0.0	263.37	22.79
14/08/82	1800	13.80	134.5	0.03	44.7	267.37	22.91
14/08/82	2300	13.80	134.5	0.00	0.0	272.37	22.91

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
15/08/82	0200	13.80	135.0	0.04	224.7	275.37	23.03
15/08/82	0400	13.80	135.0	0.00	0.0	277.37	23.03
15/08/82	0600	13.80	135.0	0.00	0.0	279.37	23.03
15/08/82	0800	13.80	135.0	0.00	0.0	281.37	23.03
15/08/82	1000	13.80	135.0	0.00	0.0	283.37	23.03
15/08/82	1600	13.70	135.0	0.02	315.0	289.37	23.13
15/08/82	1745	13.50	135.5	0.13	284.6	291.12	23.36
15/08/82	1900	13.00	136.5	0.44	291.2	292.37	23.91
15/08/82	2000	12.50	138.0	0.60	283.5	293.37	24.51
15/08/82	2100	12.00	138.0	0.50	318.0	294.37	25.01
15/08/82	2200	11.60	137.5	0.41	332.2	295.37	25.42
15/08/82	2300	11.25	137.5	0.35	317.5	296.37	25.77
16/08/82	0000	11.15	137.5	0.10	317.5	297.37	25.87
16/08/82	0200	11.40	138.0	0.13	159.2	299.37	26.14
16/08/82	0300	11.45	139.0	0.21	214.4	300.37	26.35
16/08/82	0428	11.50	141.0	0.28	222.9	301.83	26.75
16/08/82	0501	11.40	142.0	0.41	258.1	302.38	26.98
16/08/82	0606	11.10	144.0	0.46	270.4	303.47	27.47
16/08/82	0720	10.50	145.0	0.51	307.1	304.70	28.10
16/08/82	0800	10.20	146.0	0.53	294.4	305.37	28.45
16/08/82	0905	9.30	147.0	0.85	315.8	306.45	29.37
16/08/82	1003	8.60	147.0	0.72	327.0	307.42	30.07
16/08/82	1100	8.10	146.0	0.55	342.8	308.37	30.59
16/08/82	1203	7.60	144.0	0.54	353.7	309.42	31.16
16/08/82	1303	7.55	143.0	0.14	32.8	310.42	31.30
16/08/82	1403	7.70	142.0	0.20	100.9	311.42	31.50
16/08/82	1507	7.90	141.0	0.23	107.3	312.48	31.74
16/08/82	1602	8.10	140.5	0.23	121.5	313.40	31.95

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
16/08/82	1700	8.30	140.5	0.21	140.5	314.37	32.15	
16/08/82	1745	8.32	141.0	0.10	215.3	315.12	32.23	[TOW]
16/08/82	1800	8.40	142.0	0.67	202.8	315.37	32.39	[TOW]
16/08/82	1900	8.50	144.0	0.31	214.3	316.37	32.70	[TOW]
16/08/82	2000	8.60	146.0	0.31	216.5	317.37	33.02	[TOW]
16/08/82	2100	8.45	147.5	0.27	270.7	318.37	33.29	[TOW]
16/08/82	2200	8.30	147.0	0.17	353.2	319.37	33.46	[TOW]
16/08/82	2310	8.20	144.0	0.38	42.5	320.53	33.90	[TOW]
17/08/82	0000	8.20	142.5	0.26	53.2	321.37	34.11	[TOW]
17/08/82	0100	8.40	141.0	0.30	94.4	322.37	34.41	[TOW]
17/08/82	0200	8.80	140.0	0.43	119.9	323.37	34.84	[TOW]
17/08/82	0300	9.50	139.5	0.70	133.2	324.37	35.54	[TOW]
17/08/82	0400	9.90	140.0	0.41	151.7	325.37	35.95	[TOW]
17/08/82	0500	10.50	139.0	0.63	123.0	326.37	36.58	[TOW]
17/08/82	0600	11.00	140.0	0.53	160.1	327.37	37.11	[TOW]
17/08/82	0700	11.20	140.0	0.20	140.0	328.37	37.31	[TOW]
17/08/82	0800	11.20	141.0	0.20	230.5	329.37	37.50	[TOW]
17/08/82	0900	11.20	141.0	0.00	0.0	330.37	37.50	[TOW]
17/08/82	1000	11.00	141.0	0.20	321.0	331.37	37.70	[TOW]
17/08/82	1100	10.60	140.0	0.44	345.7	332.37	38.15	[TOW]
17/08/82	1200	10.60	139.5	0.09	49.7	333.37	38.24	[TOW]
17/08/82	1300	10.60	138.0	0.28	48.7	334.37	38.52	[TOW]
17/08/82	1400	10.70	137.0	0.21	75.8	335.37	38.73	[TOW]
17/08/82	1500	11.00	137.0	0.30	137.0	336.37	39.03	[TOW]
17/08/82	1600	11.50	136.0	0.54	115.1	337.37	39.57	[TOW]
17/08/82	1700	11.90	136.0	0.40	136.0	338.37	39.97	[TOW]
17/08/82	1740	12.20	136.0	0.45	136.0	339.03	40.27	[TOW]
17/08/82	1800	12.50	136.0	0.90	136.0	339.37	40.57	

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
17/08/82	1900	12.60	136.5	0.15	183.9	340.37	40.71
17/08/82	2000	12.65	136.5	0.05	136.5	341.37	40.76
17/08/82	2100	12.40	137.0	0.27	293.1	342.37	41.04
17/08/82	2200	12.20	137.0	0.20	317.0	343.37	41.24
17/08/82	2300	11.90	137.0	0.30	317.0	344.37	41.54
18/08/82	0000	11.60	136.0	0.36	350.9	345.37	41.90
18/08/82	0100	11.55	135.0	0.21	31.6	346.37	42.11
18/08/82	0200	11.60	134.0	0.21	58.4	347.37	42.32
18/08/82	0300	11.80	133.0	0.29	87.9	348.37	42.60
18/08/82	0400	11.70	133.5	0.14	267.5	349.37	42.74
18/08/82	0500	11.75	133.0	0.11	69.3	350.37	42.86
18/08/82	0615	11.75	133.0	0.00	0.0	351.62	42.86
18/08/82	0700	11.75	133.0	0.00	0.0	352.37	42.86
18/08/82	0800	11.75	133.0	0.00	0.0	353.37	42.86
18/08/82	0900	11.75	133.0	0.00	0.0	354.37	42.86
18/08/82	1000	11.75	133.0	0.00	0.0	355.37	42.86
18/08/82	1100	11.70	133.0	0.05	313.0	356.37	42.91
18/08/82	1200	11.70	133.0	0.00	0.0	357.37	42.91
18/08/82	1300	11.70	133.5	0.10	223.2	358.37	43.01
18/08/82	1600	11.80	130.5	0.21	51.2	361.37	43.63
18/08/82	1715	12.40	129.5	0.51	110.6	362.62	44.27
18/08/82	1800	12.40	129.5	0.00	0.0	363.37	44.27
18/08/82	1900	12.40	130.5	0.22	220.0	364.37	44.49
18/08/82	2000	12.40	130.5	0.00	0.0	365.37	44.49
18/08/82	2100	12.40	130.5	0.00	0.0	366.37	44.49
18/08/82	2200	12.40	130.5	0.00	0.0	367.37	44.49
18/08/82	2300	12.30	130.0	0.15	357.4	368.37	44.63
19/08/82	0000	12.25	130.0	0.05	310.0	369.37	44.68

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
19/08/82	0100	12.25	130.0	0.00	0.0	370.37	44.68
19/08/82	0200	12.40	130.0	0.15	130.0	371.37	44.83
19/08/82	0300	12.40	129.5	0.11	39.7	372.37	44.94
19/08/82	0430	12.40	130.0	0.07	219.7	373.87	45.05
19/08/82	0515	12.40	130.5	0.14	220.2	374.62	45.16
19/08/82	0610	12.40	130.0	0.12	40.2	375.53	45.27
19/08/82	0700	12.40	130.0	0.00	0.0	376.37	45.27
19/08/82	0800	12.30	130.5	0.15	263.1	377.37	45.41
19/08/82	0912	12.10	130.0	0.19	338.3	378.57	45.64
19/08/82	1002	11.70	131.0	0.54	283.1	379.40	46.09
19/08/82	1100	11.10	131.0	0.62	311.0	380.37	46.69
19/08/82	1205	10.40	131.0	0.65	311.0	381.45	47.39
19/08/82	1308	9.90	130.0	0.51	330.0	382.50	47.92
19/08/82	1400	9.60	129.5	0.36	325.6	383.37	48.23
19/08/82	1505	9.60	128.5	0.15	39.0	384.45	48.40
19/08/82	1600	9.65	127.0	0.28	49.0	385.37	48.66
19/08/82	1725	10.30	135.0	1.08	196.0	386.78	50.19
19/08/82	1906	11.10	127.0	1.01	69.1	388.47	51.89
20/08/82	1000	11.60	127.0	0.03	127.0	403.37	52.39
22/08/82	2037	12.20	128.0	0.01	146.6	461.98	53.02
22/08/82	2102	12.60	125.0	1.83	68.1	462.40	53.78
22/08/82	2132	13.00	130.0	2.37	197.8	462.90	54.97
22/08/82	2156	13.20	128.0	1.25	62.6	463.30	55.47
22/08/82	2227	13.60	129.0	0.90	158.8	463.82	55.93
22/08/82	2311	14.00	133.0	1.42	198.5	464.55	56.97
23/08/82	0152	14.40	136.0	0.31	196.2	467.23	57.82
23/08/82	0237	14.10	136.0	0.40	316.0	467.98	58.12
23/08/82	0425	13.30	139.0	0.60	275.6	469.78	59.19

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
23/08/82	0507	13.40	139.0	0.14	139.0	470.48	59.29	
23/08/82	0602	13.70	140.0	0.42	177.7	471.40	59.67	
23/08/82	0704	14.00	141.0	0.37	179.4	472.43	60.06	
23/08/82	0800	14.20	141.0	0.21	141.0	473.37	60.26	
23/08/82	0900	14.70	141.0	0.50	141.0	474.37	60.76	
23/08/82	1000	15.05	143.0	0.63	198.0	475.37	61.39	
23/08/82	1300	14.70	146.0	0.28	258.7	478.37	62.24	
23/08/82	1400	14.20	147.0	0.56	299.7	479.37	62.80	
23/08/82	1500	13.50	150.0	1.01	282.5	480.37	63.81	
23/08/82	1700	12.30	153.0	0.69	302.1	482.37	65.18	
23/08/82	1725	12.20	153.0	0.24	333.0	482.78	65.28	[TOW]
23/08/82	1820	11.90	153.0	0.33	333.0	483.70	65.58	[TOW]
23/08/82	1850	11.93	153.0	0.06	153.0	484.20	65.61	[TOW]
23/08/82	1950	12.00	153.0	0.07	153.0	485.20	65.68	
23/08/82	2040	12.00	154.0	0.25	243.5	486.03	65.89	
23/08/82	2200	12.20	154.0	0.15	154.0	487.37	66.09	
23/08/82	2300	12.10	154.0	0.10	334.0	488.37	66.19	
24/08/82	0000	12.00	156.0	0.43	258.4	489.37	66.63	
24/08/82	0130	11.30	157.0	0.49	320.3	490.87	67.35	
24/08/82	0215	10.40	160.0	1.42	306.2	491.62	68.42	
24/08/82	0400	9.20	162.0	0.71	325.1	493.37	69.67	
24/08/82	0500	8.60	161.0	0.62	356.0	494.37	70.29	
24/08/82	0600	8.10	160.0	0.52	356.6	495.37	70.81	
24/08/82	0700	7.90	159.0	0.24	14.4	496.37	71.05	
24/08/82	0800	7.90	157.0	0.28	68.0	497.37	71.33	
24/08/82	0900	8.10	154.0	0.46	91.0	498.37	71.79	
24/08/82	1000	8.30	152.0	0.35	97.9	499.37	72.14	
24/08/82	1100	8.45	151.0	0.21	107.2	500.37	72.35	

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (des.T)	SPEED (knots)	COURSE (des.T)	E.T. (h)	E.D. (n.mi.)	
24/08/82	1200	8.40	150.0	0.16	41.7	501.37	72.50	
24/08/82	1300	8.20	150.0	0.20	330.0	502.37	72.70	
24/08/82	1410	7.70	149.5	0.43	337.6	503.53	73.21	
24/08/82	1503	7.15	149.0	0.63	336.0	504.42	73.76	
24/08/82	1625	6.60	147.0	0.44	351.6	505.78	74.36	
24/08/82	1700	6.10	145.0	0.94	349.9	506.37	74.91	
24/08/82	1800	5.90	142.0	0.37	21.0	507.37	75.28	
24/08/82	1833	5.90	139.0	0.56	50.5	507.92	75.59	
24/08/82	1856	6.00	137.0	0.60	73.7	508.30	75.82	[TOW]
24/08/82	1930	6.20	134.0	0.66	77.5	508.87	76.20	[TOW]
24/08/82	2000	6.50	133.0	0.64	113.2	509.37	76.52	[TOW]
24/08/82	2030	6.90	132.0	0.83	116.2	509.87	76.93	[TOW]
24/08/82	2111	7.60	132.0	1.02	132.0	510.55	77.63	[TOW]
24/08/82	2130	7.90	132.0	0.95	132.0	510.87	77.93	[TOW]
24/08/82	2200	8.40	132.0	1.00	132.0	511.37	78.43	[TOW]
24/08/82	2230	8.80	132.0	0.80	132.0	511.87	78.83	[TOW]
24/08/82	2300	9.20	132.0	0.80	132.0	512.37	79.23	[TOW]
24/08/82	2330	9.80	132.0	1.20	132.0	512.87	79.83	[TOW]
25/08/82	0010	10.00	132.0	0.30	132.0	513.53	80.03	[TOW]
25/08/82	0030	10.20	132.0	0.60	132.0	513.87	80.23	[TOW]
25/08/82	0100	10.40	133.0	0.54	174.5	514.37	80.50	[TOW]
25/08/82	0130	10.40	134.0	0.36	223.5	514.87	80.69	[TOW]
25/08/82	0200	10.40	134.0	0.00	0.0	515.37	80.69	[TOW]
25/08/82	0230	10.40	134.0	0.00	0.0	515.87	80.69	
25/08/82	0350	10.00	134.0	0.30	314.0	517.20	81.09	
25/08/82	0500	9.70	133.5	0.27	329.7	518.37	81.40	
25/08/82	0600	9.70	132.5	0.17	43.0	519.37	81.57	
25/08/82	0700	10.00	131.5	0.35	102.2	520.37	81.91	

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
25/08/82	0800	10.50	132.0	0.51	141.9	521.37	82.42
25/08/82	0900	11.00	131.0	0.53	110.9	522.37	82.95
25/08/82	1000	11.70	132.0	0.73	147.3	523.37	83.68
25/08/82	1100	12.20	132.0	0.50	132.0	524.37	84.18
25/08/82	1200	12.50	133.0	0.37	168.2	525.37	84.55
25/08/82	1300	12.90	134.0	0.46	162.5	526.37	85.01
25/08/82	1400	13.00	137.0	0.69	217.1	527.37	85.69
25/08/82	1500	12.60	137.0	0.20	317.0	528.37	85.89
25/08/82	1600	12.60	139.0	0.49	252.3	529.37	86.38
25/08/82	1700	12.50	139.0	0.10	319.0	530.37	86.48
25/08/82	1800	12.40	139.0	0.10	319.0	531.37	86.58
25/08/82	1906	12.50	139.0	0.09	139.0	532.47	86.68
25/08/82	2000	12.70	139.0	0.22	139.0	533.37	86.88
25/08/82	2105	13.20	139.0	0.46	139.0	534.45	87.38
25/08/82	2200	13.60	140.0	0.51	169.8	535.37	87.84
25/08/82	2330	14.10	142.0	0.46	185.0	536.87	88.54
26/08/82	0026	14.30	143.0	0.34	193.6	537.80	88.86
26/08/82	0130	14.40	145.0	0.48	222.7	538.87	89.37
26/08/82	0230	14.20	147.0	0.54	257.8	539.87	89.91
26/08/82	0400	13.50	150.0	0.67	282.5	541.37	90.91
26/08/82	0500	13.10	151.0	0.46	306.4	542.37	91.38
26/08/82	0600	12.70	153.0	0.60	283.6	543.37	91.98
26/08/82	0700	12.40	154.0	0.37	297.4	544.37	92.35
26/08/82	0800	12.20	156.0	0.47	270.0	545.37	92.82
26/08/82	0900	12.10	157.5	0.33	264.2	546.37	93.16
26/08/82	1000	12.10	158.0	0.11	247.7	547.37	93.26
26/08/82	1100	12.10	159.0	0.21	248.5	548.37	93.47
26/08/82	1200	12.10	161.0	0.42	250.0	549.37	93.90

