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Sea Ice Atlas of Arctic Canada 1969-1974

by
D.G. Lindsay

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SEA-ICE ATLAS OF ARCTIC CANADA 1969-1974

D. G. LINDSAY

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PREFACE

The results of aerial sea-ice observations made by the Polar Continental Shelf Project, Department of Energy, Mines and Resources, at various intervals between March and November, from 1969 through 1974, are shown in this atlas. Most of the observations were made in the general region of the Queen Elizabeth Islands and adjacent Arctic Ocean and in Parry Channel, with additional, less complete data from more southerly waters of the arctic archipelago. A previous atlas published in 1976 describes sea-ice conditions from 1961 through 1968.

This atlas, like its predecessor, shows the geographical distribution and extent of the various types of sea-ice, and their characteristic features at different specific and identified times throughout the years. The observations recorded on each map were made over as short a period as operationally feasible — usually three to eight days — in order to give a more or less simultaneous overall view of the state and extent of sea-icer over the Canadian arctic at selected intervals. The atlas is thus an historical record of the sea-ice; it also provides sequential observations on the dynamic and constantly changing phenomena which dominate the marine areas of arctic Canada.

The basic purpose of the atlas is to make available, in comprehensive cartographic form, the reliable information available about the sea-ice in the areas covered, for the periods indicated. The information on the maps is supplemented by written descriptions which emphasize special features of the sea-ice cover at the times portrayed and describe the geographical and chronological changes throughout each season; — the progression of break-up, the process of ablation, the pattern of movement and the sequence of freeze-up. It is hoped that these descriptions will increase the usefulness of the information shown on the maps and add to the understanding of the significance of changes or similarities between successive maps or between different years. This atlas includes maps which show the routes taken and the visibilities encountered during each track, so that the reliability and extensiveness of the observations can be assessed if necessary, and information from other sources can be compared or amalgamated with that given here.

The maps comprising the atlas have been arranged in sequence from 1969 to 1974. A seasonal summary is used to introduce each year and the written description for each map faces the map to which it refers. The various types of sea-ice information are shown by a combination of colours, line patterns, symbols and numerical expressions.

It is intended that this atlas will be followed by others showing sea-ice information obtained since 1974.

CONTENTS

ABSTRACT

Aerial surveys of sea ice in the Canadian Arctic Archipelago and adjacent waters have been made by the Polar Continental Shelf Project since 1961. During these years, at various intervals between March and November, successive sets of observations have been made of distributions of sea-ice types and features, progression of break-up, advance of ablation, patterns of movement and the sequence of freeze-up. These observations are presented on 104 coloured maps, 28 x 38 cm, accompanied by written descriptions and seasonal summaries.

A previous report published in 1976 entitled "Sea-Ice Atlas of Arctic Canada 1961-1968" precedes this volume.

INTRODUCTION

The Polar Continental Shelf Project, Department of Energy, Mines and Resources has carried out investigations of the sea ice of Arctic Canada since its inauguration in 1958. The first formal field program of sea-ice observations was started in 1961 and has continued each year since. The main aims of the program are to observe and map the types, nature, distribution, break-up, ablation, movement and freeze-up of sea ice found throughout the Canadian Arctic Archipelago. Other objectives were to determine and describe the patterns of ablation and to provide background information to the Atmospheric Environment Service (A.E.S.), Ministry of Transport (M.O.T.) and other agencies who require and request this type of information.

The results of earlier years are included in a report entitled "Sea-Ice Atlas of Arctic Canada 1961-1968" published in 1976. The maps in this volume differ in two main ways from those in the previous report. Firstly, the area regularly surveyed is larger, the map scale is larger and two maps, one for the eastern region and one for the western region, are used to show the information for each flight. Secondly, the terminology used to present the information on the maps has been designed to correspond with World Meteorological Organization (W.M.O.) conventions. The format of the atlas for the years 1969 through 1974 resembles the previous atlas in that it is divided into sections, one for each calendar year. Each section shows the results of a series of flights. A flight consists of a number of reconnaissance surveys or tracks and may include data collected from between two and twenty tracks. The number of tracks per flight varies depending on weather, available flying time, and the schedule of flying required to observe as much as possible of the entire area without duplicating similar surveys conducted by other government agencies.

A seasonal summary outlining the general ice regime for each year is presented at the beginning of each section. Every map is accompanied by a written description and a figure showing the track routes on the facing page. The description outlines progressive changes in ice conditions and a paragraph entitled "Unobserved Areas" indicates the ice conditions inferred or known to exist in nearby regions which were not observed directly. The last paragraph in the description for each map includes the author's comments about features that are not immediately evident on the map. The figure showing the track routes indicates the direction and path followed during each track. The dates, and times and points of departure and arrival are listed for each track. Visibilities encountered during the survey are shown beside the line indicating the track route to enable the reader to appreciate the observing conditions as the data were recorded along each track.

Reference maps showing place names are included at the beginning and end of the atlas. A legend of symbols and terminology is included with each map to assist the user.

Since 1974 the Polar Continental Shelf Project has continued these aerial reconnaissance surveys of the sea-ice conditions in the Canadian Arctic. The results of these surveys are currently being compiled and will be presented in a forthcoming atlas.

PROGRAM

All of the in-flight field data from 1969 through 1974 were recorded on maps, scale 1:1,000,000, especially prepared for sea-ice data. Under normal observing conditions, one complete set of observations including the figures representing ice types, concentrations and surface features were recorded on these maps in the form of fractions at five-minute intervals. Pertinent boundaries of separating unique types of ice and distinguishable zones between concentrations were also noted. These fractions and boundaries were recorded and drawn continuously whenever visibilities permitted. This information was subsequently reduced and transferred by the observer to a map of scale 1:2,622,000. Normally three or four field observations were combined to form one of the fractions shown on the drafted map. After these maps were drafted they were photographically reduced to a scale of nearly 1:5,317,000, the scale of the maps in this atlas. In the field the observer planned the route for each separate survey, referred to as a track, on the basis of the need to know and according to the existing and forecast weather in order to maximize the amount of data to be collected.

Efforts were made to determine the activities of the A.E.S. ice reconnaissance flights in order to avoid duplicating observations and to provide complimentary data. The result of the care and planning made by the observers is evident in the following maps. The main method of transport for the surveys was a Beechcraft-18 aircraft. In the latter part of most seasons a twin otter aircraft was used. The author, under contract with the Department of Energy, Mines and Resources, and under the direction of the Director of the Polar Continental Shelf Project, was required to plan and direct the field programs and to analyze and prepare the results of the field surveys for publication in their present form.

Although some changes in the program occurred from year to year, they were relatively minor as the information in the following table suggests. Most of them were related to poor weather or the logistics of maintaining an aircraft in the Arctic. This table does not include the hours flown when the observers joined other flights carried out by the Polar Continental Shelf Project as routine supply missions for other projects because these flights were not charged against the bank of hours reserved for sea-ice reconnaissance.

TABLE 1
Summary of Reconnaissance
1969-1974

YEAR	PERIOD OF OBSERVATION	NO. OF MAPS	NO. OF TRACKS	HOURS FLOWN
1969	May 9-Oct. 21	16	123	475
1970	Mar. 14-Oct. 19	18	126	533[1]
1971	Apr. 1-Oct. 22	18	112	450[2]
1972	Mar. 30-Nov. 4	16	82	376[3]
1973	Apr. 11-Oct. 23	18	77[4]	450
1974	Apr. 1-Oct. 23	16	88	425

[1] Extra fuel tanks were added so that the range of the aircraft increased.
[2] Flying time allocated to the program was set at 450 hours.
[3] The set of tracks normally conducted in May was discontinued.
[4] The range of the aircraft was increased and one additional series of tracks was completed.

During the three-year interval from 1969 to 1971, Dr. E. F. Roots, the Coordinator of the Polar Continental Shelf Project, directed the program. All field observations during this period were completed by K. Peister. The work from 1972 through 1974 was carried out under the guidance of G. D. Hobson, the Director of the Polar Continental Shelf Project. In 1972 K. Peister was responsible for making the observations during the first four flights while B. Taylor completed the remaining four. Starting with B. Taylor, the two observers alternated to complete the nine flights in 1973. The first five flights of 1974 were carried out by K. Peister while B. Taylor undertook the role of observer for the last three flights.

ACKNOWLEDGMENTS

Many people were involved in the preparation of this atlas. When the observers were in the field, their ability to collect the type and quality of data required was made possible by the Polar Continental Shelf Project team who organized and provided all basic support and logistics, by the continuous efforts and co-operation of the pilots and their engineers and by the A.E.S. (Atmospheric Environment Service) who permitted the reconnaissance team to use the accommodations at their Arctic weather stations when the need arose. In Ottawa, during the preparation of the final maps, valuable suggestions and fine craftsmanship was provided by the various photo-mechanical specialists of the Map Production Division of Surveys and Mapping Branch.

I am particularly grateful to Dr. E. F. Roots, who conceived and implemented the sea-ice program, and Mr. G. D. Hobson for their help, understanding and encouragement during the various phases of the project. I wish to express my special thanks and appreciation for the dedication and skill shown by the two observers, B. Taylor and K. Peister, who collected all the field data and to Peter Hermann who co-ordinated and completed all drafting and associated operations.

TERMINOLOGY AND REPORTING SYSTEM

The terminology used in this atlas is the same as that described in the W.M.O. (World Meteorological Organization) publication entitled "WMO Sea-Ice Nomenclature", designated as WMO-No. 259, TP, 145, The first edition of this report was published in 1970 by the Secretariat of the World Meteorlogical Organization in Geneva, Switzerland. Since that time, various supplements have been issued to keep it up to date.

Terminology

An explanation for all terminology and symbols used in this atlas is given below. For a full and illustrated glossary, see WMO publication mentioned above.

Ice Types:

New ice — A general term used for recently formed ice composed of ice crystals which are only weakly, if at all, frozen together.

Nilas — A thin elastic crust of ice which is readily bent rather than fractured by waves, swell or pressure. Nilas ranges as high as 10 cm in thickness.

Young ice — Ice in the transition stage between nilas and first-year ice, 10 to 30 cm in thickness. It can be subdivided into grey ice and grey-white ice.

Grey ice — Young ice 10-15 cm thick. Less elastic than nilas and breaks on swell. Usually rafts under pressure.

Grey-white ice — Young ice 15-30 cm thick. Under pressure more likely to ridge than to raft.

First-year ice — Sea ice of not more than one winter's growth, developing from young ice with a thickness greater than 30 cm.

Second-year ice — Ice which has survived one summer's melt.

Multi-year ice — Ice which has survived two or more summer's melt.

Open water — A large area of water in which sea ice is present in concentrations less than one-tenth of the total area.

Ice Forms:

Rafting — The overriding of one piece of ice upon another; the result of such action.

Ridging — The pressure process by which ice is forced into ridges. A ridge is a wall of broken ice as a result of ridging.

Hummocking — A hump of ice formed by: a) ablation of an ice sheet through more than one year, b) ablation of rafted ice, c) ablation of ridges.

Puddling — An accumulation of water on the ice.

Thaw holes — Vertical holes through an ice cover formed when surface puddles melt through to the underlying water

Frozen Puddles — The results when ice forms across a puddle.

Iceberg — A piece of ice either afloat or aground rising more than 5 metres above sea level which has broken away from a glacier and is generally larger than a house.

Ice Island — A form of tabular iceberg. A large flat piece of floating or grounded fresh-water ice generally extending about 3 metres above sea level which has broken away from an arctic ice shelf. Characterized by a regularly undulating surface which gives it a ribbed appearance from the air.

Strip — A long narrow distinct string of small ice fragments.

Floe Size:

Brash ice — Accumulations of floating ice made up of fragments not more than 2 metres across.

Small floe — A piece of floating sea ice from 2 to 100 metres across.

Medium floe — A piece of floating sea ice from 100 to 500 metres across.

Big floe — A piece of floating sea ice from 500 to 2000 metres across.

Conventions and Symbols used on the maps

Each of the maps in this atlas has a legend which gives a brief explanation of the system used to show the observed conditions.

A more detailed description of the various components of the system is presented in the following paragraphs. The first of the three types of boundary used to indicate limits or divisions is the Observed boundary. This is a thin solid black line on the map showing the limits of two different dominant types of ice or the limits for specific concentrations of the same type of ice. An Assumed boundary is a thin broken black line when the junction between ice types or concentrations was not directly observed. The third type, Limit of visibility, is shown by the edge of a graphic pattern and colour that is not bounded by a line on the map. In most cases this unbounded limit suggests that similar ice types and concentrations extend for some distance beyond it.

The concentration or coverage and the types or ages of sea ice are represented on the maps by a combination of four colours and four line patterns in addition to the expression given in the form of a fraction. The line patterns and colours have been included to assist the user to see the general patterns and distributions at first glance without reference to the details provided by the fractions and symbols.

Ice concentrations have been grouped into four categories. Each category corresponds roughly to the navigability through the ice. These concentrations are shown on the maps by directional patterns of lines. Most ice-going vessels can move through concentrations from one to four tenths regardless of the type or age of ice which predominates. Ice in this range is shown on the maps by broken diagonal lines. Passage through ice of the next range, from four to seven tenths, shown by vertical lines, can be accomplished with some difficulty. The category including concentrations from seven to ten tenths, shown on the map by solid diagonal lines, requires an icebreaker. The final concentration pattern, crossed lines, represents a ten tenths ice cover (no water) and indicates that the entire area is completely solid or consolidated.

An additional category which ranges from less than one tenth to no ice at all is classed as open water and the letters O W are inserted on the map along with the characteristic colour to designate these areas.