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LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
26/08/82	1300	12.00	162.0	0.23	276.9	550.37	94.13	
26/08/82	1405	11.60	165.0	0.68	286.4	551.45	94.86	
26/08/82	1500	11.20	167.0	0.62	301.1	552.37	95.48	
26/08/82	1600	10.80	170.0	0.70	293.3	553.37	96.13	
26/08/82	1716	9.80	175.0	1.06	310.5	554.63	97.47	
26/08/82	1805	9.20	177.0	0.84	327.1	555.45	98.16	
26/08/82	1900	8.70	180.0	0.75	315.3	556.37	98.84	
26/08/82	2000	8.10	181.0	0.62	346.8	557.37	99.46	
26/08/82	2100	7.80	184.0	0.51	308.3	558.37	99.97	
26/08/82	2224	7.50	184.0	0.21	4.0	559.77	100.27	
26/08/82	2300	7.40	184.0	0.17	4.0	560.37	100.37	
27/08/82	0011	7.20	184.0	0.17	4.0	561.55	100.57	
27/08/82	0100	6.90	185.0	0.40	342.2	562.37	100.90	
27/08/82	0200	6.60	186.0	0.32	344.1	563.37	101.22	
27/08/82	0240	6.20	188.0	0.69	337.8	564.03	101.68	
27/08/82	0400	5.80	188.0	0.30	8.0	565.37	102.08	
27/08/82	0500	5.00	199.0	1.31	321.1	566.37	103.39	[TOW]
27/08/82	0505	4.95	199.0	0.60	19.0	566.45	103.44	[TOW]
27/08/82	0605	4.50	203.0	0.56	344.7	567.45	103.99	[TOW]
27/08/82	0630	4.40	203.0	0.24	23.0	567.87	104.09	[TOW]
27/08/82	0700	4.20	207.0	0.72	328.7	568.37	104.45	
27/08/82	0800	3.50	213.0	0.81	0.0	569.37	105.26	[TOW]
27/08/82	0900	3.10	217.0	0.46	5.0	570.37	105.72	[TOW]
27/08/82	0935	2.87	216.4	0.40	44.4	570.95	105.95	[TOW]
27/08/82	1000	2.70	216.0	0.41	42.7	571.37	106.13	
27/08/82	1100	2.35	215.0	0.35	42.7	572.37	106.48	
27/08/82	1200	1.90	210.0	0.49	54.9	573.37	106.96	[TOW]
27/08/82	1210	1.80	209.0	0.63	47.4	573.53	107.07	[TOW]

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BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
27/08/82	1217	1.75	208.0	0.50	60.3	573.65	107.13	[TOW]
27/08/82	1230	1.70	207.0	0.27	58.6	573.87	107.19	[TOW]
27/08/82	1250	1.50	198.0	0.96	74.0	574.20	107.51	[TOW]
27/08/82	1300	1.43	197.0	0.45	37.6	574.37	107.58	
27/08/82	1400	1.20	179.0	0.47	69.1	575.37	108.05	
27/08/82	1500	0.96	164.0	0.37	41.3	576.37	108.42	
27/08/82	1517	0.90	159.0	0.36	35.0	576.65	108.52	
27/08/82	1532	0.83	155.0	0.37	17.8	576.90	108.61	
27/08/82	1537	0.80	154.0	0.40	359.9	576.98	108.65	[TOW]
27/08/82	1543	0.76	151.0	0.57	18.1	577.08	108.70	[TOW]
27/08/82	1546	0.74	150.0	0.48	3.7	577.13	108.73	
27/08/82	1600	0.67	144.0	0.44	13.6	577.37	108.83	
27/08/82	1609	0.60	140.0	0.55	354.4	577.52	108.91	
27/08/82	1614	0.55	135.0	0.85	2.6	577.60	108.98	
27/08/82	1622	0.50	131.0	0.46	349.3	577.73	109.05	
27/08/82	1629	0.47	129.0	0.30	339.4	577.85	109.08	
27/08/82	1643	0.43	110.0	0.66	14.6	578.08	109.23	
27/08/82	1651	0.42	100.0	0.56	7.3	578.22	109.31	
27/08/82	1655	0.41	92.0	0.88	356.2	578.28	109.37	[TOW]
27/08/82	1712	0.46	75.0	0.49	14.5	578.57	109.50	[TOW]
27/08/82	1717	0.49	69.0	0.70	13.1	578.65	109.56	[TOW]
27/08/82	1721	0.53	64.0	0.90	18.4	578.72	109.62	[TOW]
27/08/82	1725	0.60	60.0	1.20	32.6	578.78	109.70	[TOW]
27/08/82	1733	0.69	56.0	0.75	31.4	578.92	109.80	[TOW]
27/08/82	1739	0.75	54.0	0.65	32.3	579.02	109.87	[TOW]
27/08/82	1744	0.83	52.0	1.02	34.0	579.10	109.95	[TOW]
27/08/82	1749	0.90	50.0	0.91	27.7	579.18	110.03	[TOW]
27/08/82	1758	1.01	49.0	0.74	40.9	579.33	110.14	[TOW]

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BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
27/08/82	1809	1.16	48.0	0.82	41.3	579.52	110.29	[TOW]
27/08/82	1817	1.23	48.0	0.53	48.0	579.65	110.36	[TOW]
27/08/82	1830	1.35	47.0	0.56	36.9	579.87	110.48	[TOW]
27/08/82	1845	1.50	45.5	0.62	32.3	580.12	110.64	[TOW]
27/08/82	1856	1.63	44.0	0.74	27.3	580.30	110.77	[TOW]
27/08/82	1918	1.83	41.0	0.60	18.1	580.67	110.99	[TOW]
27/08/82	1930	1.98	39.0	0.82	16.1	580.87	111.16	[TOW]
27/08/82	1947	2.20	36.0	0.87	11.0	581.15	111.40	[TOW]
27/08/82	1959	2.35	36.0	0.75	36.0	581.35	111.55	[TOW]
27/08/82	2026	2.76	35.0	0.92	29.3	581.80	111.97	[TOW]
27/08/82	2108	3.40	36.0	0.92	40.3	582.50	112.61	[TOW]
27/08/82	2138	4.00	37.0	1.21	42.6	583.00	113.21	[TOW]
27/08/82	2155	4.20	38.0	0.75	57.2	583.28	113.42	[TOW]
27/08/82	2208	4.40	38.0	0.92	38.0	583.50	113.62	[TOW]
27/08/82	2238	4.80	40.0	0.86	60.9	584.00	114.06	[TOW]
27/08/82	2254	5.00	41.0	0.82	63.7	584.27	114.27	[TOW]
27/08/82	2330	5.50	43.0	0.89	62.1	584.87	114.81	[TOW]
28/08/82	0000	5.80	46.0	0.84	89.1	585.37	115.23	[TOW]
28/08/82	0030	6.00	48.0	0.57	92.8	585.87	115.51	
28/08/82	0100	6.20	49.0	0.45	76.5	586.37	115.74	
28/08/82	0130	6.30	50.0	0.30	97.0	586.87	115.89	
28/08/82	0200	6.40	51.0	0.30	98.4	587.37	116.04	
28/08/82	0230	6.50	51.0	0.20	51.0	587.87	116.14	
28/08/82	0400	6.60	50.0	0.10	1.7	589.37	116.29	
28/08/82	0500	6.70	47.0	0.36	334.5	590.37	116.65	
28/08/82	0600	6.90	44.0	0.41	344.8	591.37	117.06	
28/08/82	0700	7.35	40.0	0.67	354.1	592.37	117.73	
28/08/82	0740	7.80	39.0	0.70	23.1	593.03	118.20	[TOW]

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BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
28/08/82	0800	7.85	37.0	0.83	318.4	593.37	118.48	[TOW]
28/08/82	0820	8.05	36.7	0.61	25.1	593.70	118.68	[TOW]
28/08/82	0900	8.40	36.0	0.55	20.3	594.37	119.05	
28/08/82	1025	9.30	35.0	0.64	25.8	595.78	119.96	[TOW]
28/08/82	1035	9.50	35.0	1.20	35.0	595.95	120.16	[TOW]
28/08/82	1058	9.90	34.0	1.13	11.6	596.33	120.59	[TOW]
28/08/82	1200	10.10	37.0	0.54	104.6	597.37	121.15	
28/08/82	1300	10.30	38.0	0.27	79.2	598.37	121.42	
28/08/82	1400	10.50	38.0	0.20	38.0	599.37	121.62	
28/08/82	1522	10.60	37.0	0.15	336.0	600.73	121.83	
28/08/82	1618	10.60	35.0	0.40	306.0	601.67	122.20	
28/08/82	1732	10.70	32.0	0.46	313.7	602.90	122.77	
28/08/82	1845	10.80	29.0	0.47	310.6	604.12	123.34	
28/08/82	1926	11.00	27.0	0.63	325.7	604.80	123.77	
28/08/82	2110	11.30	22.0	0.59	311.6	606.53	124.79	
28/08/82	2210	11.40	20.0	0.41	305.2	607.53	125.19	
28/08/82	2300	11.50	22.0	0.49	97.0	608.37	125.61	
28/08/82	2343	11.50	22.0	0.00	0.0	609.08	125.61	
29/08/82	0055	11.60	22.0	0.08	22.0	610.28	125.71	
29/08/82	0200	11.40	20.0	0.41	264.5	611.37	126.16	
29/08/82	0218	11.00	24.0	2.93	139.1	611.67	127.03	
29/08/82	0300	10.40	19.0	1.58	258.8	612.37	128.14	
29/08/82	0335	9.70	12.0	2.42	255.8	612.95	129.55	
29/08/82	0400	9.30	10.0	1.25	230.7	613.37	130.07	
29/08/82	0430	8.90	10.0	0.80	190.0	613.87	130.47	
29/08/82	0500	8.65	4.0	1.90	261.8	614.37	131.43	
29/08/82	0535	8.40	3.0	0.50	214.3	614.95	131.72	
29/08/82	0603	8.30	357.0	1.89	263.5	615.42	132.60	

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DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
29/08/82	0635	8.25	355.0	0.55	256.2	615.95	132.89
29/08/82	0700	8.30	354.0	0.37	283.6	616.37	133.04
29/08/82	0735	8.40	351.0	0.77	275.4	616.95	133.49
29/08/82	0800	8.40	348.0	1.06	259.5	617.37	133.93
29/08/82	0830	8.30	346.0	0.62	238.1	617.87	134.24
29/08/82	0900	8.40	344.0	0.62	273.9	618.37	134.55
29/08/82	1000	8.60	344.0	0.20	344.0	619.37	134.75
29/08/82	1100	8.40	341.0	0.49	228.3	620.37	135.23
29/08/82	1210	8.00	340.0	0.36	180.2	621.53	135.66
29/08/82	1315	7.50	338.0	0.52	187.4	622.62	136.23
29/08/82	1403	7.10	336.0	0.59	189.5	623.42	136.70
29/08/82	1506	6.50	334.0	0.61	176.6	624.47	137.35
29/08/82	1600	6.00	330.0	0.74	193.1	625.37	138.01
29/08/82	1648	5.70	325.0	0.74	207.1	626.17	138.60
29/08/82	1754	5.70	326.0	0.09	55.5	627.27	138.70
29/08/82	1856	5.70	326.0	0.00	0.0	628.30	138.70
29/08/82	1953	5.70	326.0	0.00	0.0	629.25	138.70
29/08/82	2103	5.70	326.0	0.00	0.0	630.42	138.70
29/08/82	2211	5.70	326.0	0.00	0.0	631.55	138.70
29/08/82	2254	5.50	326.0	0.28	146.0	632.27	138.90
29/08/82	2310	5.10	325.0	1.54	158.5	632.53	139.31
29/08/82	2315	5.00	325.0	1.20	145.0	632.62	139.41
29/08/82	2340	4.60	325.0	0.96	145.0	633.03	139.81
30/08/82	0001	4.35	326.0	0.75	128.2	633.38	140.07
30/08/82	0030	3.90	327.0	0.94	137.4	633.87	140.53
30/08/82	0053	3.60	331.0	1.04	107.9	634.25	140.93
30/08/82	0127	2.94	335.0	1.23	133.9	634.82	141.63
30/08/82	0146	2.60	337.0	1.12	140.1	635.13	141.98

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DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
30/08/82	0218	2.10	343.0	1.04	133.8	635.67	142.54
30/08/82	0228	1.95	344.8	0.98	140.9	635.83	142.70
30/08/82	0239	1.80	348.0	1.00	131.5	636.02	142.88
30/08/82	0253	1.61	350.0	0.85	151.6	636.25	143.08
30/08/82	0313	1.32	357.5	1.04	140.2	636.58	143.43
30/08/82	0324	1.14	2.0	1.11	151.5	636.77	143.63
30/08/82	0333	1.03	8.0	1.05	139.0	636.92	143.79
30/08/82	0349	0.87	17.0	0.82	149.4	637.18	144.01
30/08/82	0403	0.72	28.0	0.91	156.9	637.42	144.22
30/08/82	0412	0.64	36.0	0.83	162.1	637.57	144.35
30/08/82	0421	0.57	45.0	0.79	166.8	637.72	144.46
30/08/82	0439	0.49	70.0	0.81	166.3	638.02	144.71
30/08/82	0500	0.55	97.0	0.71	160.0	638.37	144.96
30/08/82	0506	0.59	102.0	0.64	150.7	638.47	145.02
30/08/82	0514	0.62	106.0	0.39	158.6	638.60	145.07
30/08/82	0526	0.69	122.0	0.98	183.2	638.80	145.27
30/08/82	0546	0.75	135.0	0.52	198.4	639.13	145.44
30/08/82	0608	0.91	145.0	0.59	182.2	639.50	145.66
30/08/82	0642	1.11	153.0	0.43	184.2	640.07	145.90
30/08/82	0708	1.24	156.0	0.33	179.8	640.50	146.04
30/08/82	0729	1.39	156.0	0.43	156.0	640.85	146.19
30/08/82	0802	1.58	157.0	0.35	164.3	641.40	146.39
30/08/82	0920	1.91	156.5	0.25	154.1	642.70	146.72
30/08/82	1008	2.05	153.0	0.23	113.9	643.50	146.90
30/08/82	1100	2.17	146.0	0.33	84.4	644.37	147.18
30/08/82	1208	2.48	141.0	0.33	110.3	645.50	147.55
30/08/82	1231	2.62	139.0	0.43	107.5	645.88	147.72
30/08/82	1300	2.80	138.0	0.39	123.8	646.37	147.91

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DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)	
30/08/82	1330	3.03	138.0	0.46	138.0	646.87	148.14	
30/08/82	1400	3.34	137.0	0.63	127.3	647.37	148.45	
30/08/82	1430	3.60	136.0	0.53	123.4	647.87	148.72	
30/08/82	1529	4.40	133.0	0.84	119.8	648.85	149.55	
30/08/82	1601	4.80	134.0	0.76	144.8	649.38	149.95	
30/08/82	1644	5.30	134.0	0.70	134.0	650.10	150.45	
30/08/82	1701	5.55	135.0	0.94	155.2	650.38	150.72	[TOW]
30/08/82	1715	5.80	136.0	1.15	157.1	650.62	150.99	[TOW]
30/08/82	1804	6.20	138.0	0.55	164.6	651.43	151.44	
30/08/82	1841	6.30	140.0	0.39	204.4	652.05	151.68	
30/08/82	1934	6.45	142.0	0.30	197.0	652.93	151.95	
30/08/82	2033	6.50	143.0	0.13	208.6	653.92	152.07	
30/08/82	2045	6.50	143.0	0.00	0.0	654.12	152.07	[TOW]
30/08/82	2120	6.40	144.0	0.26	275.1	654.70	152.22	[TOW]
30/08/82	2150	6.40	144.0	0.00	0.0	655.20	152.22	[TOW]
30/08/82	2232	6.40	144.0	0.00	0.0	655.90	152.22	[TOW]
30/08/82	2307	6.60	144.0	0.34	144.0	656.48	152.42	[TOW]
30/08/82	2332	6.70	143.0	0.37	94.2	656.90	152.58	[TOW]
31/08/82	0002	7.10	144.0	0.84	160.3	657.40	152.99	[TOW]
31/08/82	0027	7.15	144.0	0.12	144.0	657.82	153.04	[TOW]
31/08/82	0044	7.20	142.0	0.90	64.3	658.10	153.30	
31/08/82	0154	7.55	137.0	0.63	78.0	659.27	154.03	
31/08/82	0233	7.80	136.0	0.44	108.3	659.92	154.32	
31/08/82	0350	8.60	133.5	0.68	110.7	661.20	155.19	
31/08/82	0438	8.98	133.0	0.48	121.8	662.00	155.58	
31/08/82	0531	9.60	133.0	0.70	133.0	662.88	156.20	
31/08/82	0620	9.90	134.0	0.42	163.1	663.70	156.54	
31/08/82	0701	9.98	134.0	0.12	134.0	664.38	156.62	