There are a variety of different types of sea ice. Usually an ice field is made up of varying concentrations of each type although occasionally one type will exist as a distinct and separate entity over a large area. To help the user interpret the map the various ice types have been put into three groups based on the age of the ice. The system used to determine the predominant type of ice and the colour shown on the map is based on the oldest type for which the concentration is three tenths or more. Where this convention cannot be applied, the colour shows the ice which appears to dominate.

In addition to the patterns and colours, the ice types and their concentrations are shown on the map by expressions similar

to fractions which give the specific detail observed for that locality. The numbers in the numerator indicate the tenths of ice of each type and in the denominator show the tenths of ice floes of each type that are medium or large in size. The numbers in the numerator of the fraction which indicate the ice types are always recorded in the same sequence. The example in the legend of each map shows this sequence. Another part of the fractional expression shows the presence and abundance of sea-ice types and features. The numerator symbols indicate the type or feature and the denominator shows its occurrence in tenths of the total ice cover in the vicinity.

Terms

The following selected list includes terms and definitions used in the written descriptions which accompany each map:

Calving — The breaking away of a mass of ice from a glacier, ice shelf, iceberg or ice island.

Concentration — The ratio in tenths of the sea surface actually covered by ice to the total area of sea surface, both ice-covered and ice-free, at a specific location or over a defined area.

Fast ice — Sea ice which forms and remains fast along the coast where it is attached.

Floe — Any piece of sea ice 20 m or more across.

Ice cover — The ratio of an area of ice of any type or concentration to the total area of sea surface within some large geographic area.

Ice edge — The demarcation between the open sea and sea ice.

Pack ice — A term used in a wide sense to include any area of sea ice, other than fast ice, no matter what form it takes or how it is disposed.

Polynya — Any non-linear shaped opening of water enclosed by a solid ice cover.

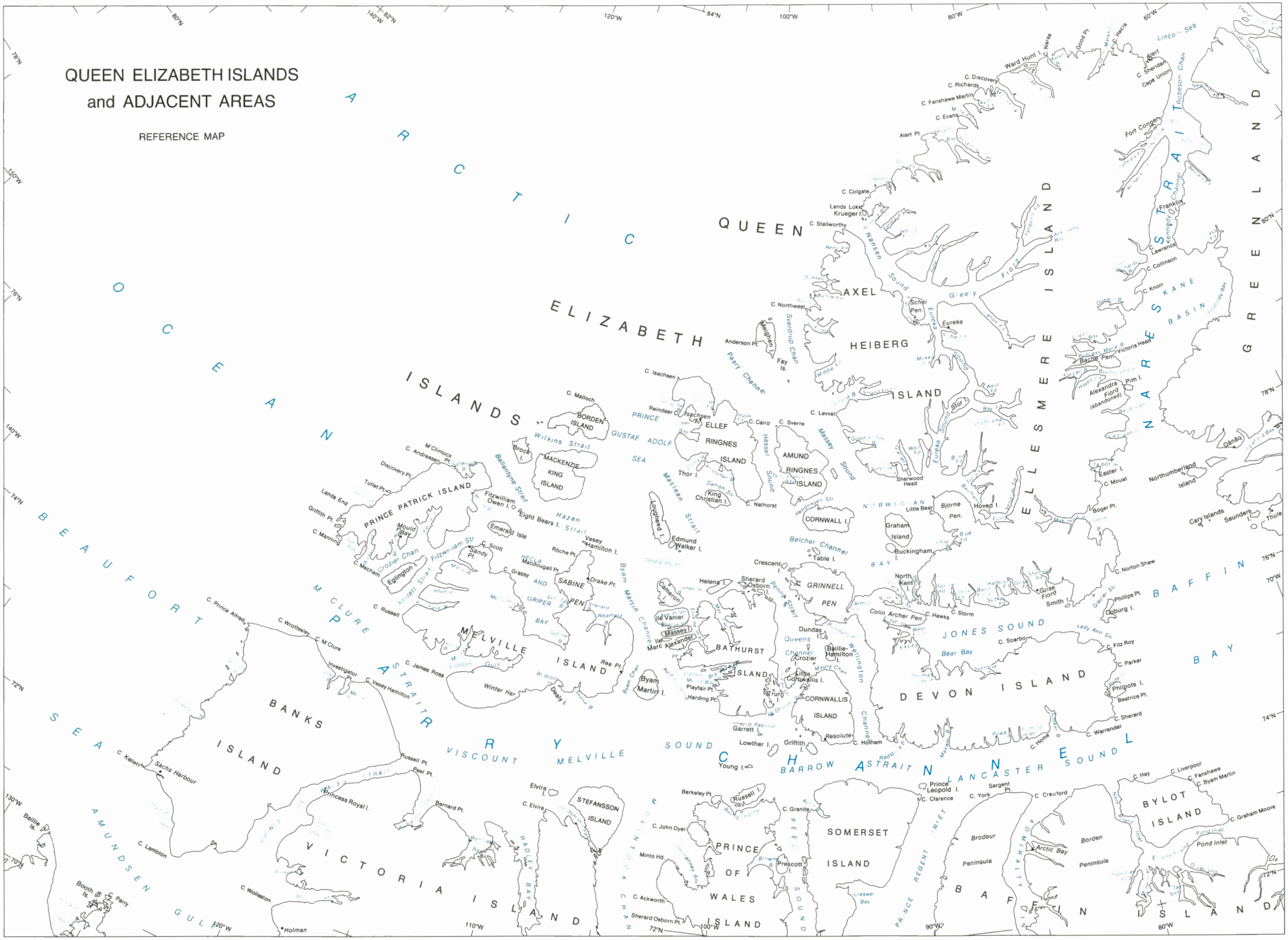
Rotten ice — Sea ice which has become honeycombed and which is in an advanced state of disintegration.

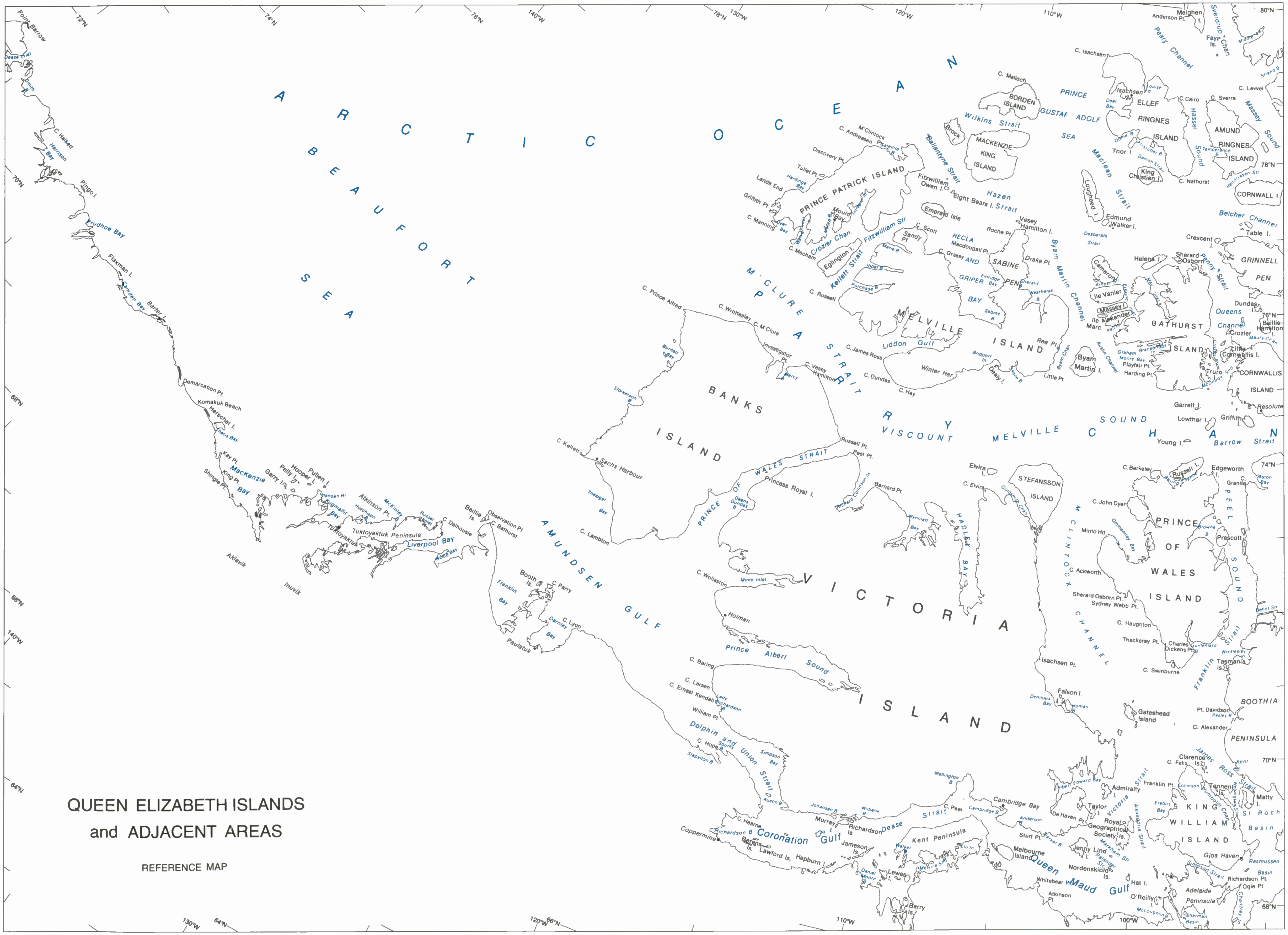
Sea ice — Any form of ice formed at sea which has originated from the freezing of seawater.

SEASONAL SUMMARIES

QUEEN ELIZABETH ISLANDS and ADJACENT AREAS

REFERENCE MAP





QUEEN ELIZABETH ISLANDS
and ADJACENT AREAS

REFERENCE MAP

SEASONAL SUMMARY: 1969

The sea-ice distributions that developed in the straits and channels of the Canadian Arctic Archipelago during the summer of 1969 were less concentrated than usual and the ice cover in the majority of the channels broke up and moved. Break-up proceeded in the typical manner and rate until mid-August. After this, two main departures from the usual pattern were observed.

In most areas of the archipelago the rate of ablation advanced faster than usual and was two weeks ahead of normal by mid-August. Even though the amount of clearing due to ablation and melting in the northern channels was greater than usual, it was not as advanced as the break-up which meant that the late summer ice concentrations in these areas remained high and hindered navigation. The amount of ablation and subsequent clearing in the eastern and south central parts of the archipelago was more extensive than most years and large ice-free areas developed.

Ice conditions in the Beaufort Sea advanced in a normal manner until the end of July at which time onshore winds forced the pack ice close to the mainland and held it there. As a result, normal shipping operations in the Beaufort Sea and along the coast of Alaska were impeded during August and September. By mid-October the concentrations and distributions in the Beaufort Sea had almost returned to normal.

No variations from the usual advance of freeze-up noted. However, since the last observations in 1969 were made at least one month before final freeze-up of the northern channels, many changes in and departures from the normal pattern could have taken place after the last reconnaissance flight.

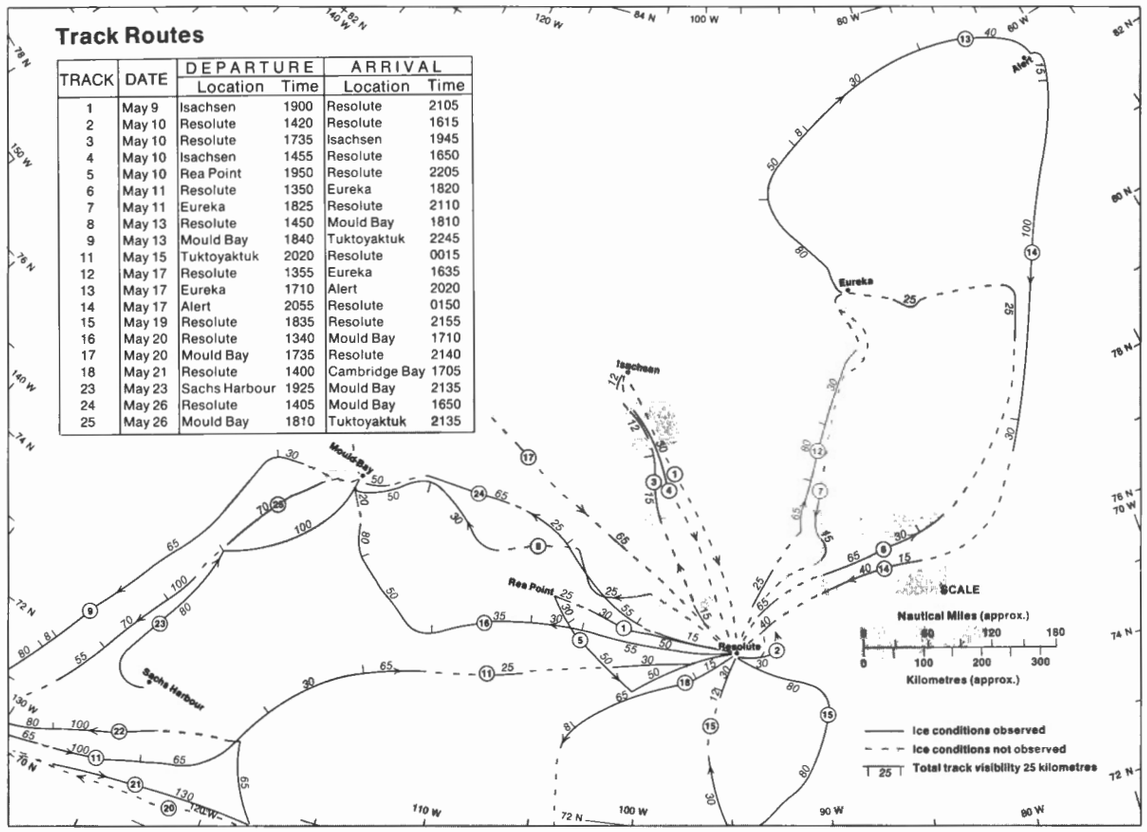
The sea-ice conditions that develop in the archipelago during the summer are influenced by many factors. To a large extent the main factors are the ice types and distributions established during the preceeding fall season and the amount of insolation permitted to affect ablation especially during early months of the current summer. These two factors and their combined effect on the subsequent ice conditions are clearly shown on the 1969 set of maps. In the fall of 1968 thick multi-year ice entered the northern channels while thinner ice covered the remaining areas. After melting had continued for some time, much of the first-year ice had melted and disappeared and the weakened multi-year ice cover in the northern channels broke up and moved south into the southern areas and was replaced by another mass of multi-year ice which moved into the northern channels from the Arctic Ocean.

Thus, more multi-year ice was present in the archipelago at the end of the 1969 summer season than at the beginning, primarily because the season was slightly warmer. In a normal year, the ice barrier across the northern channels remains unbroken; in a warm season, the barrier is broken and pack ice moves from the Arctic Ocean into the archipelago. With this increase in multi-year ice it seemed likely, assuming that the normal amount of solar radiation would be absorbed by the ice in the following summer, that the 1970 season would not be as good or as ice-free as the 1969 season.

While the concentrations and distribution of multi-year ice in the channels of the archipelago were typical, the extent of first-year ice observed in the Beaufort Sea was unusually large. A forecaster might assume, quite correctly, that this large area of relatively thin ice would melt, leave a large ice-free area, and result in a good season for shipping in the Beaufort Sea. During the summer of 1969, the first-year ice did melt as expected. However, unusually persistent northerly winds moved the multi-year floes toward the coast more quickly than they could melt with the result that the shipping season in August and September was less favourable than usual. Had the frequency of northerly winds been normal the forecaster would have been correct.

The relationship between the distribution of ice types and the amount of solar radiation used to melt the ice can be illustrated by comparing the eastern and western parts of Map 1 and Map 7-1969. Almost all of the first-year ice shown on the first pair of maps had melted and is shown as open water on Map 7 East and West. In 1969 the general ice cover was light or thin and the insolation seemed to be slightly more effective in most areas especially the central southern part of the archipelago.

During the navigation season two loaded barges en route to Rae Point on Melville Island were overpowered by sea-ice and sank in Viscount Melville Sound southwest of Bathurst Island. The "MANHATTAN" entered Lancaster Sound on September 5, met ice which seriously impeded progress in M'Clure Strait on the 11th, passed through Prince of Wales Strait and arrived at Point Barrow on the 21st. The return trip started the next day and the ship reached Winter Harbour on Melville Island via Prince of Wales Strait on October 1st. For the next 28 days the "MANHATTAN" made various tests in the ice of Viscount Melville Sound and Barrow Strait. The icebreaking tanker departed from Lancaster Sound and headed south down the ladder of latitude on October 31.



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	May 9	Isachsen	1900	Resolute	2105
2	May 10	Resolute	1420	Resolute	1615
3	May 10	Resolute	1735	Isachsen	1945
4	May 10	Isachsen	1455	Resolute	1650
5	May 10	Rea Point	1950	Resolute	2205
6	May 11	Resolute	1350	Eureka	1820
7	May 11	Eureka	1825	Resolute	2110
8	May 13	Resolute	1450	Mould Bay	1810
9	May 13	Mould Bay	1840	Tuktoyaktuk	2245
11	May 15	Tuktoyaktuk	2020	Resolute	0015
12	May 17	Resolute	1355	Eureka	1635
13	May 17	Eureka	1710	Alert	2020
14	May 17	Alert	2055	Resolute	0150
15	May 19	Resolute	1835	Resolute	2155
16	May 20	Resolute	1340	Mould Bay	1710
17	May 20	Mould Bay	1735	Resolute	2140
18	May 21	Resolute	1400	Cambridge Bay	1705
23	May 23	Sachs Harbour	1925	Mould Bay	2135
24	May 26	Resolute	1405	Mould Bay	1650
25	May 26	Mould Bay	1810	Tuktoyaktuk	2135

MAP 1-1969 East May 9-29

Flight Effectiveness

The first Flight over the eastern area was about 80 per cent successful. Some patches of low lying cloud and fog hampered observations. Fortunately, the data collected during routine supply missions added to what was obtained during the regular surveys.

Ice Conditions

The differences between ice conditions observed during the last flight in 1968 and those shown on Map 1-1969 East indicate that the flow of multi-year ice through Byam Martin Channel into Viscount Melville Sound ceased near the end of October, 1968. This explains the large area of first-year ice observed in the eastern part of Viscount Melville Sound. The multi-year ice in western Viscount Melville Sound must have entered through M'Clure Strait during the fall of 1968.

The overall conditions shown on Map 1-1969 East appear to be normal for this time of year. Two slight departures from the norm occurred in Barrow and M'Clure Straits. Typically, the eastern half of Barrow Strait remains solid with the boundary between solid and moving ice extending north across Lancaster Sound from Prince Leopold Island to Devon Island. The boundary between solid and moving ice in M'Clure Strait was farther east. One additional variation concerns the small open area in Penny Strait; although open water may be present in February, it is usually solid by mid-May.

The snow cover varied from ten tenths in the central and northern areas to eight tenths in the smaller channels to the south.

Unobserved Areas

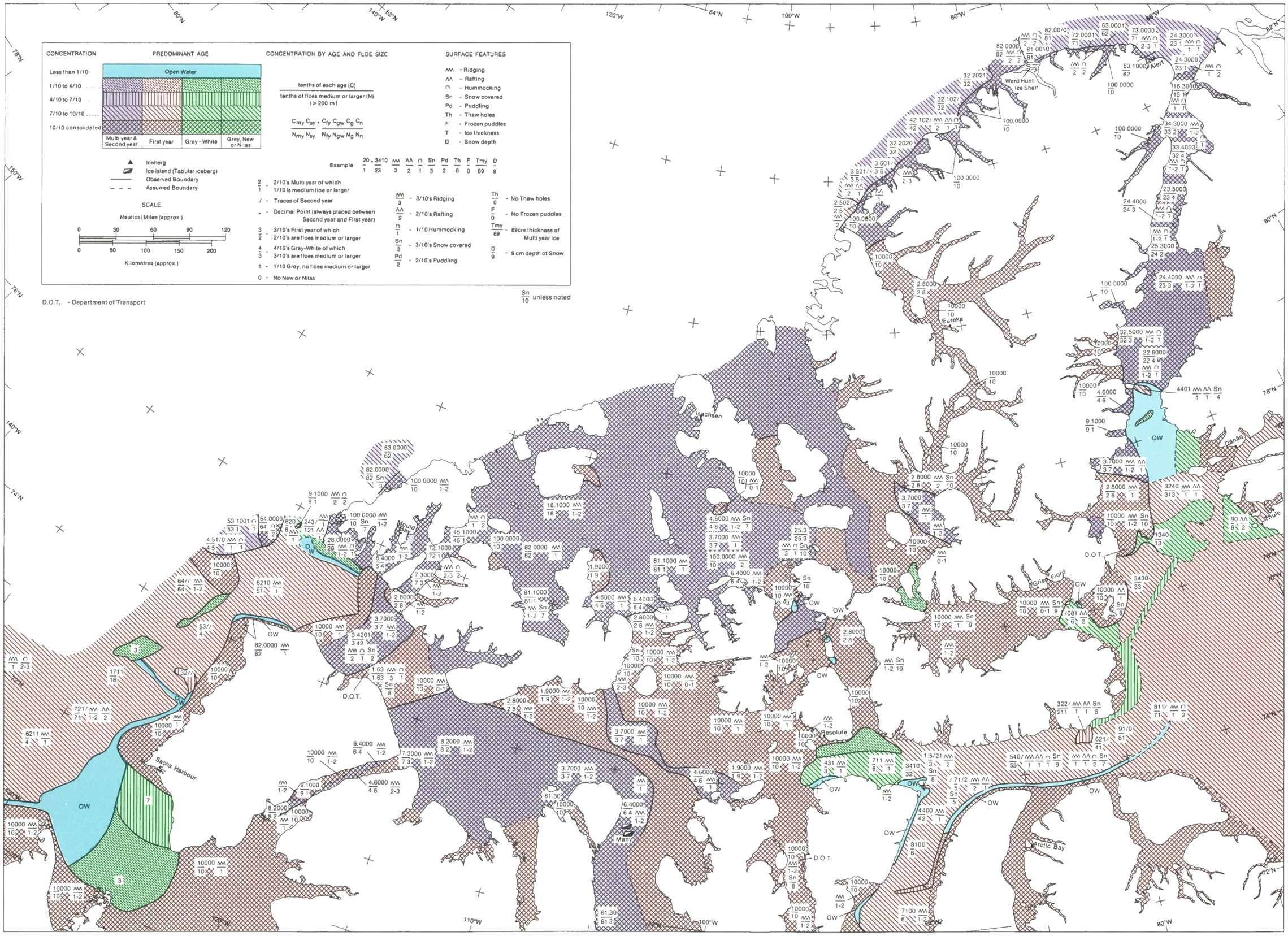
The ice conditions shown for areas not observed during Flight 1-1969 are suggested on the accompanying map and are based on information collected in other years and during later flights in the 1969 season. It is possible that reduced concentrations occasionally existed along the northern fringe of the archipelago as the multi-year ice moved offshore for brief intervals before assuming its typical position which is shown on the map.

Comments

The information shown took two weeks to collect. However, at this season the ice conditions do not change radically or rapidly. The open areas in Hell Gate and the boundary in Smith Sound appear in their normal positions. In some years Lancaster Sound is ice-free at this time of year and sometimes the central part of Prince Regent Inlet is solid. There seems to be no correlation between the ice conditions observed in these two areas at the beginning of the season, and the subsequent amount and rate of ablation, break-up and movement in the remainder of the archipelago. Therefore, it is not possible to predict the ensuing season's ice conditions from the patterns shown on Map 1-1969 East.

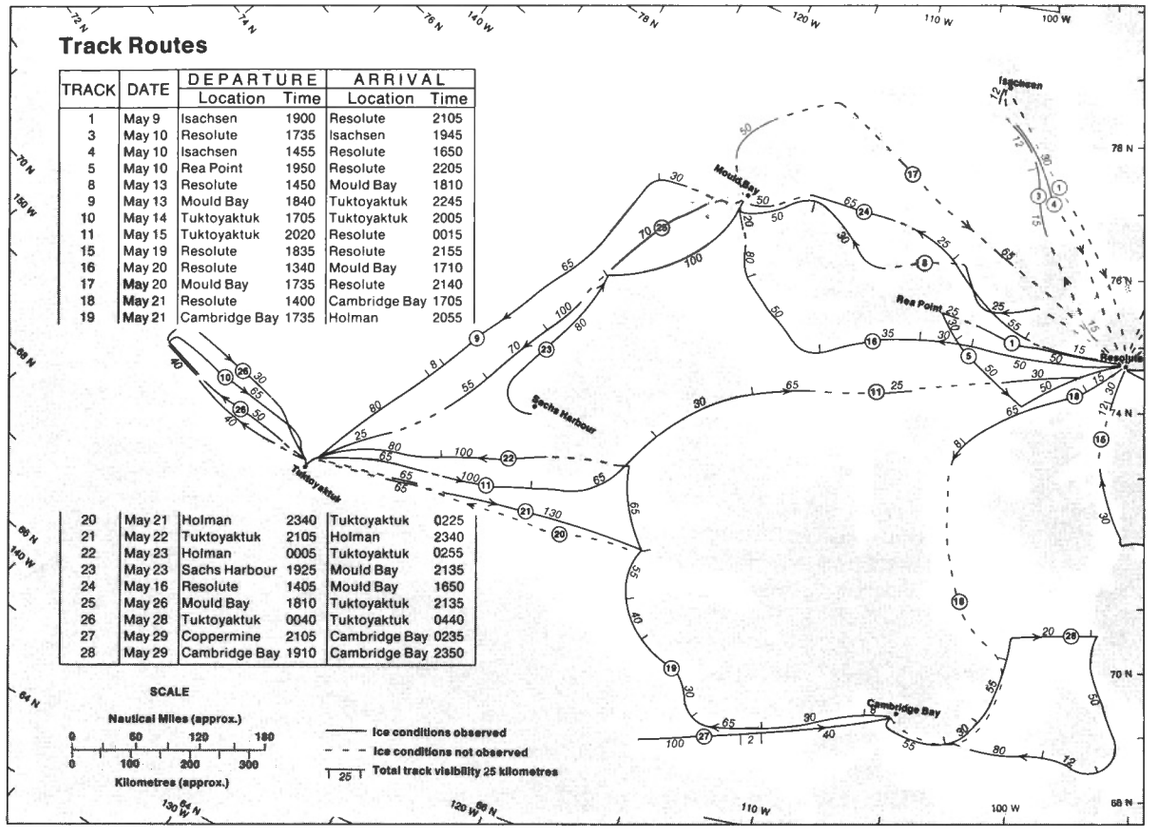
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 1 - 1969 EAST

May 9-26, 1969



MAP 1-1969 West May 9-27

Flight Effectiveness

Visibility during a few of the surveys carried out over the western area was occasionally reduced by fog and low cloud. Overall, the Flight was nearly 100 per cent effective.