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DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
31/08/82	0753	9.90	135.0	0.22	249.3	665.25	156.82
31/08/82	0845	9.62	135.0	0.32	315.0	666.12	157.10
31/08/82	0932	9.40	135.0	0.28	315.0	666.90	157.32
31/08/82	1045	9.24	135.0	0.13	315.0	668.12	157.48
31/08/82	1119	8.90	131.0	1.27	14.8	668.68	158.19
31/08/82	1207	8.70	129.0	0.46	6.9	669.48	158.56
31/08/82	1300	8.77	127.0	0.35	50.9	670.37	158.87
31/08/82	1400	8.90	124.0	0.48	51.2	671.37	159.35
31/08/82	1500	9.20	122.0	0.44	76.5	672.37	159.79
31/08/82	1612	9.75	121.0	0.48	104.8	673.57	160.36
31/08/82	1701	10.20	120.0	0.59	99.3	674.38	160.85
31/08/82	1803	10.60	120.0	0.39	120.0	675.42	161.25
31/08/82	1905	10.70	120.0	0.10	120.0	676.45	161.35
31/08/82	2036	10.70	120.0	0.00	0.0	677.97	161.35
31/08/82	2147	10.50	121.0	0.23	257.7	679.15	161.62
31/08/82	2244	10.30	120.0	0.28	342.7	680.10	161.89
01/09/82	0008	10.00	118.0	0.33	348.7	681.50	162.35
01/09/82	0102	10.00	117.0	0.19	27.5	682.40	162.53
01/09/82	0151	10.10	115.0	0.45	41.9	683.22	162.89
01/09/82	0237	10.30	114.0	0.35	72.8	683.98	163.16
01/09/82	0400	10.90	112.0	0.51	81.3	685.37	163.86
01/09/82	0435	11.20	111.5	0.54	93.9	685.95	164.18
01/09/82	0500	11.50	111.5	0.72	111.5	686.37	164.48
01/09/82	0530	11.68	111.5	0.36	111.5	686.87	164.66
01/09/82	0630	12.00	111.0	0.34	93.4	687.87	165.00
01/09/82	0700	12.14	111.0	0.28	111.0	688.37	165.14
01/09/82	0730	12.27	111.0	0.26	111.0	688.87	165.27
01/09/82	0830	12.27	111.0	0.00	0.0	689.87	165.27

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
01/09/82	0930	12.10	111.0	0.17	291.0	690.87	165.44
01/09/82	1005	11.90	110.0	0.50	336.8	691.45	165.73
01/09/82	1030	11.74	109.5	0.46	322.6	691.87	165.92
01/09/82	1104	11.55	108.0	0.63	346.8	692.43	166.28
01/09/82	1210	11.30	106.0	0.43	344.9	693.53	166.75
01/09/82	1240	11.26	103.5	0.99	10.1	694.03	167.24
01/09/82	1300	11.29	103.0	0.31	30.2	694.37	167.34
01/09/82	1330	11.33	102.5	0.21	34.8	694.87	167.45
01/09/82	1402	11.50	102.0	0.37	71.9	695.40	167.65
01/09/82	1433	11.65	101.0	0.49	48.1	695.92	167.90
01/09/82	1512	11.97	100.5	0.52	82.9	696.57	168.23
01/09/82	1546	12.20	100.0	0.45	75.6	697.13	168.49
01/09/82	1648	12.80	100.0	0.58	100.0	698.17	169.09
01/09/82	1730	13.15	100.0	0.50	100.0	698.87	169.44
01/09/82	1837	13.55	100.0	0.36	100.0	699.98	169.84
01/09/82	1941	13.90	101.0	0.40	134.9	701.05	170.26
01/09/82	2031	14.10	101.0	0.24	101.0	701.88	170.46
01/09/82	2316	13.80	100.5	0.12	302.8	704.63	170.78
02/09/82	0002	13.70	100.0	0.20	330.4	705.40	170.94
02/09/82	0057	13.70	99.5	0.13	9.7	706.32	171.06
02/09/82	0144	13.70	99.5	0.00	0.0	707.10	171.06
02/09/82	0248	14.00	99.0	0.30	77.3	708.17	171.38
02/09/82	0350	14.27	99.0	0.26	99.0	709.20	171.65
02/09/82	0500	14.70	99.5	0.38	115.6	710.37	172.10
02/09/82	0610	15.12	100.0	0.38	117.0	711.53	172.54
02/09/82	0700	15.40	100.0	0.34	100.0	712.37	172.82
02/09/82	0800	15.50	100.5	0.17	153.7	713.37	172.99
02/09/82	0900	15.40	100.5	0.10	280.5	714.37	173.09

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 059 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
02/09/82	1000	15.20	100.0	0.24	314.0	715.37	173.33
02/09/82	1100	14.90	98.5	0.50	332.0	716.37	173.83
02/09/82	1219	14.60	96.0	0.54	342.3	717.68	174.54
02/09/82	1305	14.55	95.0	0.34	354.4	718.45	174.79
02/09/82	1506	15.00	92.0	0.44	33.7	720.47	175.69
02/09/82	1552	15.40	91.5	0.55	73.4	721.23	176.11

CPA:

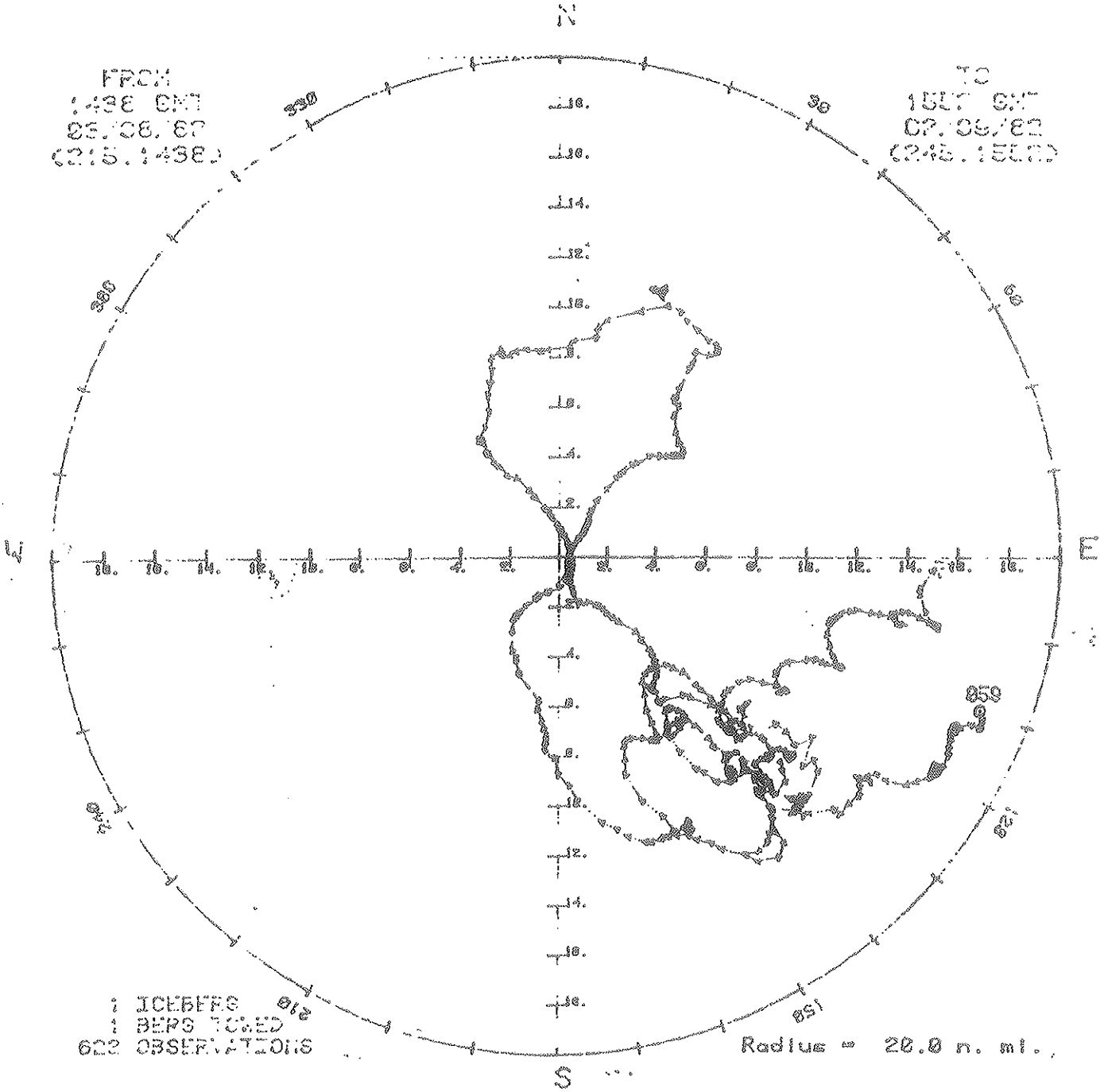
27/08/82	1655	0.41	92.0

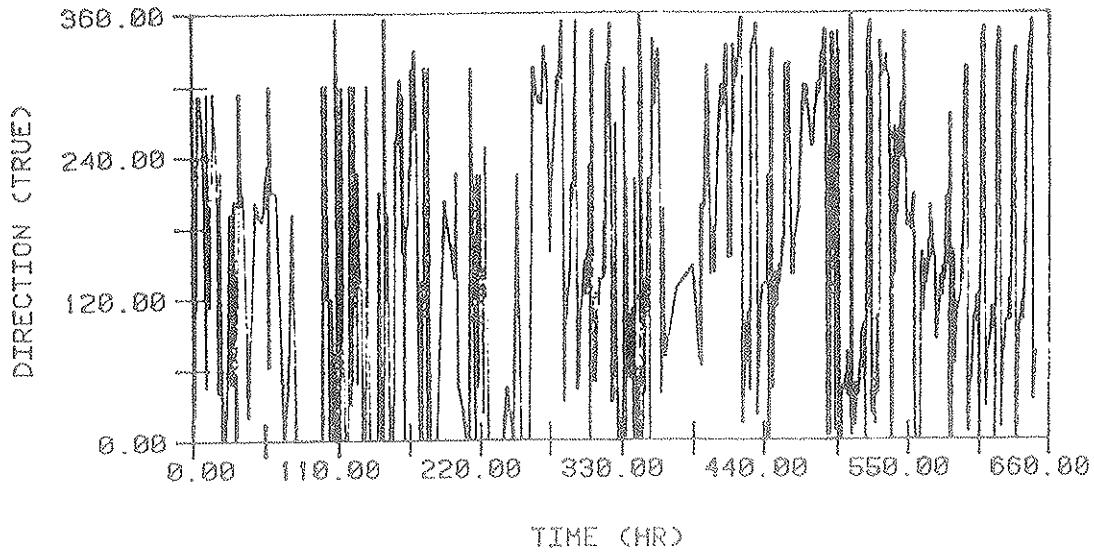
SPEEDS (knots)

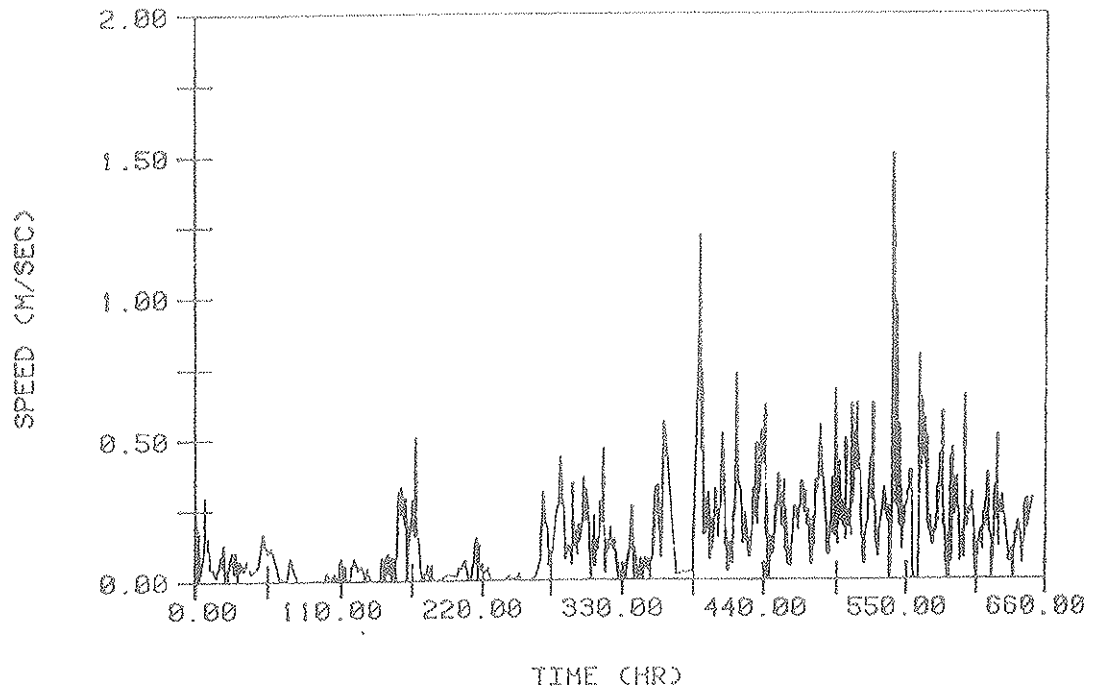
MIN.	MAX.	MEAN
0.00	2.93	0.39

TOTAL NO. OF OBSERVATIONS = 622

Wellsite: PUT H-11, 1982 Vessel: PACNORSE I

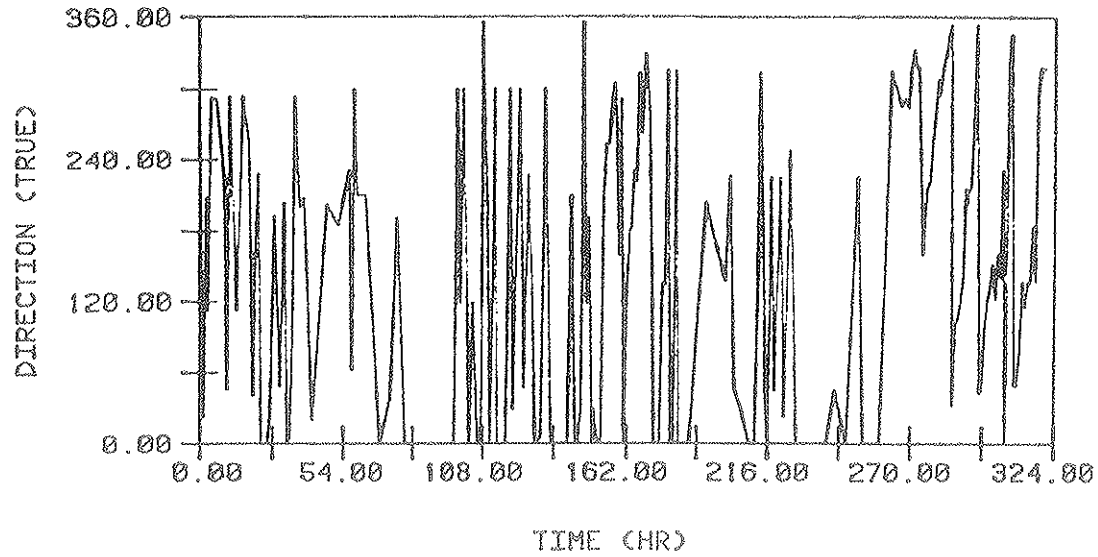


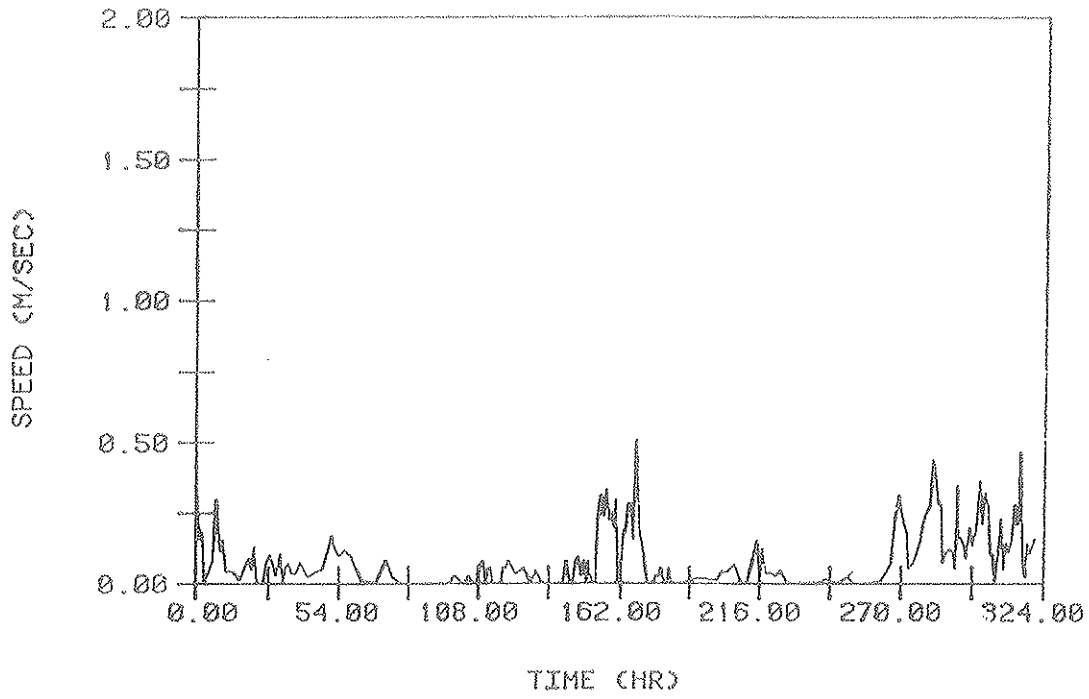




TIME HISTORY OF SPEED AND DIRECTION

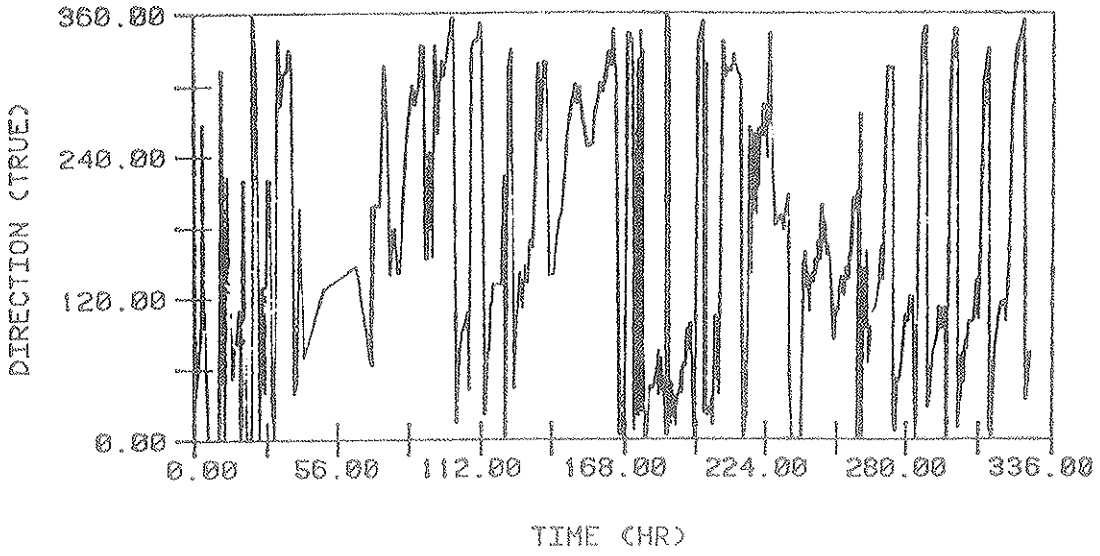
BERG # 059 RUT H-11 1982

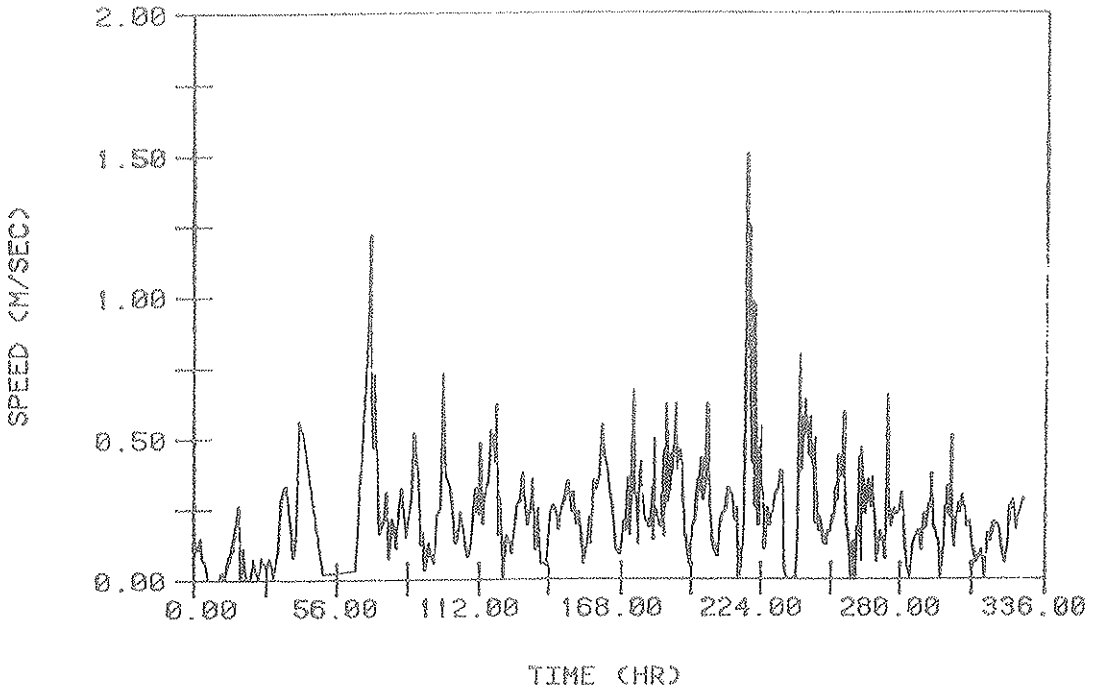




TIME HISTORY OF SPEED AND DIRECTION

BERG#059 RUT H-11 AUG.3 TO 17,1982

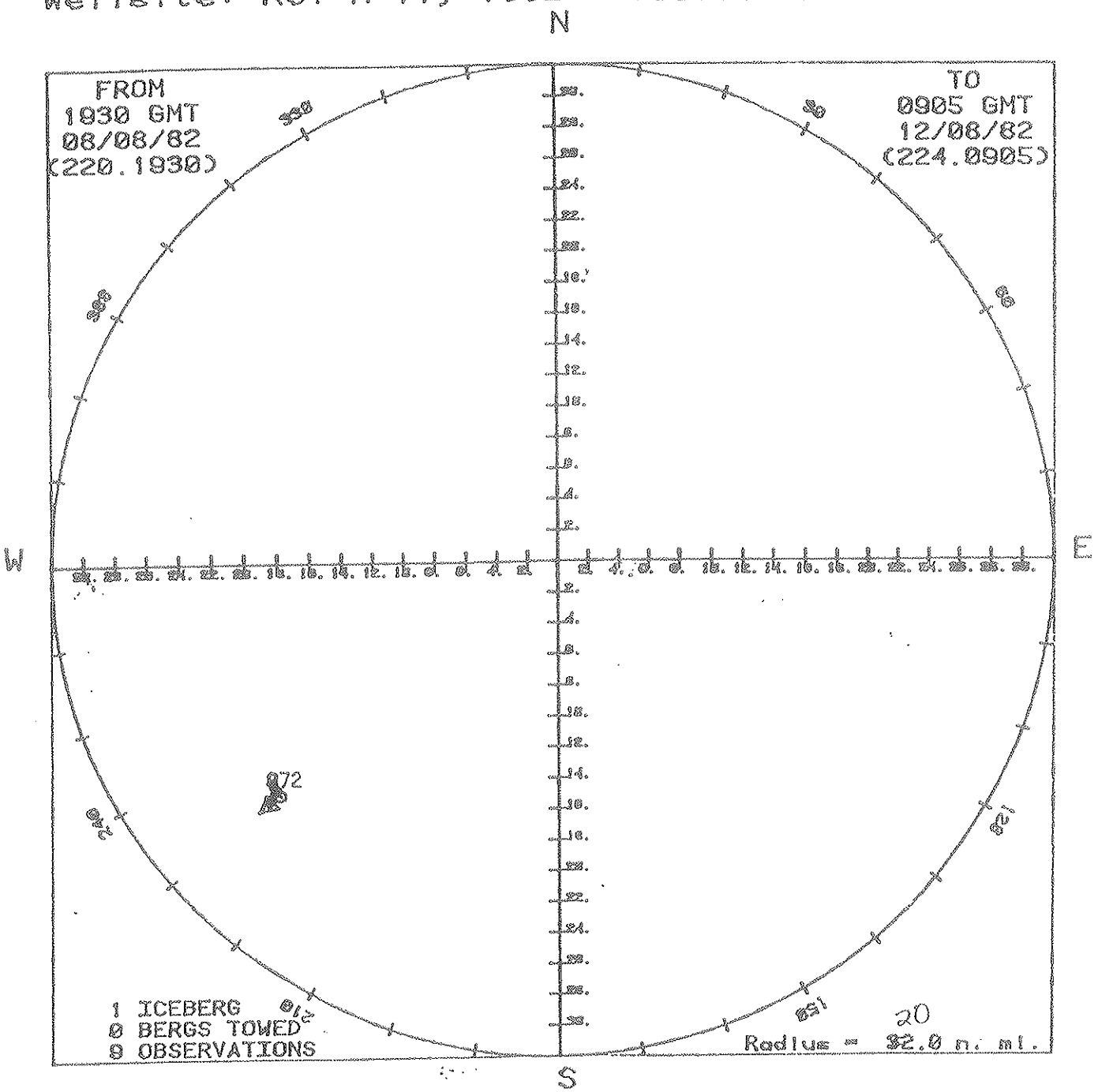


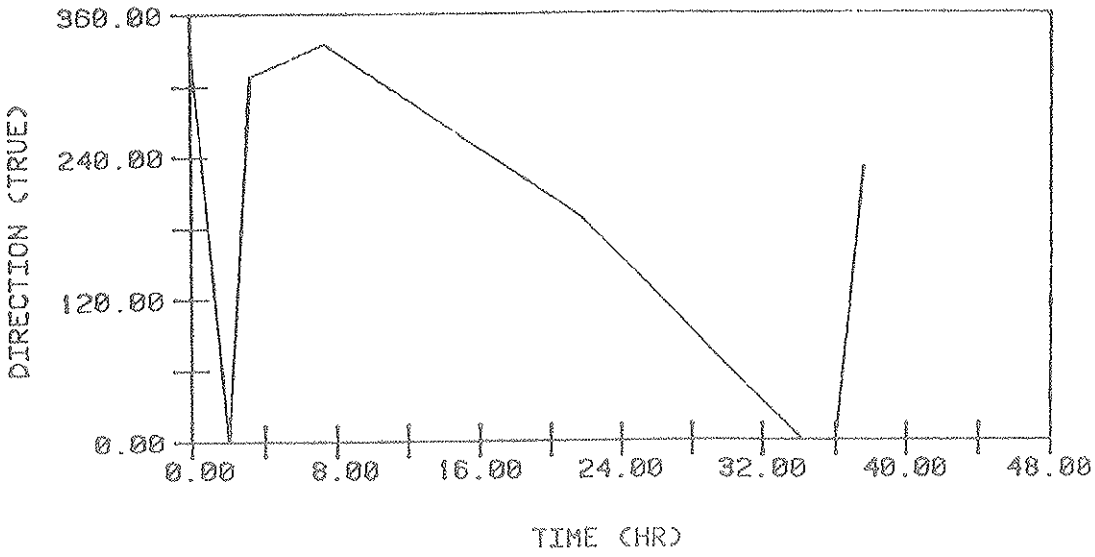


TIME HISTORY OF SPEED AND DIRECTION

BERG #059 RUT H-11 AUG.18 TO SEPT.03,1982

Wellsite: RUT H-11, 1982 Vessel: PACNORSE I





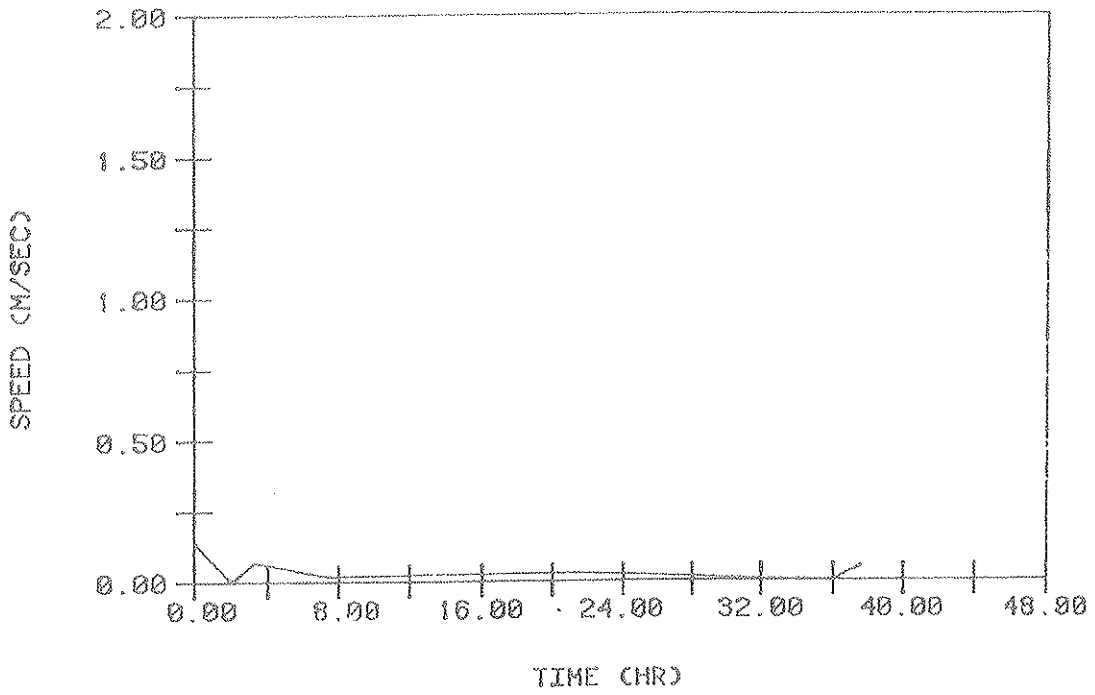


FIG. TIME HISTORY OF SPEED AND DIRECTION

BERG # 072 RUT H-11 1982

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: FACNORSE 1

BERG 072

DATE (GMT)	TIME (GMT)	RANGE (n.mi.)	BEARING (des.T)	SPEED (knots)	COURSE (des.T)	E.T. (h)	E.D. (n.mi.)
08/08/82	1930	23.30	230.0	0.00	0.0	0.00	0.00
08/08/82	2100	23.20	231.0	0.28	334.3	1.50	0.42
08/08/82	2200	23.20	231.0	0.00	0.0	2.50	0.42
08/08/82	2330	23.25	231.5	0.14	307.4	4.00	0.63
09/08/82	0605	23.20	232.0	0.03	335.6	10.58	0.84
10/08/82	0420	24.10	230.0	0.05	188.5	32.83	2.06
12/08/82	0700	24.10	230.0	0.00	0.0	83.50	2.06
12/08/82	0800	24.10	230.0	0.00	0.0	84.50	2.06
12/08/82	0905	24.20	230.0	0.09	230.0	85.58	2.16

CPA:

08/08/82	2100	23.20	231.0

SPEEDS (knots)

MIN.	MAX.	MEAN
0.00	0.28	0.07

TOTAL NO. OF OBSERVATIONS = 9

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
01/10/82	0700	19.20	16.0	0.00	0.0	0.00	0.00
01/10/82	0746	18.70	15.0	0.78	229.0	0.77	0.60
01/10/82	0830	18.40	15.0	0.41	195.0	1.50	0.90
01/10/82	0904	18.10	14.5	0.60	222.7	2.07	1.24
01/10/82	0958	17.80	12.0	0.93	262.3	2.97	2.08
01/10/82	1100	17.70	10.0	0.61	271.8	4.00	2.71
01/10/82	1153	17.80	10.0	0.11	10.0	4.88	2.81
01/10/82	1307	17.80	8.0	0.50	279.0	6.12	3.43
01/10/82	1356	17.70	8.0	0.12	188.0	6.93	3.53
01/10/82	1452	17.60	10.0	0.67	108.2	7.87	4.15
01/10/82	1550	17.10	12.0	0.81	140.5	8.83	4.94
01/10/82	1700	16.40	14.0	0.78	153.1	10.00	5.85
01/10/82	1800	15.70	15.0	0.75	172.7	11.00	6.60
01/10/82	1900	14.80	16.0	0.94	179.0	12.00	7.54
01/10/82	2000	14.00	15.0	0.84	212.9	13.00	8.38
01/10/82	2100	13.40	12.0	0.93	243.6	14.00	9.31
01/10/82	2200	13.00	10.0	0.61	240.0	15.00	9.92
01/10/82	2300	12.70	7.0	0.74	254.5	16.00	10.66
02/10/82	0000	12.70	6.0	0.22	276.5	17.00	10.88
02/10/82	0100	12.70	5.5	0.11	275.7	18.00	10.99
02/10/82	0200	12.70	6.0	0.11	95.7	19.00	11.10
02/10/82	0300	12.60	6.5	0.15	138.4	20.00	11.25
02/10/82	0400	12.20	7.0	0.41	171.6	21.00	11.67
02/10/82	0455	11.70	8.0	0.59	164.9	21.92	12.21
02/10/82	0600	11.35	9.0	0.37	158.6	23.00	12.61
02/10/82	0701	11.00	8.0	0.39	217.6	24.02	13.01
02/10/82	0800	11.00	8.0	0.00	0.0	25.00	13.01
02/10/82	0900	11.00	8.0	0.00	0.0	26.00	13.01