Ice Conditions

The ice conditions in the areas adjacent to the southern and eastern parts of the Beaufort Sea were not typical. The ice cover in M'Clure Strait was broken 100 kilometres farther east. Normally, the boundary separating solid from moving ice extends across the strait from Prince Patrick Island to the northwest tip of Banks Island. The extent of solid ice along the west coast of Banks Island appeared to be twice as wide as it usually is at this time of year. Similarly, the fast ice from Cape Bathurst to Herschel Island was wider than usual. The most notable departure was the extreme development of the open area in Amundsen Gulf often called the Bathurst Polynya. In May, 1969 it was almost three times its normal size. The ice cover in the eastern half of Amundsen Gulf was almost free of pressure ridges. Normally there are many more signs of movement in this area.

The two features shown in Victoria Strait as icebergs could have been upended pieces of ice island. The size of the ice islands observed further north left no doubt that they were once associated with the large ice island, T-1, which moved into northern M'Clintock Channel in 1964.

A narrow band of open water about 20 kilometres long, and not shown on Map 1-1969 West because of its small size, clung to the north part of Dundas Island. This area in the eastern part of Dolphin and Union Strait is normally the first to support open water although break-up does not take place for another five weeks.

Unobserved Areas

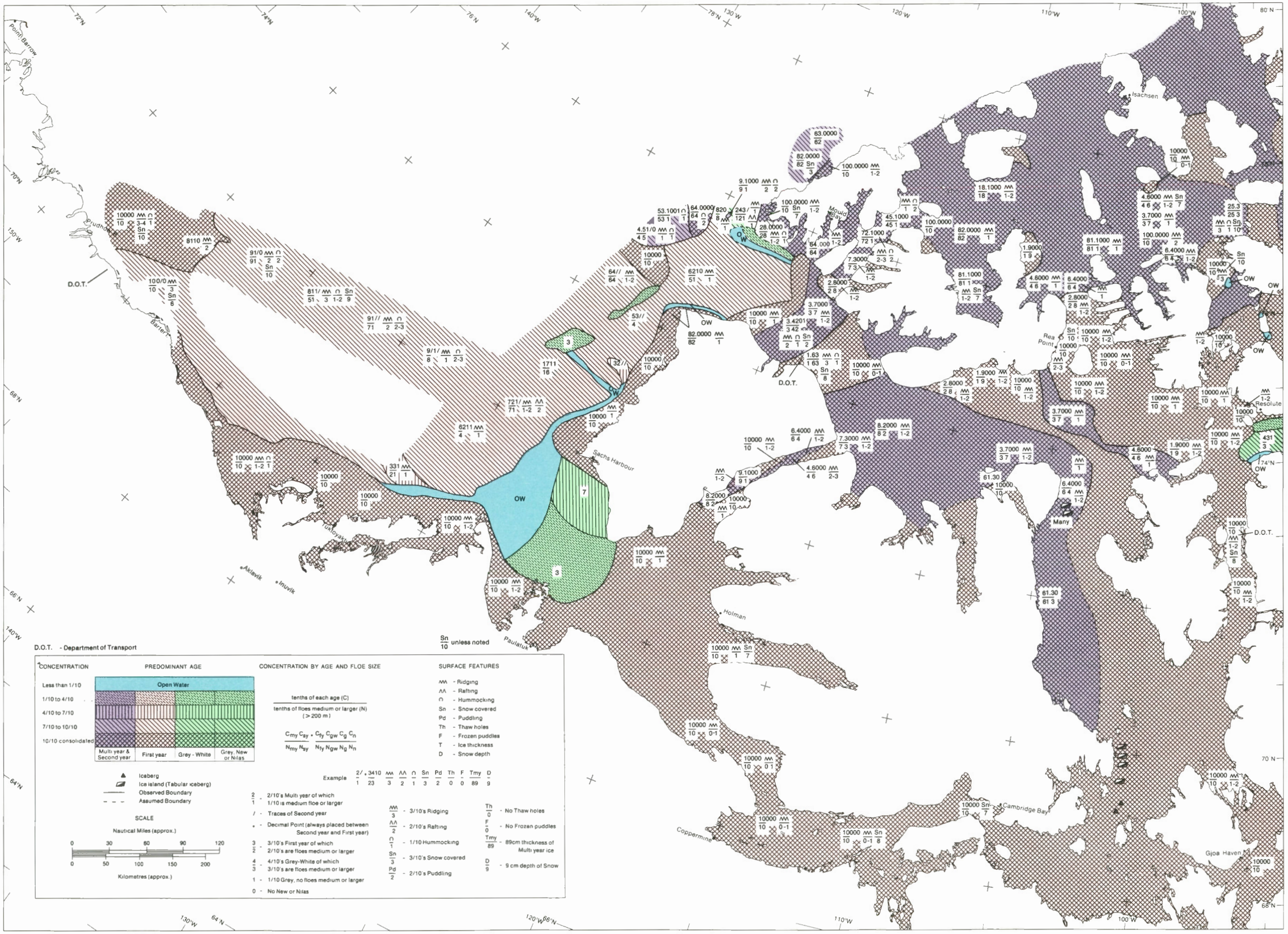
A band of landfast ice up to 15 kilometres wide likely extended west from Demarcation Point along the coast of Alaska. The large solid area observed north of Prudhoe Bay was temporary and would soon break into smaller floes.

The conditions shown in M'Clintock Channel are based on previous observations in 1968 as well as on data collected during Flight 3-1969. In this channel, ice generally remains solid and unmoving until the latter part of August. During some years no break-up occurs at all.

Comments

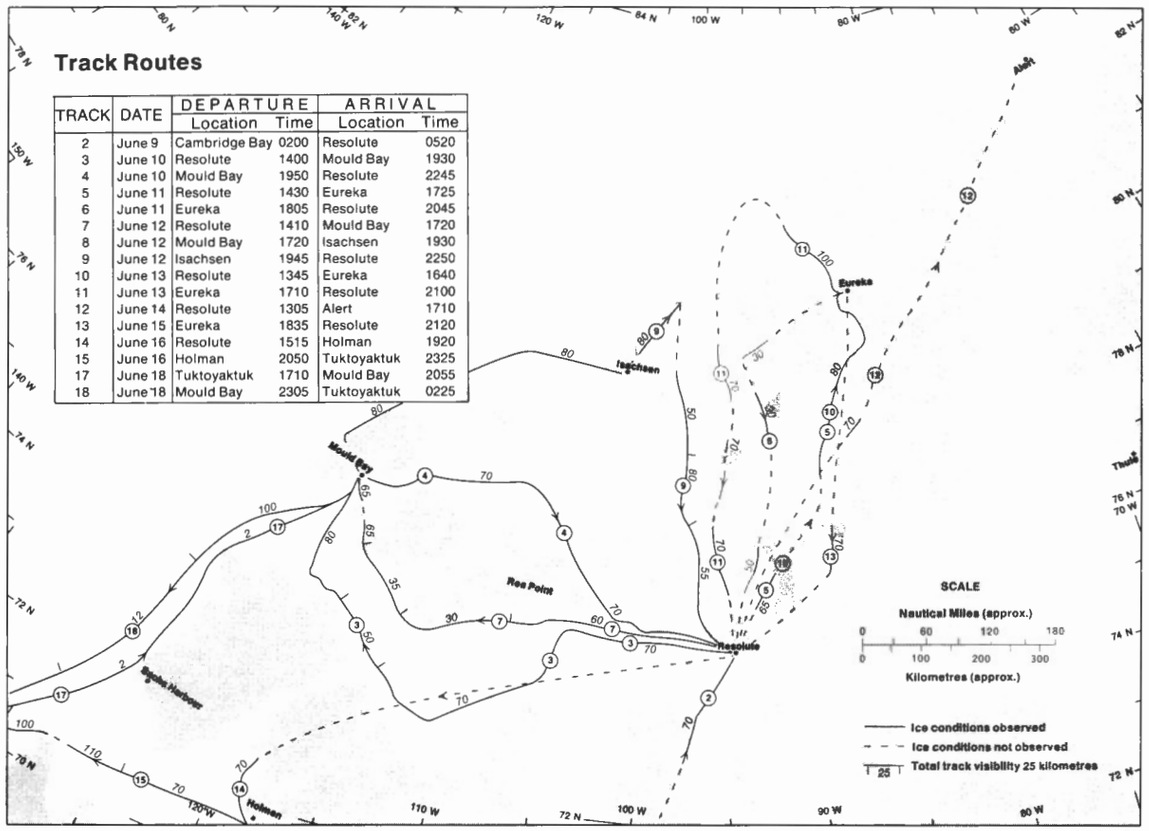
Vast areas of first-year ice existed in the Beaufort Sea. Southeasterly winds were likely responsible for this deviation from the normal situation.

Generally the ice in the southern half of the Beaufort Sea exhibits a net westerly movement while drift rates and directions vary considerably. Two examples of movements in this area were observed at hydrographic surveys camps set up on the ice by the Polar Continental Shelf Project in the springs of 1968 and 1969. In 1968 the first camp was established on ice 6 metres thick on March 18 at 75° 26′N, 129° 22′W, nearly 300 kilometres west of Mould Bay. The camp was evacuated on April 28 at 75° 11′N, 130° 42′W. During the 41 days of drift, the ice floe moved a total distance of 140 kilometres with a net westerly drift of 48 kilometres. The 1969 camp was established on March 26 at 72° 11′N, 131° 57′W, approximately 300 kilometres north of Tuktoyaktuk. The camp was evacuated on April 19 at 72° 19′N, 135° 46′W. During the 24 days of drift the ice floe moved in a westerly direction a total distance of 180 kilometres and a net distance of 130 kilometres.



MAP 1 - 1969 WEST

May 9-29, 1969



MAP 2-1969 East June 9-18

Flight Effectiveness

Most of the eastern area was surveyed during Flight 2-1969. Some observations were restricted by low clouds and fog. Overall, the Flight was almost 90 per cent effective.

Ice Conditions

Large amounts of ice were removed from Lancaster Sound, Baffin Bay and eastern Barrow Strait during the three-week interval between Flights 1 and 2. The ice-free areas in Penny Strait expanded and the floe sizes in Prince Regent Inlet decreased. The ice in the remainder of the area remained solid and unmoving and the boundaries between solid and moving ice across Barrow Strait and M'Clure Strait maintained the same positions.

The overall ice conditions and the amounts of open water in Hell Gate, Penny Strait and Lancaster Sound indicated that break-up was progressing at a normal rate. Puddling had not started to appear, although the small sheltered southern channels were rapidly losing their snow cover. No unusual signs of decay or weakness were observed, which might indicate that the ensuing ice season would be better, or worse, than usual.

Unobserved Areas

Fortunately, good satellite photos from E.S.S.A.-8 were available and ice conditions for Baffin Bay and Lancaster Sound were determined from these photographs.

Although the ice conditions in Nares Strait, around Lougheed Island, and in M'Clintock Channel were not observed during Flight 2, subsequent surveys confirmed the conditions shown on Map 2-1969.

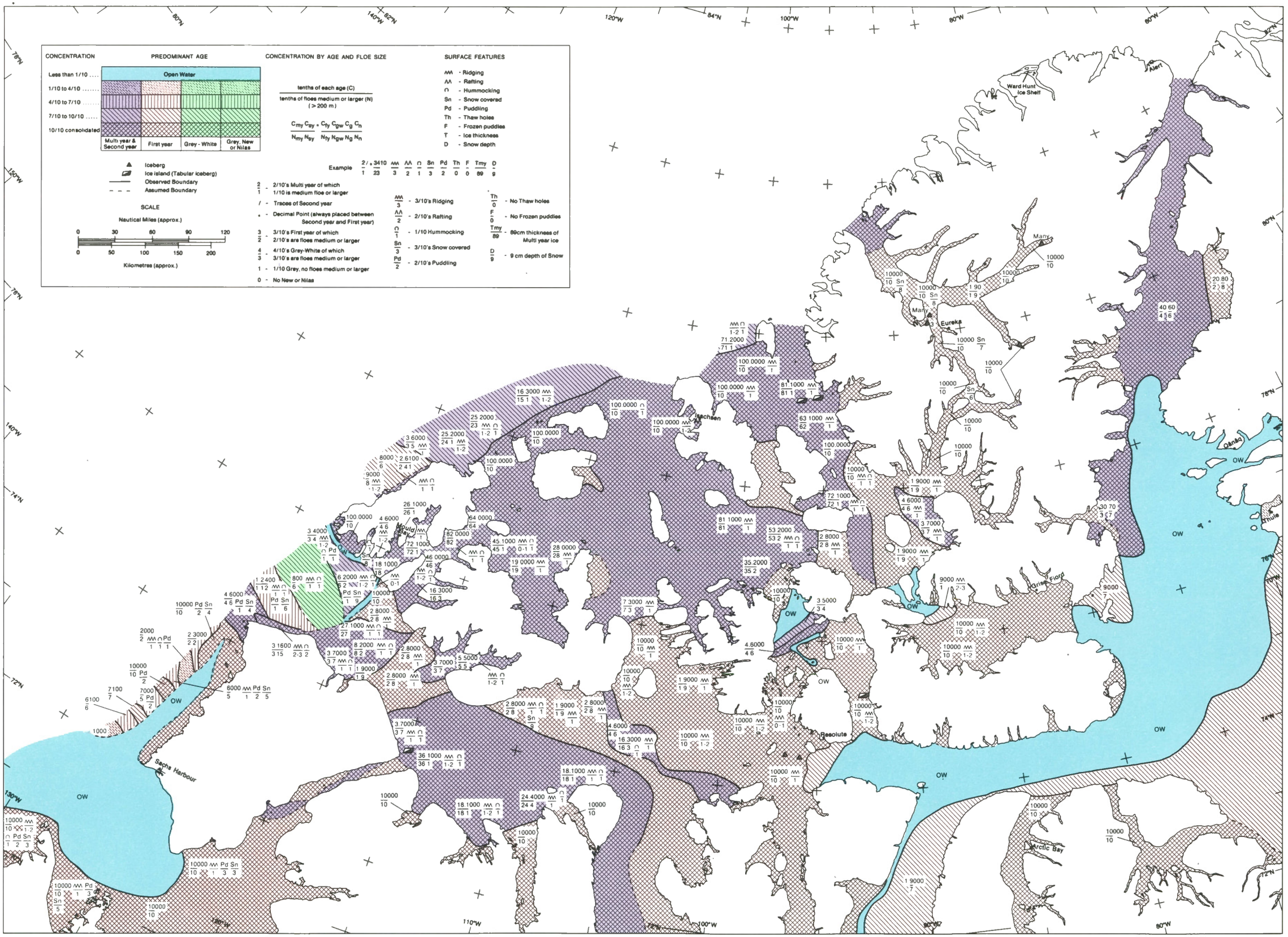
The distribution of ice and the general boundaries between moving and solid ice along the north shore of Ellesmere Island at the time of Flight 2 probably resembled those shown on Map 1-1969 East. It is likely that the boundary between moving ice to the north and solid ice to the south extended across the northern entrances of Prince Gustaf Adolf Sea, Peary Channel and Sverdrup Channel. It can be assumed that the boundary separating solid from moving ice between northern Ellesmere Island and Greenland appeared across the southern portion of the Lincoln Sea.