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
02/10/82	1000	11.00	8.0	0.00	0.0	27.00	13.01
02/10/82	1100	11.10	7.0	0.22	304.9	28.00	13.23
02/10/82	1200	11.30	6.5	0.22	340.7	29.00	13.45
02/10/82	1300	11.50	6.5	0.20	6.5	30.00	13.65
02/10/82	1400	11.50	6.0	0.10	276.2	31.00	13.75
02/10/82	1500	11.50	6.0	0.00	0.0	32.00	13.75
02/10/82	1550	11.50	6.0	0.00	0.0	32.83	13.75
02/10/82	1601	11.50	6.0	0.00	0.0	33.02	13.75
02/10/82	1700	11.50	6.0	0.00	0.0	34.00	13.75
02/10/82	1800	11.50	6.0	0.00	0.0	35.00	13.75
02/10/82	1900	11.50	6.0	0.00	0.0	36.00	13.75
02/10/82	2000	11.50	6.0	0.00	0.0	37.00	13.75
02/10/82	2100	11.50	6.0	0.00	0.0	38.00	13.75
02/10/82	2200	11.50	6.0	0.00	0.0	39.00	13.75
02/10/82	2302	11.60	6.0	0.10	6.0	40.03	13.85
03/10/82	0000	11.60	6.0	0.00	0.0	41.00	13.85
03/10/82	0100	11.60	6.0	0.00	0.0	42.00	13.85
03/10/82	0200	11.60	6.0	0.00	0.0	43.00	13.85
03/10/82	0353	11.50	6.0	0.05	186.0	44.86	13.95
03/10/82	0455	11.50	6.5	0.10	96.2	45.92	14.05
03/10/82	0604	11.60	6.5	0.09	6.5	47.07	14.15
03/10/82	0658	11.60	6.5	0.00	0.0	47.97	14.15
03/10/82	0800	11.60	6.5	0.00	0.0	49.00	14.15
03/10/82	0902	11.60	6.5	0.00	0.0	50.03	14.15
03/10/82	0958	11.60	6.5	0.00	0.0	50.97	14.15
03/10/82	1101	11.60	6.0	0.10	276.2	52.02	14.26
03/10/82	1201	11.50	5.5	0.14	231.0	53.02	14.40
03/10/82	1257	11.50	5.5	0.00	0.0	53.95	14.40

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
03/10/82	1401	11.60	5.5	0.09	5.5	55.02	14.50
03/10/82	1503	11.60	5.5	0.00	0.0	56.05	14.50
03/10/82	1600	11.60	5.5	0.00	0.0	57.00	14.50
03/10/82	1701	11.60	5.5	0.00	0.0	58.02	14.50
03/10/82	1801	11.60	5.5	0.00	0.0	59.02	14.50
03/10/82	1903	11.60	5.5	0.00	0.0	60.05	14.50
03/10/82	2005	11.60	6.0	0.10	95.7	61.08	14.60
03/10/82	2100	11.60	6.0	0.00	0.0	62.00	14.60
03/10/82	2200	11.60	6.0	0.00	0.0	63.00	14.60
03/10/82	2300	11.60	6.0	0.00	0.0	64.00	14.60
04/10/82	0000	11.60	6.0	0.00	0.0	65.00	14.60
04/10/82	0100	11.60	6.0	0.00	0.0	66.00	14.60
04/10/82	0200	11.60	6.0	0.00	0.0	67.00	14.60
04/10/82	0300	11.60	6.0	0.00	0.0	68.00	14.60
04/10/82	0400	11.60	6.0	0.00	0.0	69.00	14.60
04/10/82	0500	11.60	6.0	0.00	0.0	70.00	14.60
04/10/82	0557	11.60	6.0	0.00	0.0	70.95	14.60
04/10/82	0655	11.60	6.0	0.00	0.0	71.92	14.60
04/10/82	0800	11.60	6.0	0.00	0.0	73.00	14.60
04/10/82	0857	11.60	6.0	0.00	0.0	73.95	14.60
04/10/82	1000	11.60	7.0	0.19	96.5	75.00	14.80
04/10/82	1100	11.60	5.0	0.40	276.0	76.00	15.21
04/10/82	1200	11.60	5.0	0.00	0.0	77.00	15.21
04/10/82	1300	11.60	7.0	0.40	96.0	78.00	15.61
04/10/82	1400	11.60	7.0	0.00	0.0	79.00	15.61
04/10/82	1500	11.60	7.0	0.00	0.0	80.00	15.61
04/10/82	1600	11.60	7.0	0.00	0.0	81.00	15.61
04/10/82	1700	11.60	7.0	0.00	0.0	82.00	15.61

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (des.T)	SPEED (knots)	COURSE (des.T)	E.T. (h)	E.D. (n.mi.)
04/10/82	1800	11.60	6.0	0.20	276.5	83.00	15.81
04/10/82	1900	11.60	6.0	0.00	0.0	84.00	15.81
04/10/82	2000	11.60	6.0	0.00	276.6	85.00	15.81
04/10/82	2112	11.60	6.0	0.00	96.0	86.20	15.81
04/10/82	2202	11.60	6.0	0.00	0.0	87.03	15.81
04/10/82	2302	11.60	6.0	0.00	0.0	88.03	15.81
05/10/82	0000	11.60	6.0	0.00	0.0	89.00	15.81
05/10/82	0103	11.60	6.0	0.00	0.0	90.05	15.81
05/10/82	0200	11.60	6.0	0.00	0.0	91.00	15.81
05/10/82	0315	11.60	6.0	0.00	0.0	92.25	15.81
05/10/82	0400	11.60	6.0	0.00	0.0	93.00	15.81
05/10/82	0505	11.60	6.0	0.00	0.0	94.08	15.81
05/10/82	0600	11.60	6.0	0.00	0.0	95.00	15.81
05/10/82	0703	11.60	6.0	0.00	0.0	96.05	15.81
05/10/82	0756	11.60	6.0	0.00	0.0	96.93	15.81
05/10/82	0900	11.60	6.0	0.00	0.0	98.00	15.81
05/10/82	0956	11.60	6.0	0.00	0.0	98.93	15.81
05/10/82	1100	11.60	6.0	0.00	0.0	100.00	15.81
05/10/82	1200	11.60	6.0	0.00	0.0	101.00	15.81
05/10/82	1307	11.60	6.0	0.00	0.0	102.12	15.81
05/10/82	1355	11.60	6.0	0.00	0.0	102.92	15.81
05/10/82	1500	11.60	6.0	0.00	0.0	104.00	15.81
05/10/82	1610	11.60	6.0	0.00	0.0	105.17	15.81
05/10/82	1700	11.60	6.0	0.00	0.0	106.00	15.81
05/10/82	1800	11.60	6.0	0.00	0.0	107.00	15.81
05/10/82	1900	11.60	6.0	0.00	0.0	108.00	15.81
05/10/82	2000	11.60	6.0	0.00	0.0	109.00	15.81
05/10/82	2104	11.60	6.0	0.00	0.0	110.07	15.81

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
05/10/82	2206	11.60	6.0	0.00	0.0	111.10	15.81
05/10/82	2305	11.60	6.0	0.00	0.0	112.08	15.81
06/10/82	0001	11.60	6.0	0.00	0.0	113.02	15.81
06/10/82	0100	11.60	6.0	0.00	0.0	114.00	15.81
06/10/82	0200	11.60	5.0	0.20	275.5	115.00	16.02
06/10/82	0302	11.60	6.0	0.20	95.5	116.03	16.22
06/10/82	0402	11.50	6.0	0.10	186.0	117.03	16.32
06/10/82	0453	11.50	6.0	0.00	0.0	117.88	16.32
06/10/82	0556	11.50	6.0	0.00	0.0	118.93	16.32
06/10/82	0700	11.50	6.0	0.00	0.0	120.00	16.32
06/10/82	0756	11.60	6.0	0.11	6.0	120.93	16.42
06/10/82	0906	11.50	6.0	0.09	186.0	122.10	16.52
06/10/82	0958	11.60	6.0	0.12	6.0	122.97	16.62
06/10/82	1059	10.90	7.5	0.75	163.9	123.98	17.38
06/10/82	1202	10.40	6.0	0.55	215.9	125.03	17.95
06/10/82	1232	10.20	4.5	0.67	238.7	125.53	18.29
06/10/82	1300	9.90	4.5	0.64	184.5	126.00	18.59
06/10/82	1402	9.70	2.5	0.38	243.2	127.03	18.98
06/10/82	1506	9.30	4.0	0.44	151.4	128.10	19.45
06/10/82	1606	8.85	3.0	0.48	202.9	129.10	19.93
06/10/82	1635	8.55	5.0	0.88	138.6	129.58	20.36
06/10/82	1702	8.20	4.0	0.64	207.2	130.03	20.74
06/10/82	1753	7.40	5.0	0.95	174.8	130.88	21.55
06/10/82	1833	6.50	10.0	1.63	153.5	131.55	22.63
06/10/82	1903	5.90	14.0	1.48	156.2	132.05	23.37
06/10/82	1935	5.20	22.0	1.95	150.0	132.58	24.41
06/10/82	2000	4.90	28.0	1.46	144.5	133.00	25.02
06/10/82	2032	4.40	37.0	1.66	156.8	133.53	25.91

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
06/10/82	2113	4.00	48.0	1.31	158.8	134.22	26.80
06/10/82	2150	3.80	57.0	1.04	160.5	134.83	27.45
06/10/82	2235	3.60	63.0	0.58	177.3	135.58	27.88
06/10/82	2335	3.60	63.0	0.00	0.0	136.58	27.88
07/10/82	0005	3.65	63.0	0.10	63.0	137.08	27.93
07/10/82	0030	3.65	63.0	0.00	0.0	137.50	27.93
07/10/82	0100	3.65	63.0	0.00	0.0	138.00	27.93
07/10/82	0130	3.65	63.0	0.00	0.0	138.50	27.93
07/10/82	0200	3.65	63.0	0.00	0.0	139.00	27.93
07/10/82	0230	3.65	63.0	0.00	0.0	139.50	27.93
07/10/82	0300	3.65	63.0	0.00	0.0	140.00	27.93
07/10/82	0400	3.65	63.0	0.00	0.0	141.00	27.93
07/10/82	0454	3.65	63.0	0.00	0.0	141.90	27.93
07/10/82	0600	3.65	63.0	0.00	0.0	143.00	27.93
07/10/82	0656	3.65	63.0	0.00	0.0	143.93	27.93
07/10/82	0756	3.65	63.0	0.00	0.0	144.93	27.93
07/10/82	0905	3.65	63.0	0.00	0.0	146.08	27.93
07/10/82	1000	3.65	63.0	0.00	0.0	147.00	27.93
07/10/82	1100	3.65	63.0	0.00	0.0	148.00	27.93
07/10/82	1200	3.65	63.0	0.00	0.0	149.00	27.93
07/10/82	1252	3.65	63.0	0.00	0.0	149.87	27.93
07/10/82	1400	3.65	63.0	0.00	0.0	151.00	27.93
07/10/82	1500	3.65	63.0	0.00	0.0	152.00	27.93
07/10/82	1600	3.65	63.0	0.00	0.0	153.00	27.93
07/10/82	1700	3.65	63.0	0.00	0.0	154.00	27.93
07/10/82	1800	3.65	63.0	0.00	0.0	155.00	27.93
07/10/82	1900	3.65	63.0	0.00	0.0	156.00	27.93
07/10/82	2000	3.65	63.0	0.00	0.0	157.00	27.93

ICEBERGS, 1982

LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
07/10/82	2100	3.65	63.0	0.00	0.0	158.00	27.93
07/10/82	2200	3.65	63.0	0.00	0.0	159.00	27.93
07/10/82	2300	3.65	63.0	0.00	0.0	160.00	27.93
08/10/82	0000	3.65	63.0	0.00	0.0	161.00	27.93
08/10/82	0100	3.65	63.0	0.00	0.0	162.00	27.93
08/10/82	0200	3.65	63.0	0.00	0.0	163.00	27.93
08/10/82	0300	3.65	63.0	0.00	0.0	164.00	27.93
08/10/82	0400	3.65	63.0	0.00	0.0	165.00	27.93
08/10/82	0500	3.65	63.0	0.00	0.0	166.00	27.93
08/10/82	0607	3.65	63.0	0.00	0.0	167.12	27.93
08/10/82	0701	3.59	63.0	0.07	243.0	168.02	27.99
08/10/82	0729	3.48	67.5	0.64	176.9	168.48	28.29
08/10/82	0800	3.45	80.0	1.46	166.0	169.00	29.05
08/10/82	0833	3.65	93.5	1.56	163.4	169.55	29.90
08/10/82	0900	4.00	104.0	1.74	162.3	170.00	30.69
08/10/82	0930	4.50	112.0	1.55	157.9	170.50	31.46
08/10/82	1000	5.00	119.5	1.59	167.0	171.00	32.26
08/10/82	1053	5.80	131.0	1.52	178.9	171.88	33.60
08/10/82	1132	6.30	140.0	1.65	197.8	172.53	34.67
08/10/82	1156	6.70	144.0	1.51	190.6	172.93	35.28
08/10/82	1230	7.20	149.0	1.39	197.0	173.50	36.06
08/10/82	1300	7.40	152.0	0.86	212.9	174.00	36.49
08/10/82	1400	8.00	162.0	1.47	223.0	175.00	37.96
08/10/82	1500	8.70	166.0	0.91	203.8	176.00	38.87
08/10/82	1605	9.50	170.0	0.94	206.5	177.08	39.90
08/10/82	1703	10.25	173.0	0.94	206.1	178.05	40.81
08/10/82	1811	11.30	175.0	0.98	193.7	179.18	41.92
08/10/82	1900	12.00	175.0	0.86	175.0	180.00	42.62

ICEBERGS, 1982
LOCATION: RUT H-11 VESSEL: PACNORSE I

BERG 091 (Cont'd)

DATE	TIME (GMT)	RANGE (n.mi.)	BEARING (deg.T)	SPEED (knots)	COURSE (deg.T)	E.T. (h)	E.D. (n.mi.)
08/10/82	2001	13.20	176.0	1.20	185.9	181.02	43.84
08/10/82	2115	14.80	176.0	1.30	176.0	182.25	45.44
08/10/82	2200	15.70	175.0	1.25	159.0	183.00	46.38
08/10/82	2300	16.90	174.0	1.23	161.2	184.00	47.61

CPA:

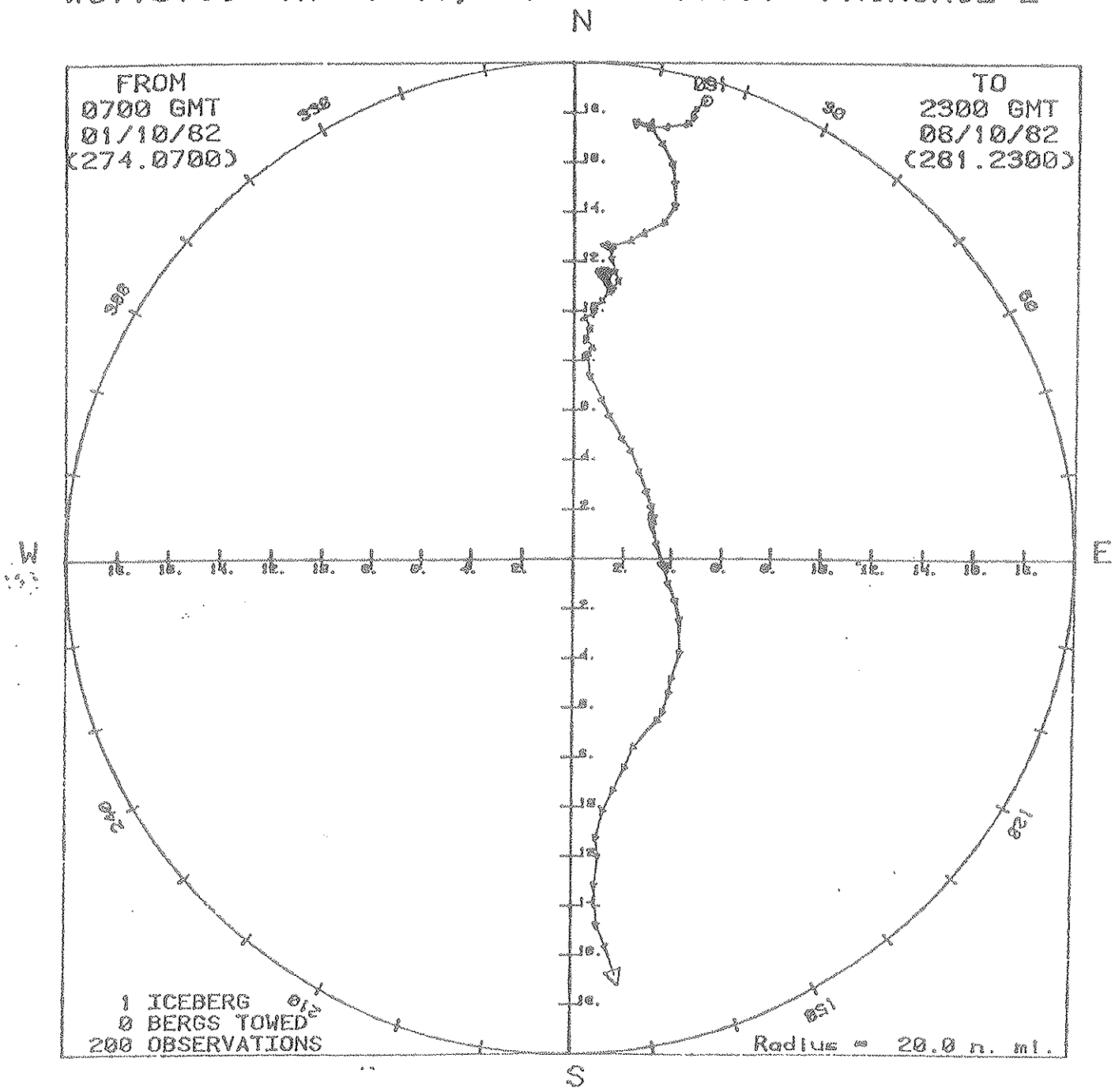
08/10/82	0800	3.45	80.0

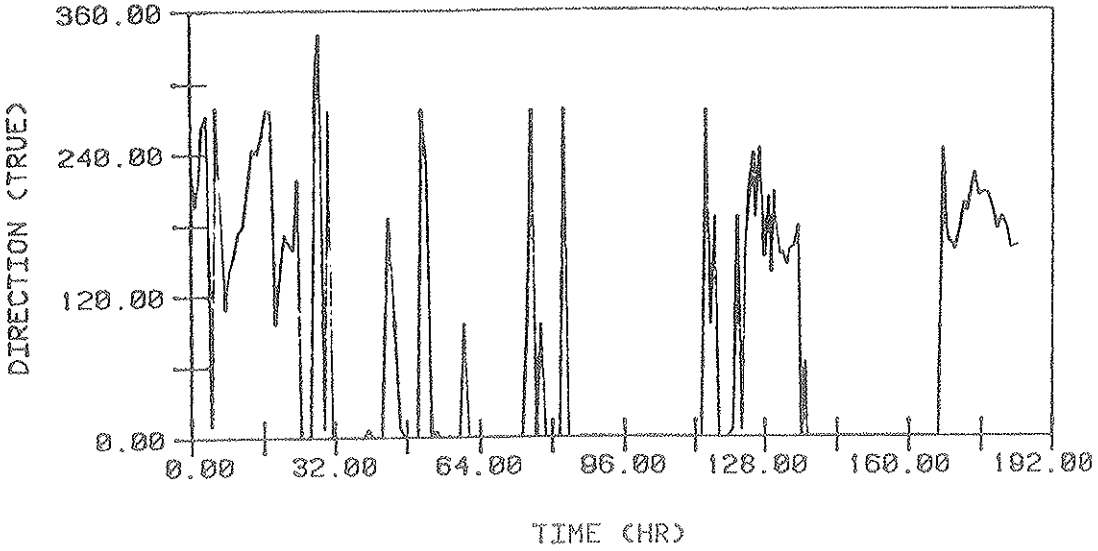
SPEEDS (knots)

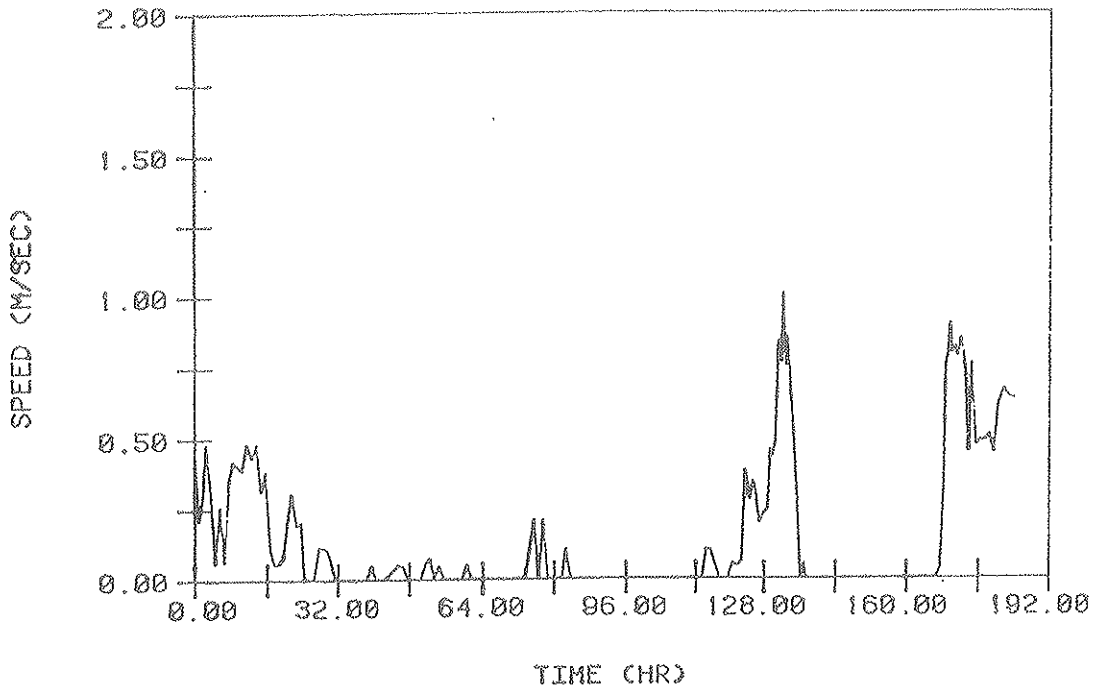
MIN.	MAX.	MEAN
0.00	1.95	0.31

TOTAL NO. OF OBSERVATIONS = 200

Wellsite: RUT H-11, 1982 Vessel: PACNORSE I







TIME HISTORY OF SPEED AND DIRECTION

BERG # 091 RUT H-11 1982

Appendix 3

Sample grounding analysis form

Year	1973
Wellsite	BJARNI H-81
Water Depth	139m
Iceberg No.	037
Tracking Period	Aug. 30 - Sept. 15

Iceberg Data:

Type	Non-Tabular	Length	141m
Mass	10.0 (10^6)	Width	N/A
Height	82m	Draft	N/A (meas ____, est ____)

Iceberg Grounding Data:

1. Period of zero of very low velocity
   Minimun Speed 0 (knts)
   Period 189.6 (hr), From 2345/30 to 1257/03 (GMT)

   Range/Variation 18.9 (± .1) (n.mi.)

   Bearing/Variation 297.5 (± 1.5) (°T)

2. Other Icebergs Moving (within 5 n.mi.)
   Yes _____, Range to other Berg _____ n.mi.
3. Observers Verification
   Yes X
4. Environmental Forces Produce Low Velocity
   No _____
5. Draft Comparable to Water Depth
   Yes _____, Water Depth _____
   Measured _____, Bathymetry Chart _____
6. High Tide when Icebergs started to move
   Yes _____

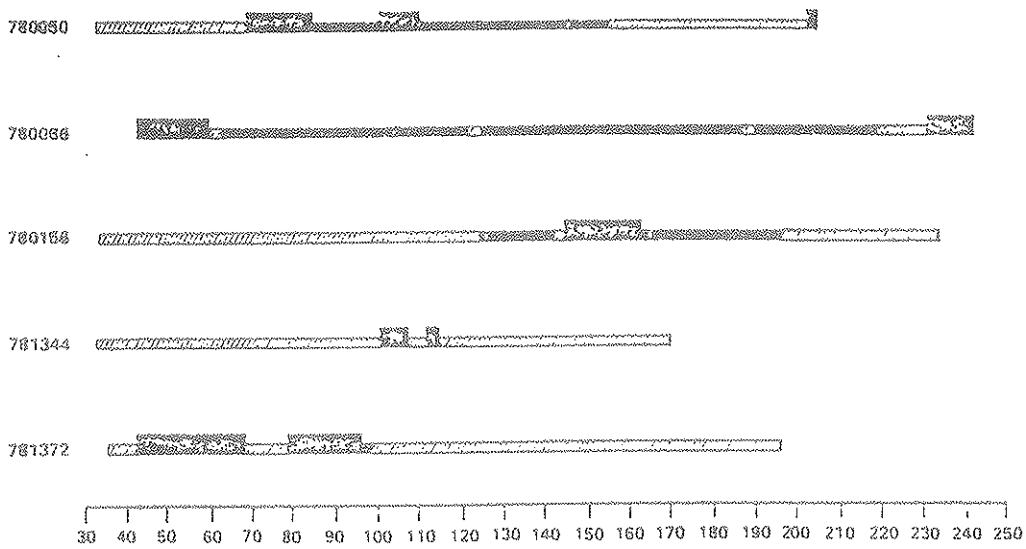
Positive Grounding	X
Probable Grounding	

COMMENTS: Iceberg grounded a number of times during this tracking period.

Appendix 4

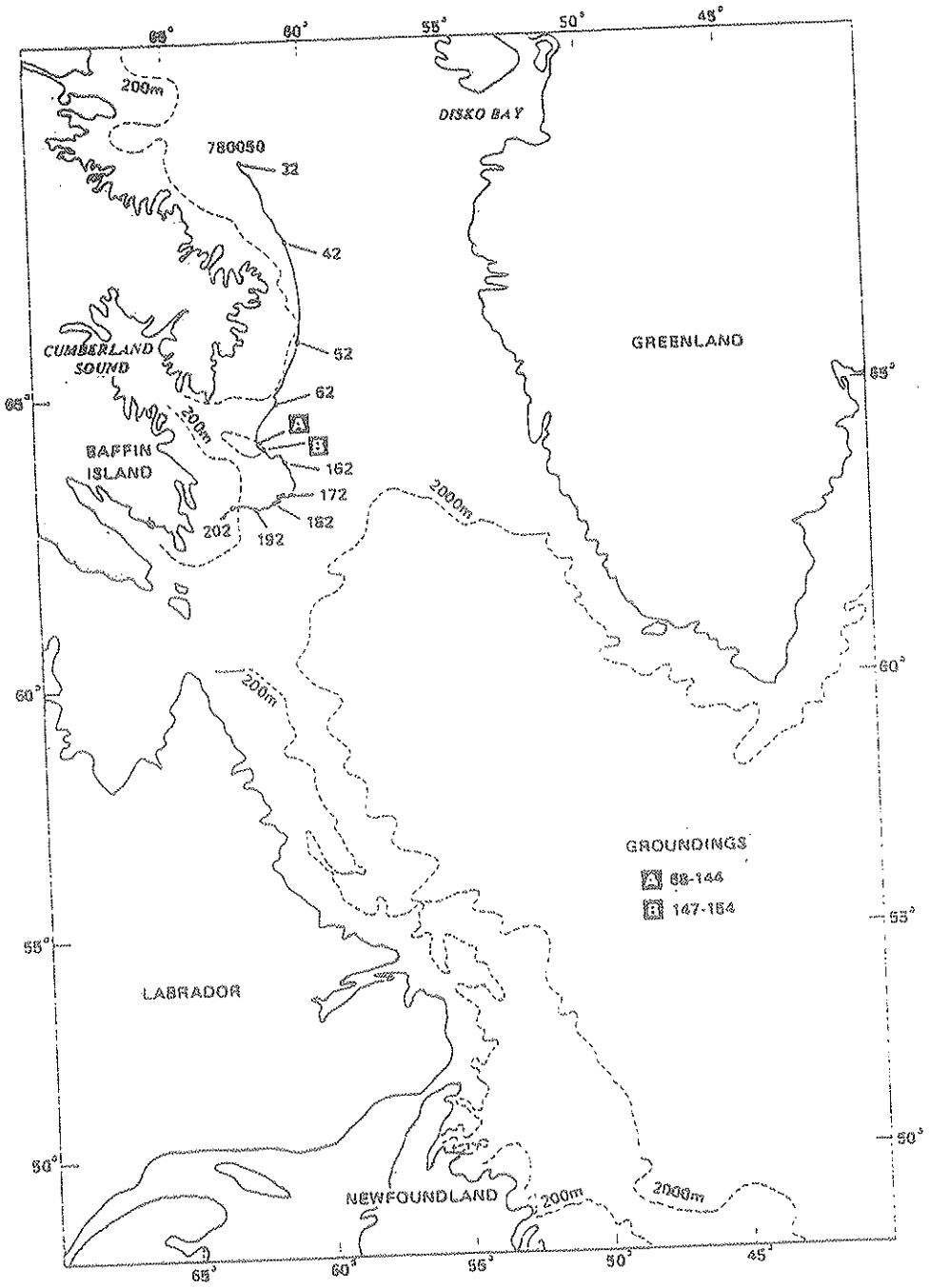
Grounding duration and drift trajectories of icebergs tracked by satellite

These figures are redrawn from an International Ice Patrol data report "Long-term drift of icebergs in Baffin Bay and the Labrador Sea", (Robe et al. 1979).