Comments

The ice island fragments located northwest of Amund Ringnes Island and in Wellington Channel, as well as the icebergs observed in Eureka Sound and Barrow Strait, are normally expected in these areas. However, it is not usual to find an ice island fragment near the northern entrance to Prince of Wales Strait. This mass of ice probably moved south through Byam Martin Channel, west along the coast of Melville Island and then south to its position of June 10, 1969. The large ice island, T-1, drifted in a similar manner during the break-up seasons of 1962 and 1963.

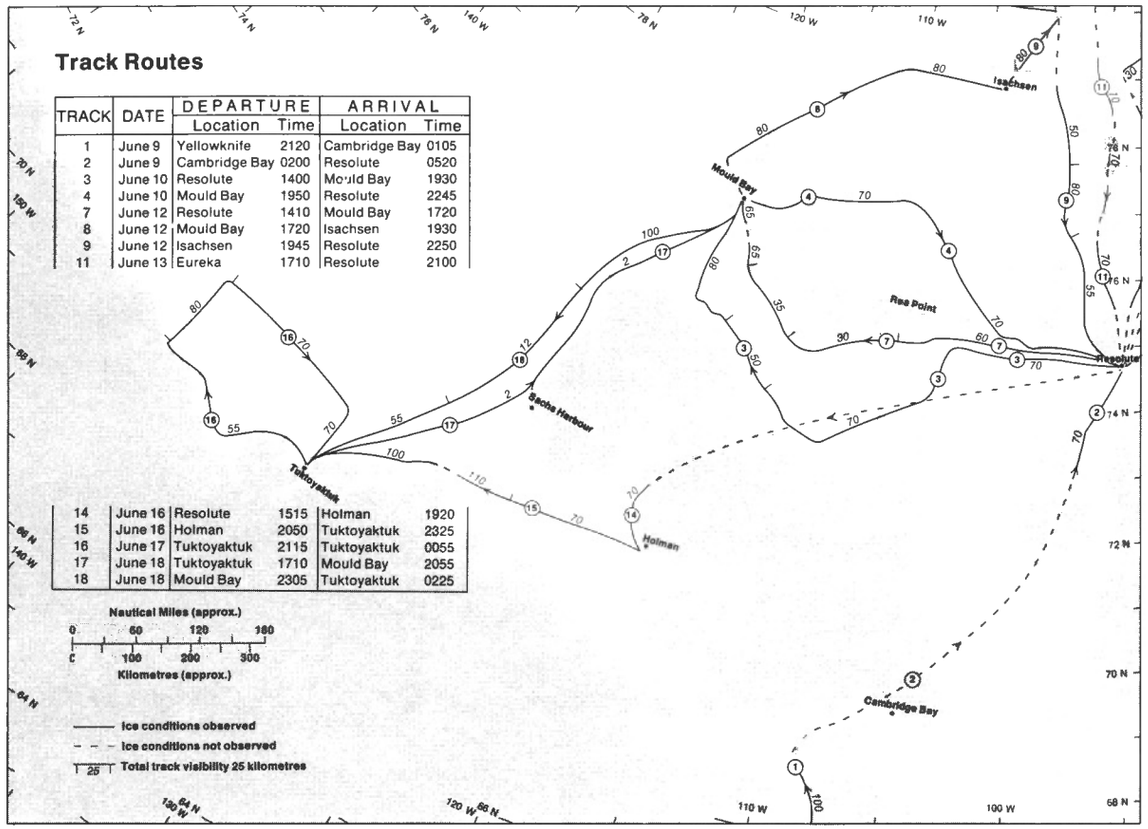
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 2 - 1969 EAST

June 9-18, 1969



MAP 2-1969 West June 9-18

Flight Effectiveness

Poor visibility hampered some of the tracks carried out in the western area but fine weather prevailed for the remaining tracks and the Flight was considered 85 per cent effective.

Ice Conditions

No unexpected changes in the ice conditions in the western part of the Canadian Arctic had occurred between Flights 1 and 2. The solid, unmoving ice cover continued to exist across the interior channels while the ice in the Beaufort Sea remained in motion.

The ice-free area in Amundsen Gulf had expanded considerably due to the disappearance of the new ice observed in May. There was no appreciable retreat of the boundary separating the open water from the solid ice covering the remainder of Amundsen Gulf.

Ablation had advanced and signs of break-up were beginning to appear in Dolphin and Union Strait, Coronation Gulf and Dease Strait. An area of open water had developed at the eastern end of Dolphin and Union Strait. The extent of clearing indicated that the break-up was advancing in a normal fashion and that complete break-up of the ice cover in these channels would occur within four weeks. Other small areas of open water were present in Bathurst Inlet and Bellot Strait. The currents through Bellot Strait do not permit a thick ice cover to form so that portions of it may remain ice-free throughout the winter.

Unobserved Areas

The ice conditions in many channels of the western Arctic were not observed during Flight 2. However, on the basis of previous and subsequent surveys, and through the use of satellite photographs from E.S.S.A.-8, the ice cover in eastern Amundsen Gulf and in all the channels south and east of Victoria Island, except for the open areas previously maintained, has been shown on Map 2-1969 West as solid and unmoving.

The observed portions of Amundsen Gulf were four tenths puddled and a similar or slightly greater concentration likely existed in the narrow channels south of Victoria Island and King William Island. In the larger areas, including Victoria Strait and Queen Maud Gulf, puddling would be just starting while the ice in M'Clintock Channel and Peel Sound would be snow covered with little or no melting.

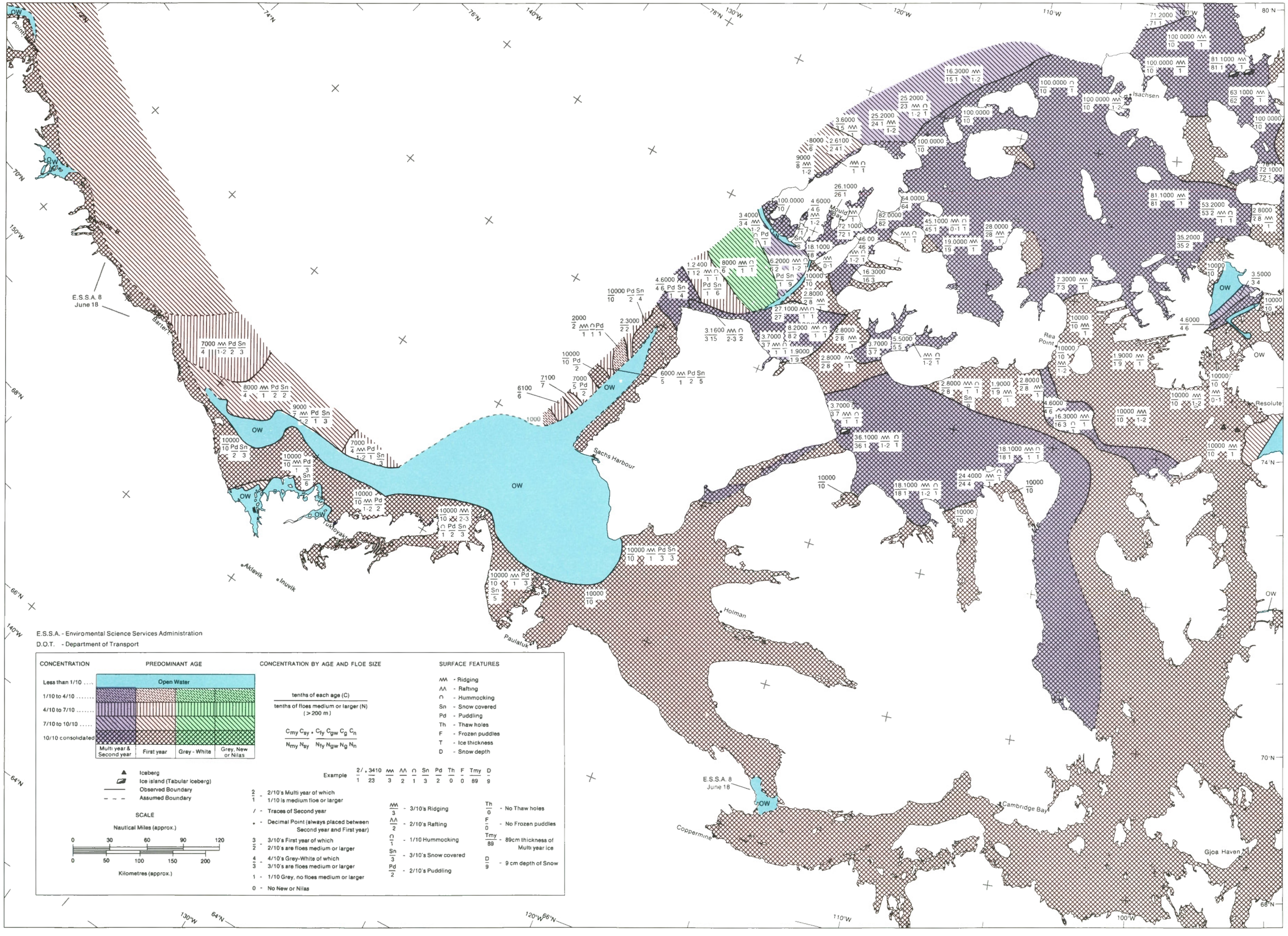
The ice conditions shown along the north coast of Alaska and in the northern part of the Beaufort Sea are based on information from the E.S.S.A.-8 satellite. Since from this imagery it is not possible to distinguish closely-packed, moving ice from a solid ice cover, assumed boundaries are shown along the Alaskan coast. Probably the unobserved part of the Beaufort Sea north of these assumed boundaries supported a nine tenths concentration of mainly first-year ice.

Comments

The photographs from E.S.S.A.-8 are useful tools to help determine ice conditions in unobserved areas. The degree of reliability of the interpretation varies inversely with the distance between the area photographed and an area of known ice types and conditions.

Relatively large areas of open water are shown at the mouths of the Mackenzie River. Some of these areas may actually be flooded portions with ice still extant beneath the flood water.

Ice in the channels south of Victoria Island probably reached its greatest thickness, about 1.25 metres, by June 10th or about the time when puddles covered three tenths of the ice surface.



E.S.S.A. - Enviromental Science Services Administration
D.O.T. - Department of Transport

CONCENTRATION

Less than 1/10 ....
1/10 to 4/10 .....
4/10 to 7/10 .....
7/10 to 10/10 .....
10/10 consolidated

PREDOMINANT AGE

Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas

▲ Iceberg
Ice island (Tabular Iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy}\ .\ C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ \ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2}{1}/.\frac{3}{23}\frac{410}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

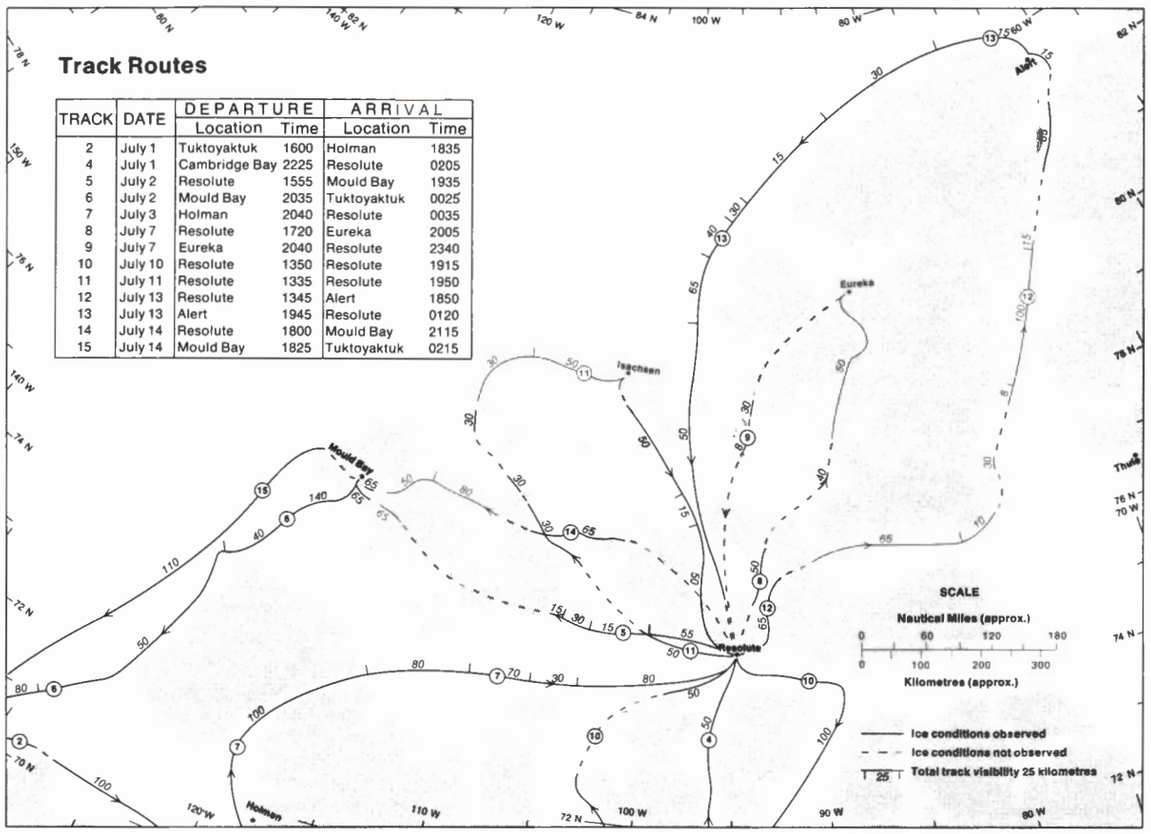
$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
. - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{\wedge\wedge}{3}$ - 3/10's Ridging
$\frac{\wedge\wedge}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

ᴧᴧ - Ridging
ᴧᴧ - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow



TRACK	DATE	DEPARTURE Location	Time	ARRIVAL Location	Time
2	July 1	Tuktoyaktuk	1600	Holman	1835
4	July 1	Cambridge Bay	2225	Resolute	0205
5	July 2	Resolute	1555	Mould Bay	1935
6	July 2	Mould Bay	2035	Tuktoyaktuk	0025
7	July 3	Holman	2040	Resolute	0035
8	July 7	Resolute	1720	Eureka	2005
9	July 7	Eureka	2040	Resolute	2340
10	July 10	Resolute	1350	Resolute	1915
11	July 11	Resolute	1335	Resolute	1950
12	July 13	Resolute	1345	Alert	1850
13	July 13	Alert	1945	Resolute	0120
14	July 14	Resolute	1800	Mould Bay	2115
15	July 14	Mould Bay	1825	Tuktoyaktuk	0215

MAP 3-1969 East July 1-14

Flight Effectiveness

Observations in the eastern area during Flight 3 were hampered by poor weather. Although the ice conditions in most channels were only partially mapped, the Flight was assessed as being 80 per cent effective.

Ice Conditions

During the interval between Flights 2 and 3, the boundaries separating solid from moving ice in Barrow Strait and M'Clure Strait remained stationary. The area of open water in Hell Gate expanded slightly toward the south and into Jones Sound. The open area in Penny Strait expanded to the north as well as to the south into Queens Channel. Puddling was well underway in all areas and thaw holes were developing in Eureka Sound. The advent of thaw holes indicates that break-up is imminent.

The solid ice cover in Kennedy Channel and northern Kane Basin had broken. The solid area in southern Kane Basin would soon give way permitting the ice to flush through Smith Sound and into Baffin Bay.

The overall ice conditions noted in the eastern area during Flight 3 indicated that break-up was progressing at a normal rate.

Unobserved Areas

The ice conditions shown for the central part of Prince Gustaf Adolf Sea and for the eastern half of M'Clure Strait are based on information gathered during subsequent surveys. The distributions shown in Lancaster Sound and Baffin Bay were based on E.S.S.A.-8 imagery and confirmed in some areas by data collected by the D.O.T. ice reconnaissance team.

Across the northern entrances to Ballantyne Strait and Sverdrup Channel, the boundaries between moving and solid ice likely resembled those shown on Map 2-1969 East.

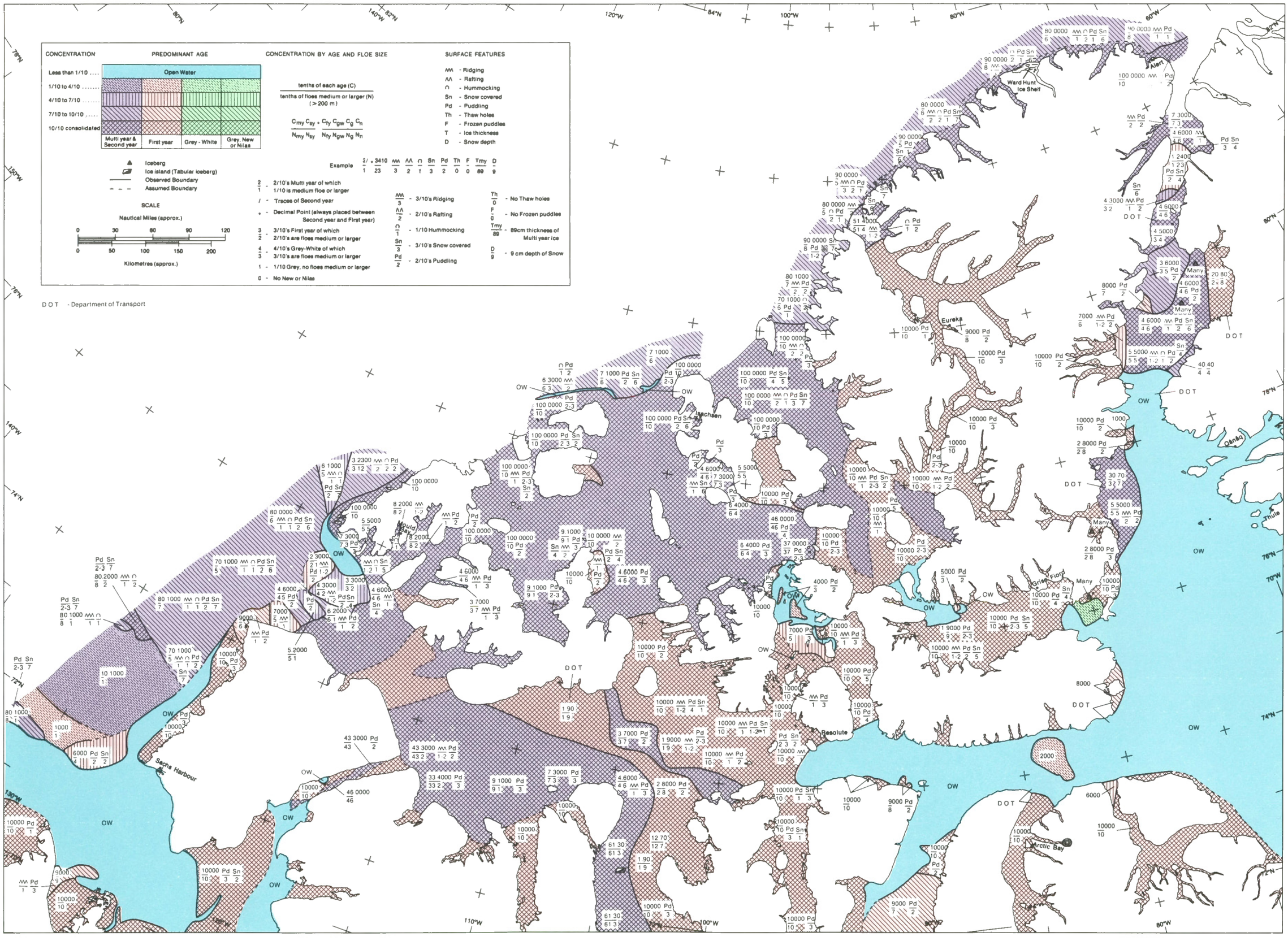
Comments

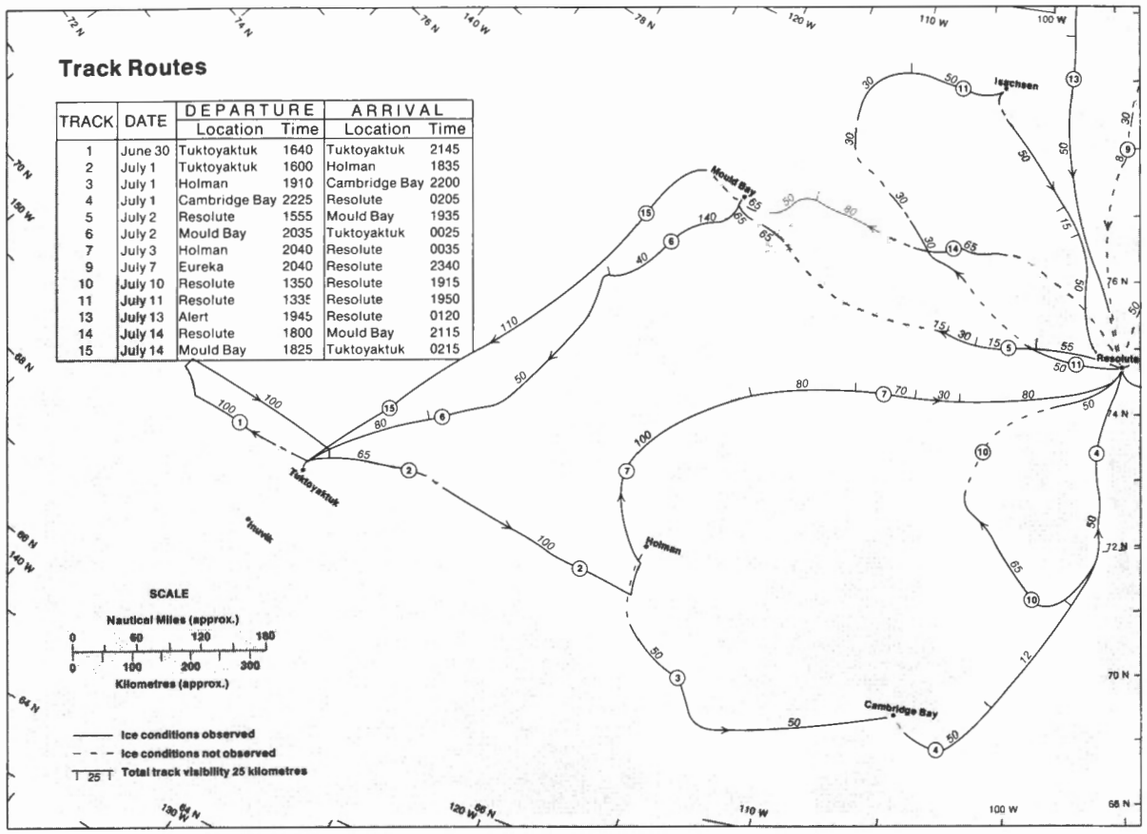
The boundaries between the moving and the solid ice covers in Barrow and M'Clure Straits had remained stationary since they were first observed early in May. Very likely these boundaries had been established in March. Typically, the ice cover in western M'Clure Strait does not break up until the beginning of June. However, the timing of break-up in eastern Barrow Strait cannot be relied on with the same confidence. In some years the ice cover in eastern Barrow Strait may remain solid as far east as Prince Regent Inlet until the end of June when break-up gradually progresses through the strait toward the west. In other years the eastern half of Barrow Strait may break up as far west as Resolute in March. This early break-up does not mean that the subsequent summer break-up will be earlier than usual nor that the summer ice conditions will be lighter than normal. It does mean, however, that there was a winter storm strong enough to break the ice cover as far west as the central part of the strait. Even though the ice breaks up in March rather than June, the boundary established in March will remain in the same place until warmer temperatures permit the normal progression of break-up in mid-July to continue.

Boundaries other than those described above for Barrow and M'Clure Straits form during the winter months. The boundary across the southern entrance to Smith Sound can be relied upon to appear at the same time and in the same place year after year. Similarly, the boundaries across the northern entrances to Ballantyne Strait, Prince Gustaf Adolf Sea, Peary Channel, and Sverdrup Channel can be predicted with confidence.

SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT





MAP 3-1969 West

June 30-July 14

Flight Effectiveness

Fine weather and excellent visibility prevailed during the surveys over the western area resulting in almost 100 per cent effectiveness.

Ice Conditions

A considerable change in the ice conditions had taken place in the western area during the interval between the end of Flight 2 and the finish of Flight 3. The area of open water in the southern half of the Beaufort Sea almost doubled. There was a marked decrease in the concentration of ice in the northeastern part of the Beaufort Sea where the ice cover declined from seven tenths to two tenths. A more subtle transition in the same area was the southerly drift of multi-year ice. In May the area was mainly first-year ice. By July 14 multi-year ice had invaded the northern quarter of the Beaufort Sea. The southerly drift of multi-year ice progressed at the same rate as the existing ice melted with the result that the concentrations remained the same and the boundary between the ice and the open water remained relatively stationary until early in August when northerly winds moved the pack across the Beaufort Sea to the mainland.

The ice-free area in Mackenzie Bay increased considerably and the characteristic solid hook of ice remained across the northern entrance to the Bay. There was practically no change in the area of open water in Kugmallit Bay while the increase in the area of open water in Dolphin and Union Strait was slight compared with the rapid expansion which took place between May 28 and June 18.

There were some indications that the break-up season in the western part of the archipelago was advancing slightly faster than normal. Firstly, the small ice-free area in the central part of Prince of Wales Strait appeared earlier than generally expected. A second indication of an advanced break-up appeared in Amundsen Gulf. On July 3rd the area east of a line between Nelson Head and Cape Parry was solid and there were no signs of weakness such as major cracks or thaw holes. Twelve days later the entire ice cover had broken and large areas of ice had melted.