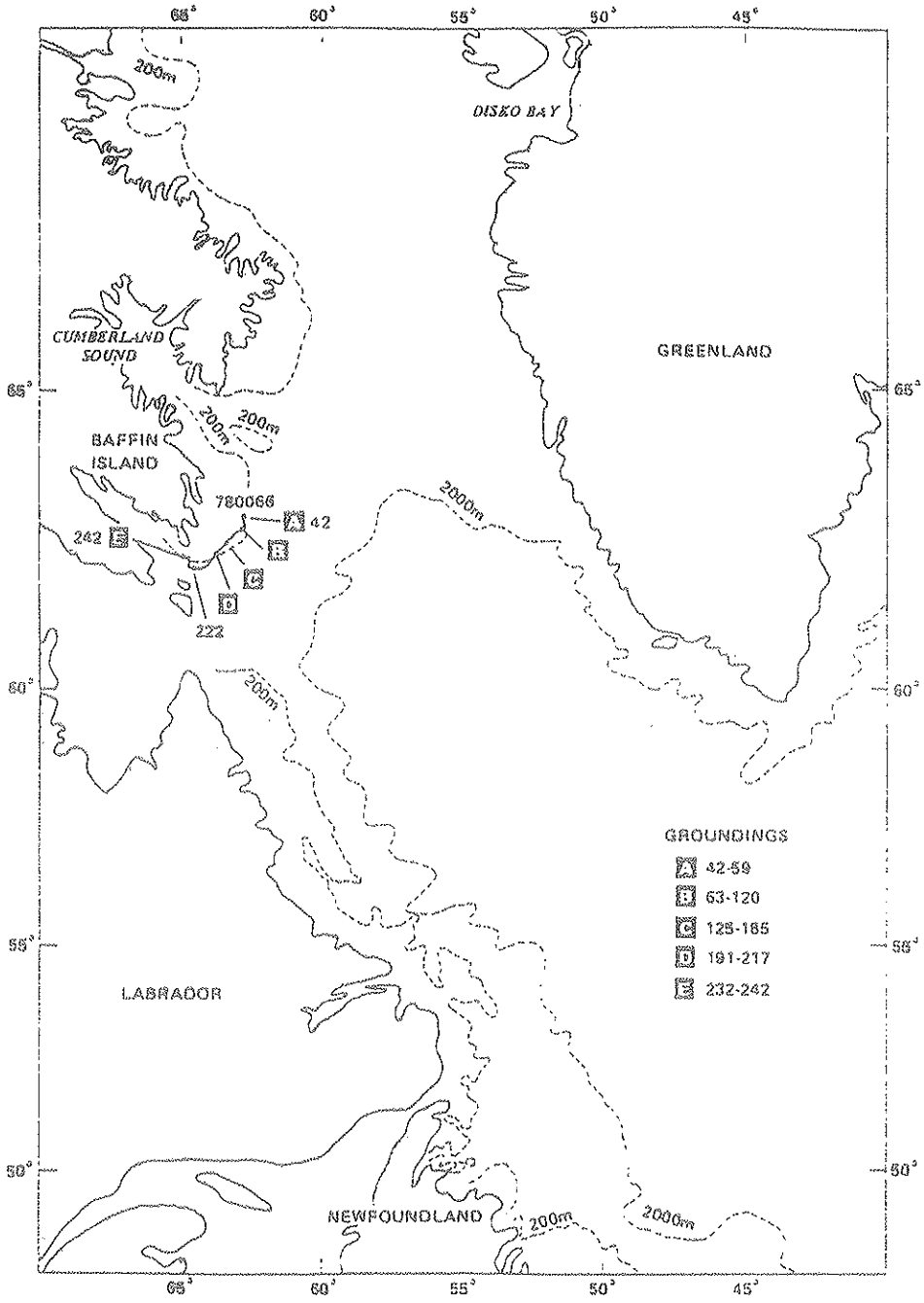


DRIFT AND GROUNDINGS OF ICEBERGS TRACKED IN 1978

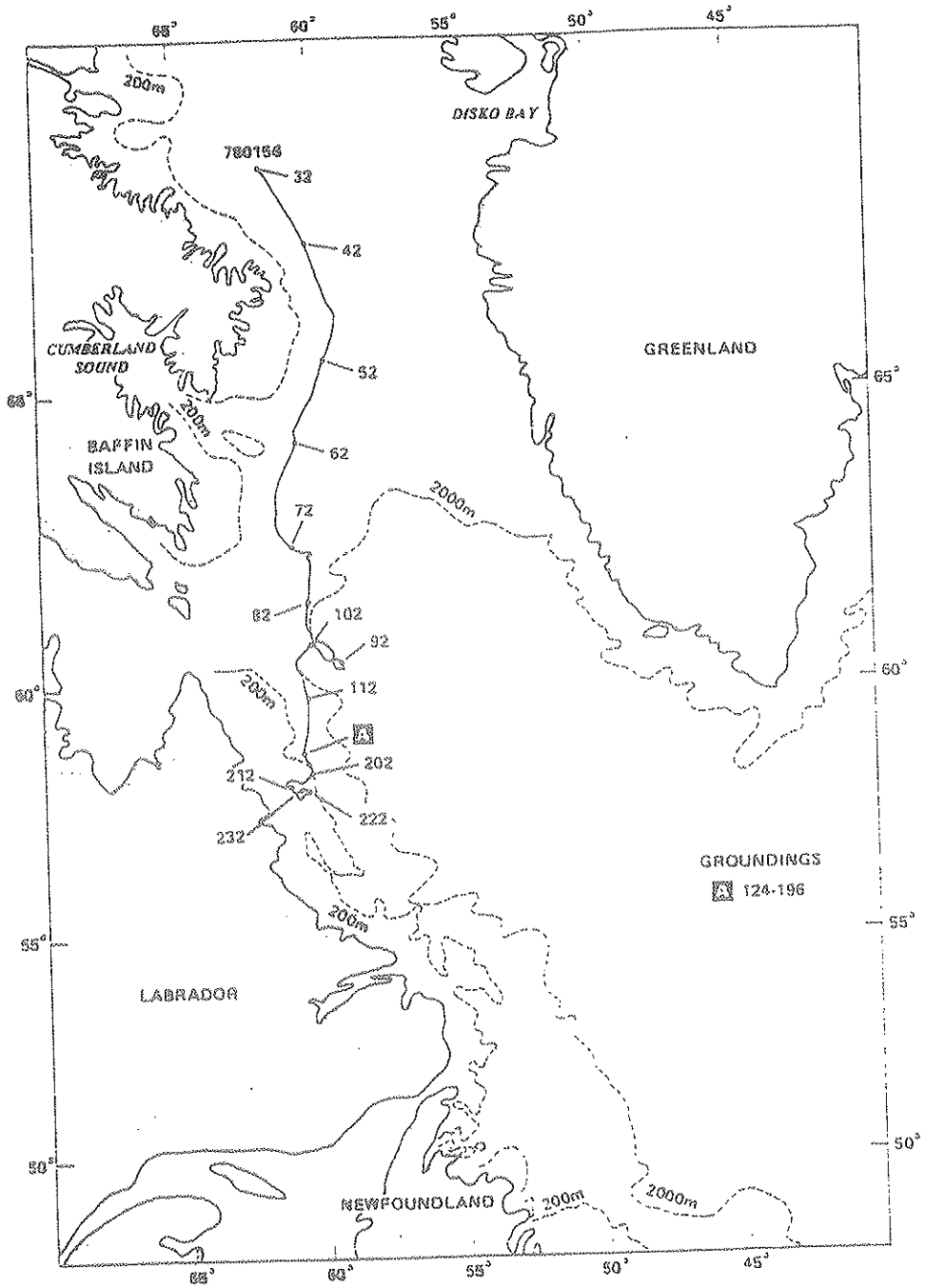
DRIFT AND GROUNDINGS OF ICEBERGS TRACKED DURING 1978



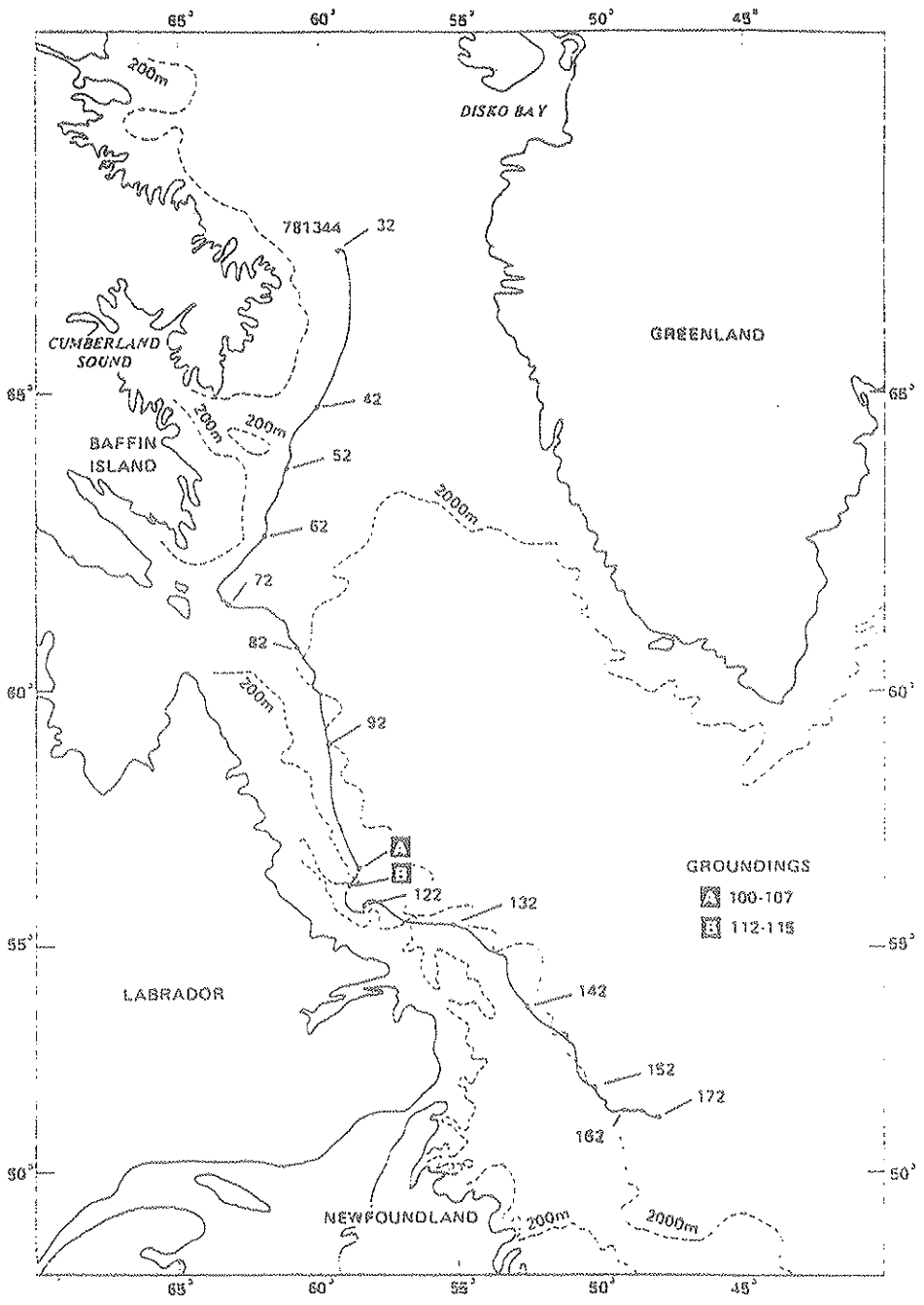
DRIFT TRACK OF BUOY NUMBER 780050



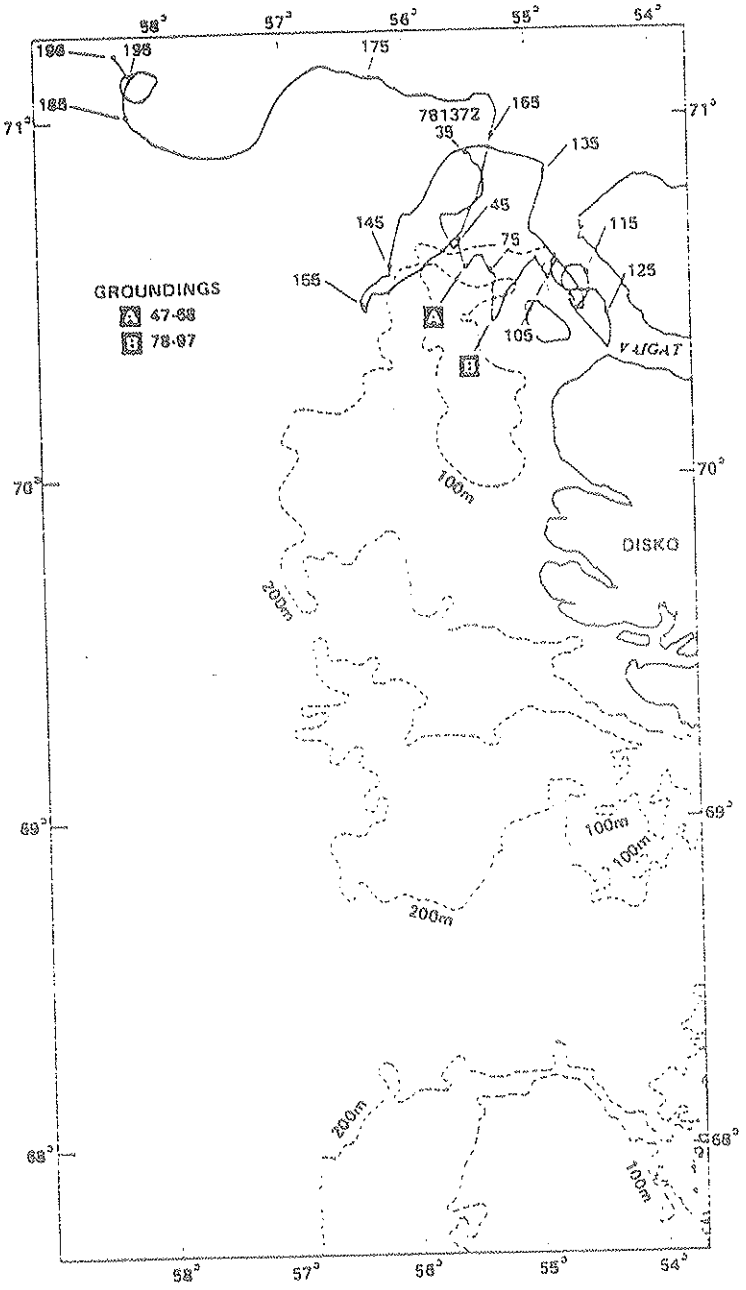
DRIFT TRACK OF BUOY NUMBER 780066



DRIFT TRACK OF BUOY NUMBER 780156



DRIFT TRACK OF BUOY NUMBER 781344



DRIFT TRACK OF BUOY NUMBER 781372

Appendix 5

Tape documentation form and directory listing
of all the files on tape

Fenco Newfoundland Limited

Tape Documenation Form

Contract Report Title and date	:	ESRF Study 112-24-05 "Documentation of Iceberg Grounding", Dec. 1984.
Name of Client	:	Environmental Studies Revolving Funds
Fenco Tape #	:	38101
Number of Tracks	:	9
Tape Density	:	1600 bpi
Labelled/Unlabelled	:	Unlabelled
Machine on which tape was written	:	VAX 11/780
Number of files on tape	:	16 Directories which contain 242 files. A listing is attached.