Although ablation in Amundsen Gulf appeared to be advancing at a more rapid rate than normal, adjacent areas seemed to be slightly slower. Normally at this time of the season, thaw holes are observed in Dolphin and Union Strait, Coronation Gulf and Dease Strait. None were observed during Flight 3.

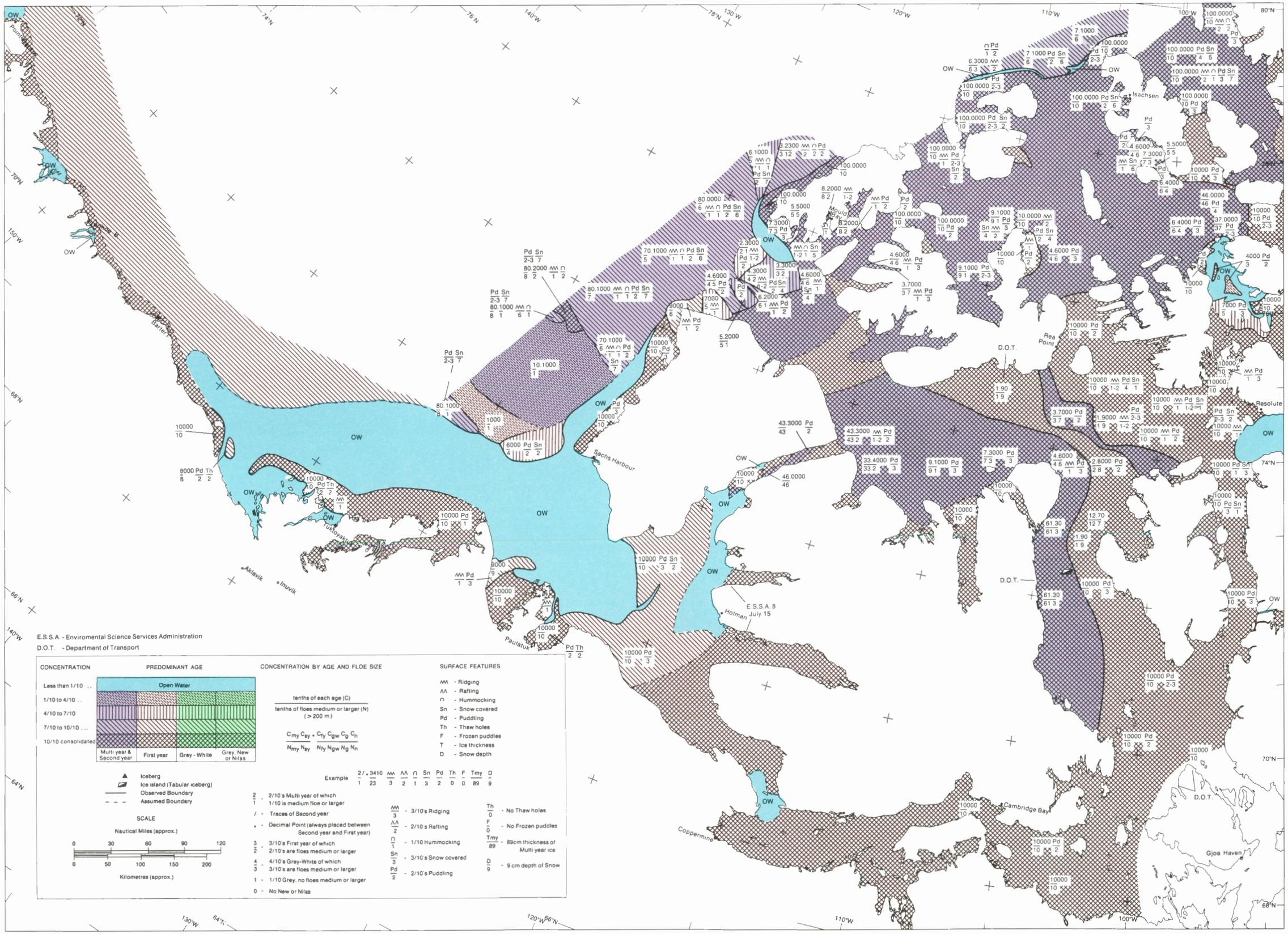
Unobserved Areas

The ice conditions in the unobserved straits and channels surrounding King William Island would be solid and similar to those shown on Map 2-1969 West. Some small ice-free areas were likely developing in the constricted portions of the channels to the east and south of the island.

The ice conditions noted at both ends and in the eastern section of M'Clintock Channel indicated that the central part of that channel supported a solid ice cover. The trends in this area also support this conclusion. Along the north coast of Alaska the ice conditions shown were established from satellite information and data collected prior to and after Flight 3.

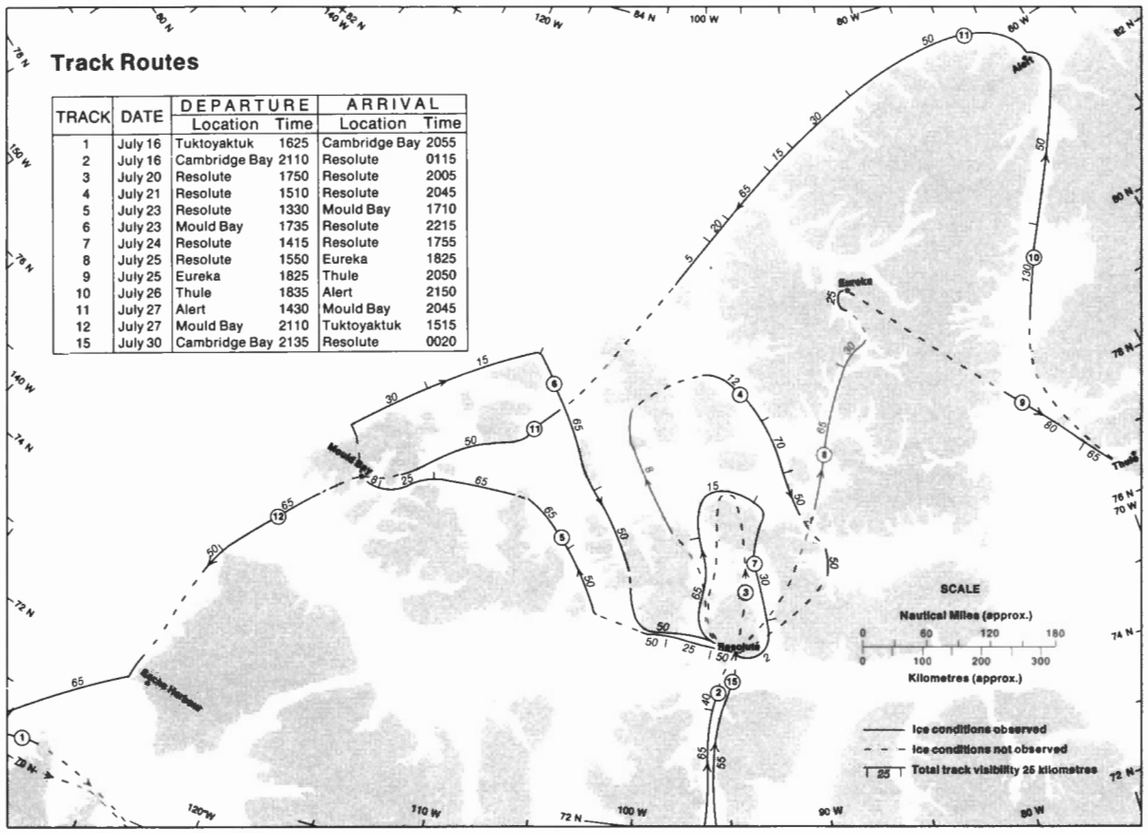
Comments

The extent of open water in the Beaufort Sea and in Amundsen Gulf was much greater than is normally expected at this time of year. The large area of low concentrations of ice to the west of Banks Island was also a considerable departure from normal.



MAP 3 - 1969 WEST

June 30 - July 14, 1969



TRACK	DATE	DEPARTURE Location	Time	ARRIVAL Location	Time
1	July 16	Tuktoyaktuk	1625	Cambridge Bay	2055
2	July 16	Cambridge Bay	2110	Resolute	0115
3	July 20	Resolute	1750	Resolute	2005
4	July 21	Resolute	1510	Resolute	2045
5	July 23	Resolute	1330	Mould Bay	1710
6	July 23	Mould Bay	1735	Resolute	2215
7	July 24	Resolute	1415	Resolute	1755
8	July 25	Resolute	1550	Eureka	1825
9	July 25	Eureka	1825	Thule	2050
10	July 26	Thule	1835	Alert	2150
11	July 27	Alert	1430	Mould Bay	2045
12	July 27	Mould Bay	2110	Tuktoyaktuk	1515
15	July 30	Cambridge Bay	2135	Resolute	0020

MAP 4-1969 East July 16-30

Flight Effectiveness

Poor weather limited visibility many times during the surveys in the eastern area and as a result Flight 4 was rated as 75 per cent effective.

Ice Conditions

A rapid break-up had fractured the solid ice cover in the central and western parts of Barrow Strait. Normally the ice cover in this area does not begin to move until mid-August. Most of the ice in Penny Strait had melted and a similar condition was developing in Queens Channel. The southern part of Wellington Channel remained solid in spite of the early break-up in its northern reaches. The ice cover in the northern part of Eureka Sound was in motion. With the exception of a solid plug of ice in Robeson Channel the length of Nares Strait supported a moving ice cover. Some of the ice in Kane Basin was starting to drift south through Smith Sound into Baffin Bay.

Small areas of open water appeared in their expected locations in Belcher Channel and in Crozier Strait. Additional indications of the rapid advance of ablation were the thaw holes observed in McDougall Sound, Barrow Strait, Kane Basin and in Hecla and Griper Bay. No thaw holes were observed in the northern channels but puddling had started. Shore leads were noted along the Sabine Peninsula and around King Christian Island and similar conditions were likely developing along other coasts.

Generally break-up was advancing slightly faster than normal. The widespread amount of puddling and thaw holes indicated that this trend would continue and the solid ice cover remaining in the channels in the southeast part of the region would soon break up and start to move.

Unobserved Areas

The boundaries between the solid ice in the archipelago and the moving ice in the Arctic Ocean probably ran from headland to headland across the northern entrances to Ballantyne Strait, Prince Gustaf Adolf Sea, Peary Channel and Sverdrup Channel.

The ice conditions shown in most of Jones Sound, Lancaster Sound and Baffin Bay were interpreted from satellite photographs and from observations made by the D.O.T. ice reconnaissance unit. The same sources were used to estimate the ice cover in Viscount Melville Sound and eastern M'Clure Strait.

Comments

Large numbers of icebergs were frozen into the ice in the southern part of Peabody Bay adjacent to Kane Basin. The concentration of these large masses of ice in this area is normal and they would continue their southerly drift when the solid ice cover around them fractured.

Two ice islands, one with dimensions about two by four kilometres and the other approximately one by two kilometres, were observed in the Arctic Ocean to the north of Cape Malloch on Borden Island. Neither of these features were seen again in 1969. However, it is possible that one of them was sighted in March, 1970 near the northwest tip of Banks Island.

The concentrations of multi-year ice in the Arctic Ocean adjacent to the northern coast of the archipelago were generally one tenth lower than is usual for the time of year. Probably concentrations increased to nine tenths or more about 100 kilometres from the coast.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$$\frac{C_{my}\,C_{sy} \cdot C_{ty}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy} \quad N_{ty}\,N_{gw}\,N_g\,N_n}$$

Example: 2/. 3410 MM 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
. - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

MM/3 - 3/10's Ridging
AA/2 - 2/10's Rafting
∩/1 - 1/10 Hummocking
Sn/3 - 3/10's Snow covered
Pd/2 - 2/10's Puddling

Th/0 - No Thaw holes
F/0 - No Frozen puddles
Tmy/89 - 89cm thickness of Multi year ice
D/9 - 9 cm depth of Snow

SURFACE FEATURES

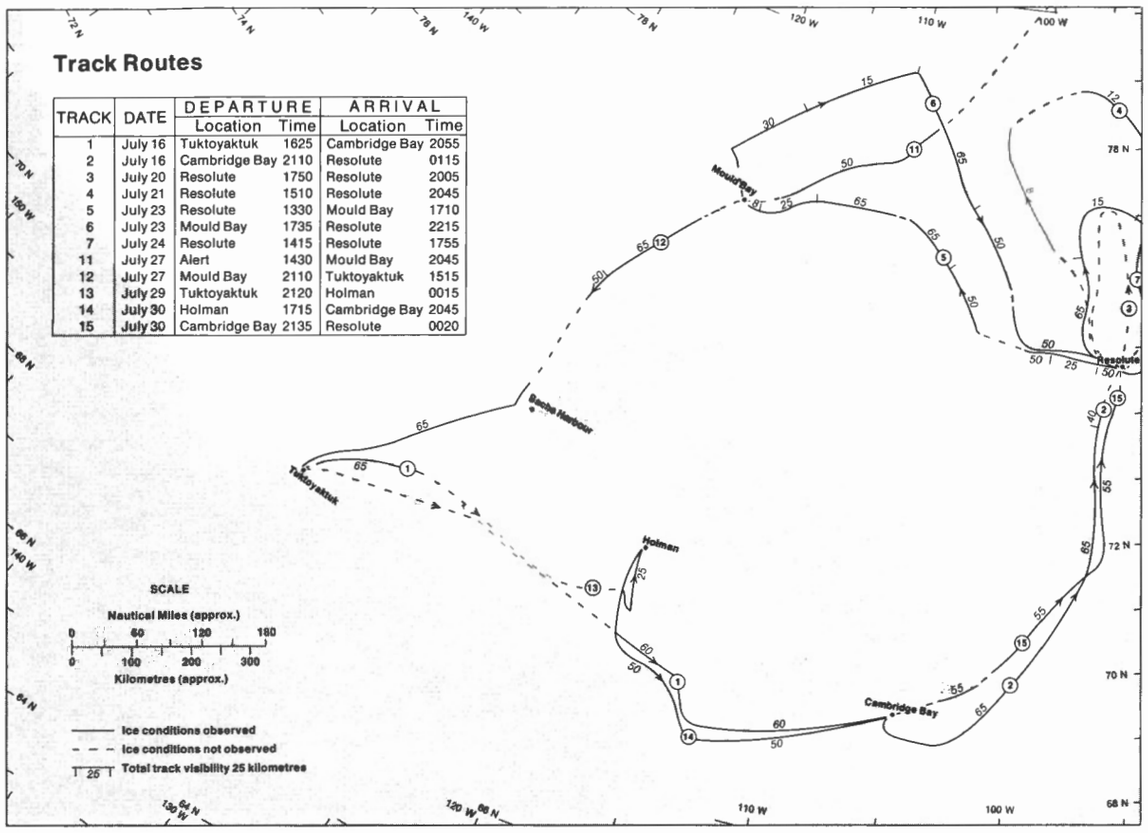
MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