Directory Listing of All
Grounded Icebergs off Canada's
East Coast (1973 - 1982)

```
$ SET DEF [P380101.GROUND]

$ DIR


Directory DRA4:[P38101.GROUND]

LAB73.DIR;1                1          4-JAN-1985 13:51
LAB74.DIR;1                1          4-JAN-1985 13:51
LAB75.DIR;1                1          4-JAN-1985 13:51
LAB76.DIR;1                1          4-JAN-1985 13:52
LAB78.DIR;1                1          4-JAN-1985 13:52
LAB79.DIR;1                2          4-JAN-1985 13:52
LAB80.DIR;1                2          4-JAN-1985 13:52
LAB81.DIR;1                5          4-JAN-1985 13:52
LAB82.DIR;1                1          4-JAN-1985 13:53
ROBE.DIR;1                 1          4-JAN-1985 13:53
SAGLEK.DIR;1               1          4-JAN-1985 13:53
SAT.DIR;1                  1          4-JAN-1985 13:53
SBI79.DIR;1                1          4-JAN-1985 13:53
SBI80.DIR;1                1          4-JAN-1985 13:53
SBI81.DIR;1                1          4-JAN-1985 13:53
SBI82.DIR;1                3          4-JAN-1985 13:53

Total of 16 files, 24 blocks.
$
```

```
$ SET DEF [F38101.GROUND.LAB73]

$ DIR


Directory DRA4:[F38101.GROUND.LAB73]

H48BRG017.DAT;1          14        21-MAR-1984 20:08
H81BRG037.DAT;1          11        21-MAR-1984 22:58
H81BRG040.DAT;1           2        21-MAR-1984 23:04

Total of 3 files, 27 blocks.
$
```

```
$ SET DEF [P38101.GROUND.LAB743]

$ DIR


Directory DRA4:[P38101.GROUND.LAB743]

H55BRG006.DAT;1              7        24-MAR-1984 12:09
H55BRG010.DAT;1              2        24-MAR-1984 12:18
H55BRG011.DAT;1              1        24-MAR-1984 12:19
H55BRG012.DAT;1              2        24-MAR-1984 12:19
H55BRG122.DAT;1             23        26-MAR-1984 15:40
H55BRG124.DAT;1             18        26-MAR-1984 15:52
H55BRG150.DAT;1              7        26-MAR-1984 16:27

Total of 7 files, 60 blocks.
$
```

```
$ SET DEF [F38101.GROUND.LAB75]

$ DIR


Directory DRA4:[F38101.GROUND.LAB75]

A13BRG016.DAT;1              9          9-APR-1984 19:05
B87BRG013.DAT;1              2          9-APR-1984 18:26
B87BRG014.DAT;1              1          9-APR-1984 18:27
H52BRG001.DAT;1              1          9-APR-1984 18:49
H52BRG008.DAT;1              5          9-APR-1984 18:51
J90BRG012.DAT;1              6          9-APR-1984 19:33
J90BRG013.DAT;1              4          9-APR-1984 19:35
J90BRG014.DAT;1              3          9-APR-1984 19:36
J90BRG040.DAT;1              3          9-APR-1984 19:49
J90BRG046.DAT;1              4          9-APR-1984 19:52

Total of 10 files, 38 blocks.
$
```

```
$ SET DEF [F38101.GROUND.LAB76]

$ DIR

Directory DRA4:[F38101.GROUND.LAB76]

A13BRG007.DAT;1          11        10-APR-1984 09:59
A13BRG018.DAT;1          10        10-APR-1984 10:08
G91BRG001.DAT;1          21        28-FEB-1984 07:51
G91BRG002.DAT;1          15        28-FEB-1984 07:51
G91BRG104.DAT;1           5        28-FEB-1984 08:41
H52BRG004.DAT;1           3        10-APR-1984 10:29
H92BRG024.DAT;1           3        11-APR-1984 19:18
J90BRG008.DAT;1           1        11-APR-1984 07:50
J90BRG012.DAT;1           3        11-APR-1984 07:50

Total of 9 files, 72 blocks.
$
```

```
$ SET DEF [EP38101.GROUND.LAB78]

$ DIR


Directory DRA4:[EP38101.GROUND.LAB78]

E07BRG002.DAT;1          31        14-JAN-1985 09:19
E07BRG005.DAT;1           2        10-APR-1984 19:09
E07BRG006.DAT;1           2        10-APR-1984 19:10
E07BRG007.DAT;1           2        10-APR-1984 19:10
E07BRG017.DAT;1          12        10-APR-1984 19:14
E07BRG026.DAT;1           2        10-APR-1984 19:29
E07BRG044.DAT;1           6        14-JAN-1985 09:22
E33BRG043.DAT;1           3        10-APR-1984 12:34

Total of 8 files, 60 blocks.
$
```

```
$ SET DEF [F38101.GROUND.LAB79]

$ DIR

Directory DRA4:[F38101.GROUND.LAB79]

F53BRG001.DAT;1          14        31-MAY-1984 15:31
F53BRG007.DAT;1           6        31-MAY-1984 18:18
F53BRG008.DAT;1           7        31-MAY-1984 18:21
F53BRG009.DAT;1           7        31-MAY-1984 18:23
F53BRG010.DAT;1           1        31-MAY-1984 18:26
F53BRG014.DAT;1           2        31-MAY-1984 18:28
K92BRG045.DAT;1          12        11-APR-1984 20:34
K92BRG093.DAT;1           9        11-APR-1984 21:19
082BRG002.DAT;1           3         1-JUN-1984 07:28
082BRG007.DAT;1          34         1-JUN-1984 07:46
082BRG016.DAT;1           2         1-JUN-1984 07:51
082BRG025.DAT;1           3         1-JUN-1984 08:08
082BRG034.DAT;1           3         1-JUN-1984 08:19
082BRG038.DAT;1          24         1-JUN-1984 08:35
082BRG039.DAT;1           5         1-JUN-1984 08:35
082BRG047.DAT;1           7         1-JUN-1984 08:44
082BRG049.DAT;1           3         1-JUN-1984 08:48
082BRG071.DAT;1           7         1-JUN-1984 09:26
082BRG101.DAT;1           7         1-JUN-1984 09:55
P10BRG001.DAT;1           6        31-MAY-1984 21:06
P10BRG006.DAT;1           4        31-MAY-1984 21:11
P10BRG011.DAT;1           3        31-MAY-1984 21:18
P10BRG012.DAT;1          14        31-MAY-1984 21:19
P10BRG014.DAT;1           5        31-MAY-1984 21:26
P10BRG042.DAT;1           2        31-MAY-1984 21:48
P10BRG051.DAT;1           1        31-MAY-1984 21:53
P10BRG052.DAT;1           3        31-MAY-1984 21:54
```

```
F10BR6114.DAT;1          12        31-MAY-1984 22:52

Total of 28 files, 206 blocks.
$
```

```
$ DIR

Directory DRA4:[P38101.GROUND.LAB80]

C02BRG007.DAT;1          1    31-MAY-1984 19:37
C02BRG025.DAT;1          1    31-MAY-1984 20:01
E72BRG007.DAT;1          2    31-MAY-1984 20:23
E72BRG010.DAT;1          1    31-MAY-1984 20:27
E72BRG013.DAT;1          1    31-MAY-1984 20:27
E72BRG017.DAT;1          1    31-MAY-1984 20:29
E72BRG021.DAT;1          1    31-MAY-1984 20:30
E72BRG028.DAT;1          1    31-MAY-1984 20:38
F53BRG005.DAT;1         41    26-MAY-1984 19:49
F53BRG009.DAT;1         17    26-MAY-1984 19:58
F53BRG014.DAT;1         15    26-MAY-1984 20:04
F53BRG019.DAT;1          4    26-MAY-1984 20:13
F53BRG025.DAT;1          1    26-MAY-1984 20:23
F53BRG029.DAT;1          6    26-MAY-1984 20:26
F53BRG030.DAT;1         27    26-MAY-1984 20:40
F53BRG033.DAT;1         44    26-MAY-1984 21:02
F53BRG051.DAT;1          3    27-MAY-1984 14:08
N79BRG072.DAT;1          6     1-JUN-1984 12:38
N79BRG101.DAT;1         11     1-JUN-1984 13:06
N79BRG102.DAT;1          0     1-JUN-1984 13:11
N79BRG107.DAT;1          1     1-JUN-1984 13:16
N79BRG109.DAT;1          2     1-JUN-1984 13:16
O82BRG001.DAT;1         14    14-JAN-1985 09:30
O82BRG002.DAT;1         14    14-JAN-1985 09:36
O82BRG005.DAT;1          7    14-JAN-1985 09:43

Total of 25 files, 222 blocks.
$
```

```
$ DIR

Directory DRA4:[EP38101.GROUND.LAB813]

F06BRG001.DAT;1              4          1-JUN-1984 10:12
F06BRG007.DAT;1              3          1-JUN-1984 10:17
F06BRG010.DAT;1              4          1-JUN-1984 10:20
F06BRG011.DAT;1              0          1-JUN-1984 10:21
H11BRG006.DAT;1              8         12-APR-1984 20:44
H11BRG007.DAT;1             16         12-APR-1984 20:49
H11BRG008.DAT;1              1         12-APR-1984 20:49
H11BRG009.DAT;1             44         12-APR-1984 21:07
H11BRG010.DAT;1              0         12-APR-1984 21:07
H11BRG011.DAT;1              1         12-APR-1984 21:17
H11BRG012.DAT;1             35         12-APR-1984 21:25
H11BRG015.DAT;1              1         12-APR-1984 21:25
H11BRG032.DAT;1              1         12-APR-1984 21:29
H11BRG065.DAT;1             43         12-APR-1984 21:47
H11BRG078.DAT;1              3         12-APR-1984 21:54
H11BRG083.DAT;1              4         12-APR-1984 21:57
H11BRG085.DAT;1              1         12-APR-1984 21:58
H11BRG086.DAT;1              1         12-APR-1984 21:58
H11BRG087.DAT;1              2         12-APR-1984 21:59
H11BRG091.DAT;1              1         12-APR-1984 21:59
H11BRG107.DAT;1              1         12-APR-1984 22:05
H11BRG111.DAT;1              2         12-APR-1984 22:05
H11BRG117.DAT;1              0         12-APR-1984 22:09
H11BRG137.DAT;1              2         12-APR-1984 22:30
H11BRG138.DAT;1              2         12-APR-1984 22:31
H11BRG141.DAT;1              3         12-APR-1984 22:31
H11BRG148.DAT;1             10         12-APR-1984 22:34
H11BRG151.DAT;1              1         12-APR-1984 22:37
H11BRG158.DAT;1              3         12-APR-1984 22:47
```

H11BRG161.DAT;1	1	12-APR-1984 22:49
H11BRG163.DAT;1	1	12-APR-1984 22:49
H11BRG180.DAT;1	9	14-JAN-1985 10:31
H11BRG188.DAT;1	1	14-JAN-1985 10:45
H11BRG200.DAT;1	2	14-JAN-1985 11:01
082BRG006.DAT;1	2	11-APR-1984 23:20
082BRG016.DAT;1	8	11-APR-1984 23:27
082BRG020.DAT;1	3	11-APR-1984 23:31
082BRG022.DAT;1	2	11-APR-1984 23:34
082BRG023.DAT;1	1	11-APR-1984 23:35
082BRG024.DAT;1	3	11-APR-1984 23:35
082BRG040.DAT;1	1	11-APR-1984 23:42
082BRG061.DAT;1	1	11-APR-1984 23:46
082BRG104.DAT;1	2	11-APR-1984 23:56
082BRG105.DAT;1	1	11-APR-1984 23:57
082BRG106.DAT;1	3	11-APR-1984 23:57
082BRG110.DAT;1	1	11-APR-1984 23:59
082BRG140.DAT;1	1	12-APR-1984 00:05
082BRG142.DAT;1	2	12-APR-1984 00:06
082BRG216.DAT;1	1	12-APR-1984 00:21
082BRG217.DAT;1	1	12-APR-1984 00:22
082BRG224.DAT;1	1	12-APR-1984 00:23
082BRG269.DAT;1	10	12-APR-1984 00:29
082BRG273.DAT;1	1	12-APR-1984 00:34
082BRG276.DAT;1	1	12-APR-1984 00:35
082BRG288.DAT;1	1	12-APR-1984 00:39
082BRG290.DAT;1	1	12-APR-1984 00:40
082BRG295.DAT;1	1	12-APR-1984 00:41
082BRG335.DAT;1	2	12-APR-1984 00:49
082BRG343.DAT;1	2	12-APR-1984 00:52
082BRG355.DAT;1	2	12-APR-1984 01:02
082BRG356.DAT;1	2	12-APR-1984 01:02
082BRG371.DAT;1	2	12-APR-1984 01:18
082BRG377.DAT;1	2	12-APR-1984 01:21
082BRG386.DAT;1	1	12-APR-1984 01:25
082BRG391.DAT;1	3	12-APR-1984 01:27

```
Total of 65 files, 276 blocks.
$
```

```
$ SET DEF [F38101.GROUND.LAB82]

$ DIR


Directory DRA4:[F38101.GROUND.LAB82]

H11BRG009.DAT;1              1        23-FEB-1984 09:28
H11BRG010.DAT;1              1        23-FEB-1984 09:28
H11BRG059.DAT;1             42        23-FEB-1984 10:02
H11BRG069.DAT;1              2        23-FEB-1984 10:06
H11BRG072.DAT;2              1        23-FEB-1984 10:09
H11BRG073.DAT;1              1        23-FEB-1984 10:09
H11BRG089.DAT;1              1        23-FEB-1984 10:18
H11BRG091.DAT;1             14        23-FEB-1984 10:18
K92BRG051.DAT;1              1        24-FEB-1984 09:08
K92BRG054.DAT;1              3        24-FEB-1984 09:10
K92BRG055.DAT;1              3        24-FEB-1984 09:11
N19BRG056.DAT;1              5         1-JUN-1984 13:48
N19BRG108.DAT;1              1         4-JUN-1984 13:13
N19BRG111.DAT;1              6         4-JUN-1984 13:17
P85BRG066.DAT;1              2        24-FEB-1984 12:59

Total of 15 files, 84 blocks.
$
```

```
$ SET DEF [F38101.GROUND.SBI793]

$ DIR


Directory DRA4:[F38101.GROUND.SBI793]

SCBERG1.DAT;5               1        24-NOV-1981 08:33
SCBERG2.DAT;5               1        27-NOV-1981 12:48

Total of 2 files, 2 blocks.
$
```

```
$ SET DEF [P38101.GROUND.SBI80]

$ D


Directory DRA4:[P38101.GROUND.SBI80]

FLM3BERG2.DAT;6      FLM3BERG3.DAT;8      FLM4BERG1.DAT;5      FLM5BERG2.DAT;6
SCBERG5.DAT;3        SCBERG7.DAT;3        SCBERG8.DAT;5        SCBERG9.DAT;4

Total of 8 files.
$
```

```
$ SET DEF [F38101.GROUND.SBI81]

$ DIR

Directory DRA4:[F38101.GROUND.SBI81]

FLM25BRG1.DAT;3              3        3-NOV-1981 13:12
FLM26BRG1.DAT;11             5       30-SEP-1981 11:37
FLM26BRG3.DAT;9              3        7-OCT-1981 09:50
FLM26BRG4.DAT;8              3       30-SEP-1981 13:26
SBERG0027.DAT;5              2       25-NOV-1981 07:55
SBERG0037.DAT;6              3       25-NOV-1981 14:34
SBERG009.DAT;4               2       30-OCT-1981 02:24
SBERG057.DAT;3               3       30-OCT-1981 12:54
SBERG058.DAT;2               2       30-OCT-1981 03:03
SBERG073.DAT;7               3       26-NOV-1981 08:42
SBERG075.DAT;2               1       23-NOV-1981 13:00
SBERG077.DAT;3               2       25-NOV-1981 08:14

Total of 12 files, 32 blocks.
$
```

```
$ SET DEF [F38101.GROUND.SBI82]

$ DIR

Directory DRA4:[F38101.GROUND.SBI82]

BERG001.DAT;1          29      17-FEB-1984 13:00
BERG005.DAT;1           3       5-APR-1984 09:31
BERG016.DAT;1           2      17-FEB-1984 13:07
BERG017.DAT;1           1      17-FEB-1984 13:08
BERG020.DAT;1           2      17-FEB-1984 13:09
BERG043.DAT;1           4      17-FEB-1984 13:19
BERG048.DAT;1           4      17-FEB-1984 13:22
BERG050.DAT;1           1      17-FEB-1984 13:23
BERG053.DAT;1           2      17-FEB-1984 13:24
BERG054.DAT;1           3      17-FEB-1984 13:25
BERG056.DAT;1           1      17-FEB-1984 13:26
BERG057.DAT;1           2      17-FEB-1984 13:27
BERG061.DAT;1           2      17-FEB-1984 13:28
BERG062.DAT;1           6      17-FEB-1984 13:28
BERG063.DAT;1           3      17-FEB-1984 13:31
BERG067.DAT;1           8      17-FEB-1984 13:32
BERG069.DAT;1           1      17-FEB-1984 13:36
BERG075.DAT;1           1      17-FEB-1984 13:37
BERG076.DAT;1           2      17-FEB-1984 13:37
BERG087.DAT;1           3      17-FEB-1984 13:42
BERG090.DAT;1           4      17-FEB-1984 13:44
BERG092.DAT;1           8      17-FEB-1984 13:46
BERG094.DAT;1           2      17-FEB-1984 13:49
BERG095.DAT;1           3      17-FEB-1984 13:50
BERG097.DAT;1           1      17-FEB-1984 13:51
BERG099.DAT;1           2      17-FEB-1984 13:52
BERG103.DAT;1           2      17-FEB-1984 13:54
```

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BERG106.DAT;1              3        17-FEB-1984 13:55
BERG107.DAT;1              2        17-FEB-1984 13:56
BERG108.DAT;1              6        17-FEB-1984 13:57
BERG109.DAT;1              2        17-FEB-1984 13:59
BERG110.DAT;1              1        17-FEB-1984 14:00
BERG113.DAT;1              4        17-FEB-1984 14:02
BERG115.DAT;1              2        17-FEB-1984 14:04
BERG116.DAT;1              4        17-FEB-1984 14:04
BERG122.DAT;1              2        17-FEB-1984 14:08
BERG123.DAT;1              2        17-FEB-1984 14:08
BERG129.DAT;1              2        17-FEB-1984 14:10
BERG130.DAT;1              1        17-FEB-1984 14:11

Total of 39 files, 133 blocks.
$
```

```
$ SET DEF [P38101.GROUND.ROBE]

$ DIR


Directory DRA4:[P38101.GROUND.ROBE]

BERG0050.DAT;1              97        12-MAR-1984 09:26
BERG0066.DAT;1              58        12-MAR-1984 09:27
BERG0156.DAT;1             137        12-MAR-1984 08:25
BERG0160.DAT;1             133        11-MAR-1984 13:31
BERG1344.DAT;1              58        12-MAR-1984 09:27
BERG1372.DAT;1              94        12-MAR-1984 09:28
BERG1550.DAT;1              37        12-MAR-1984 09:28

Total of 7 files, 614 blocks.
$
```

```
$ SET DEF [EF38101.GROUND.SAGLEK]

$ DIR


Directory DRA4:[EF38101.GROUND.SAGLEK]

BERG72.DAT;1                73        20-FEB-1984 09:46
BERG73.DAT;3               228        22-MAR-1984 07:33
BERG74.DAT;7                86        11-MAR-1984 16:44

Total of 3 files, 387 blocks.
$
```

```
$ SET DEF [CP38101.GROUND.SAT]

$ DIR


Directory DRA4:[CP38101.GROUND.SAT]

SAT78T081.DAT;1        641          7-MAR-1984 08:44

Total of 1 file, 641 blocks.
$
```

REFERENCES

Barrie, J.V., Lynas, C.M.T., and Gidney, G. 1981. Iceberg grounding review from well-site observations. Geological Survey of Canada, Open File 880:

EL-Tahan, M., EL-Tahan, H., and Venkatesh, S., 1983, Forecast of iceberg ensemble drift. Proceedings of Offshore Technology Conference, 2-5 May, 1983, Paper No. 4460.

El-Tahan, M. and El-Tahan, H. 1982. Estimation of Iceberg draft Ocean 82, 20-22 May, 1982, Washington, D.C.

Fissel, D.B., Lemon, D., and Birch, J.R., 1980, The physical oceanography of western Baffin Bay and Lancaster Sound, Report by Arctic Sciences Ltd., prepared for Petro-Canada Ltd. Calgary, Alberta. 345

Lynas, G.M.T., Simms, A. and Rendell, C.M. 1984. Iceberg Research News Letter No. 7, March, 1984.

Marine Exploration Ltd. (Marex), 1972 Environmental Data Appendix: Wind, Waves, Weather and Icebergs in Baffin Bay and Davis Strait Summer 1972. Report prepared by Marex for Arctic Petroleum Operators Association, Calgary, Alberta.

Robe, R.Q. Maier, D.C., and Russell, W.E., 1979, Long-term drift of icebergs in Baffin Bay and the Labrador Sea. The Iceberg Dynamic Symposium, St. John's, Newfoundland. Also United States Coast Guard Report CG-D-36-79.

Robe, R.Q. 1982, Iceberg drift near Greenland, 1980 to 1982. United States Coast Guard Report CG-D-36-82.