E.S.S.A. - Environmental Science Services Administration
D.O.T. - Department of Transport

Ward Hunt Ice Shelf
Alert
Eureka
Isachsen
Many
Qaanaq
Thule
Grise Fiord
Resolute
Sachs Harbour
Gould Bay
Arctic Bay
D.O.T.
July 16 1969 Line of 10000 10
E.S.S.A. 8 July 21
OW

MAP 4 - 1969 EAST

July 16-30, 1969



MAP 4-1969 West July 16-30

Flight Effectiveness

The number of surveys carried out in the western part of the area were less than normal. Poor weather, combined with other demands for the aircraft, reduced the Flight to the point where it was judged to be about 65 per cent effective.

Ice Conditions

On July 16 a solid ice cover was observed in the channels to the south of Victoria Island. The ice conditions were similar to those shown on Map 3-1969 West. When the same channels were surveyed on July 30 the solid cover had broken and in situ melting had reduced the concentrations to between five and eight tenths. Similar changes had taken place in Albert Edward Bay and the adjacent part of Victoria Strait. Likely the break-up in the western part of Victoria Strait was recent because the floe sizes were still quite large and concentrations were nine tenths or more.

The ice-free area in the Beaufort Sea had increased slightly between the end of Flight 3 and the finish of Flight 4. Although it is not immediately obvious from the map, considerable change had taken place in the Beaufort Sea. The multi-year ice which had started to drift into the northern part of the sea in June had continued its invasion throughout July. During the 16-day interval between surveys in this area, the multi-year ice had drifted 80 kilometres further south into the central part of the Beaufort Sea.

Unobserved Areas

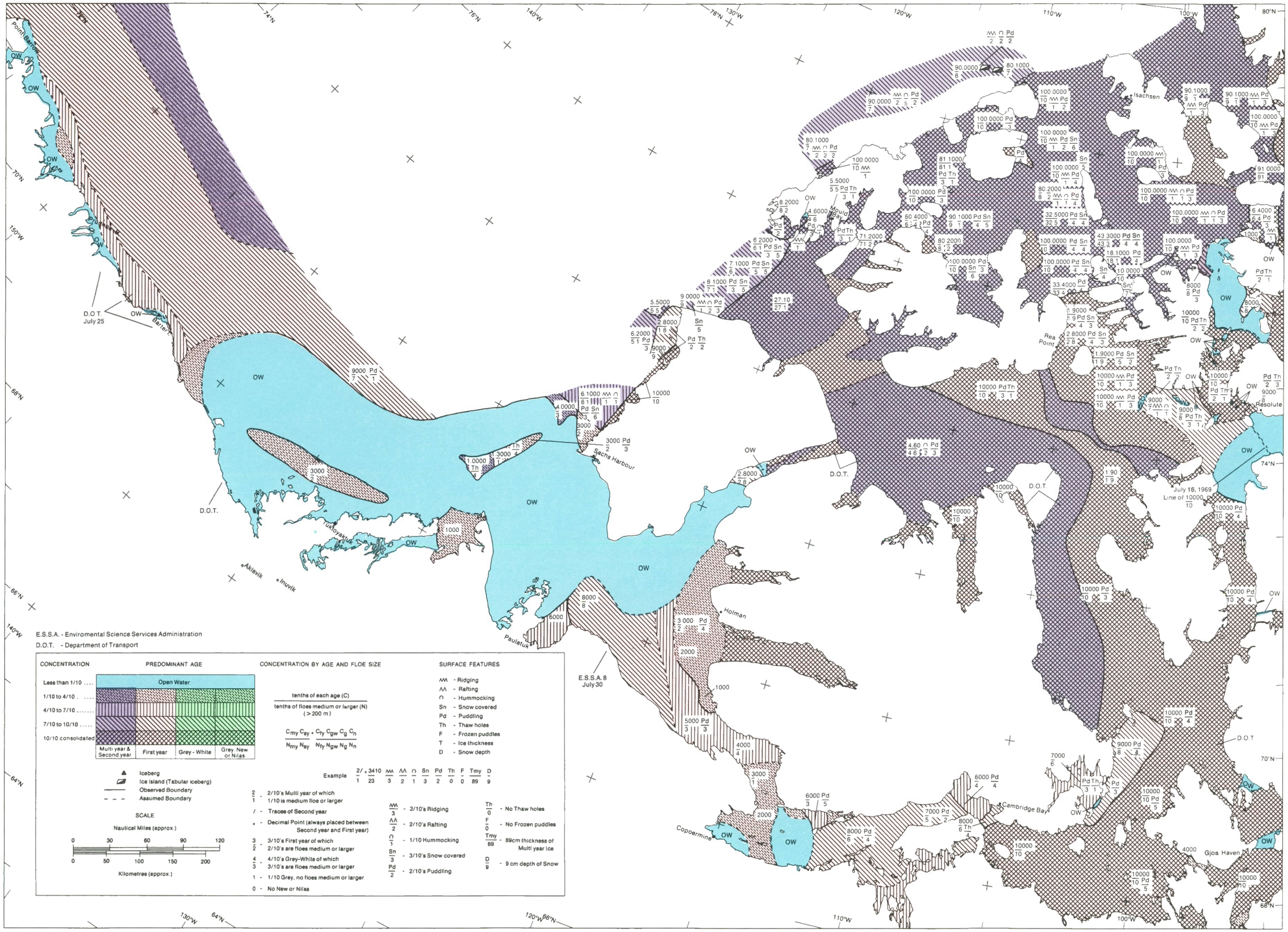
Although the ice conditions in many of the channels usually surveyed by the Polar Continental Shelf Project remained unobserved at the end of Flight 4, information gathered by the D.O.T. (now M.O.T., Ministry of Transport, Department of the Environment) ice reconnaissance unit combined with satellite photographs filled many parts of Map 4-1969 West, which would have remained vacant otherwise. Even with this additional information, the ice conditions in some areas remained unobserved. For example, the central western part of the Beaufort Sea likely supported an eight to nine tenths cover of multi-year ice. Also from the satellite photographs a solid ice cover appeared to exist over Minto Inlet and Prince Albert Sound. However, the satellite image does not resolve large-scale features; it is likely that some cracks crossed these channels and that a shore lead existed along their coastline.

Comments

The boundary separating solid from moving ice across M'Clure Strait observed during Flight 4, was farther west than was noted in the three previous flights. It is not clear why this boundary appeared to shift to the west rather than to the east as is normally expected at this time of year.

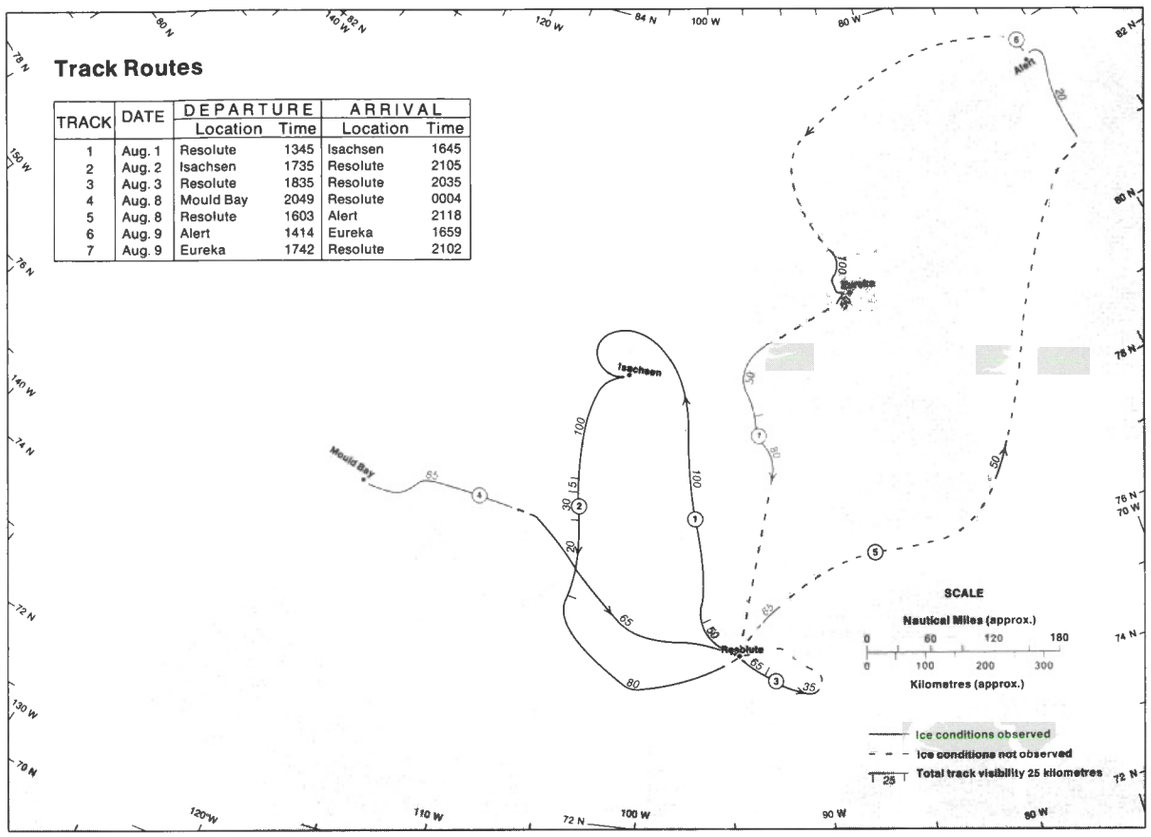
During the interval between May 9 and July 30 multi-year ice had drifted nearly 250 kilometres south into the Beaufort Sea or about three and one half kilometres per day. This rate is slightly faster than the mean daily drift rates that have been determined for ice islands which have moved through the area at various seasons in other years.

Throughout Flight 4-1969 West it was noted that fcg and low cloud did not interfere so frequently if the observations were conducted in the late evening.



MAP 4 - 1969 WEST

July 16-30, 1969



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 1	Resolute	1345	Isachsen	1645
2	Aug. 2	Isachsen	1735	Resolute	2105
3	Aug. 3	Resolute	1835	Resolute	2035
4	Aug. 8	Mould Bay	2049	Resolute	0004
5	Aug. 8	Resolute	1603	Alert	2118
6	Aug. 9	Alert	1414	Eureka	1659
7	Aug. 9	Eureka	1742	Resolute	2102

MAP 5-1969 East August 1-9

Flight Effectiveness

Poor weather, routine aircraft checks and maintenance, and search and rescue operations considerably reduced the number of surveys carried out during Flight 5. As a result the Flight was less than 50 per cent effective.

Ice Conditions

The main change between the end of Flights 4 and 5 was the progression of break-up which was advancing about one week ahead of normal.

Thaw holes appeared in Hassel Sound, shore leads came into existence along the coasts of the Sabine Peninsula and areas of open water were developing along the southern coast of Melville Island. Break-up of the consolidated ice cover in each of these areas was imminent.

A rapid clearing had taken place in Belcher Channel. On July 7 a solid ice cover prevailed. By August 9 the concentrations in the main parts of the channel were reduced to one tenth.

Break-up had spread through southern Norwegian Bay and a similar advance occurred in Austin Channel. Typically, the ice in these areas does not begin to move until mid-August. The break-up in Jones Sound, Admiralty Inlet, Navy Board Inlet, northern Peel Sound, as well as in the extremities of Eureka Sound and eastern M'Clure Strait, was also slightly ahead of the usual time.

Kennedy Channel was ice-free. Generally as much as seven tenths of this area remains ice covered at the beginning of August.

The solid ice cover on McDougall Sound may appear to be atypical considering that the ice cover in the surrounding areas had already broken up. However, McDougall Sound, if it does break up, does so in the last week of August or in the first weeks of September.

Unobserved Areas

The observations around the northern part of Ellef Ringnes Island indicate that the boundaries separating the moving ice in the Arctic Ocean from the solid ice in Ballantyne Strait, Prince Gustaf Adolf Sea, Peary Channel, and Sverdrup Channel remained stationary and extended across the northern entrances of these channels from headland to headland.

Concentrations in Greely Fiord and the fiords adjoining it probably ranged from two tenths near the heads to nine tenths at the entrances.

Comments

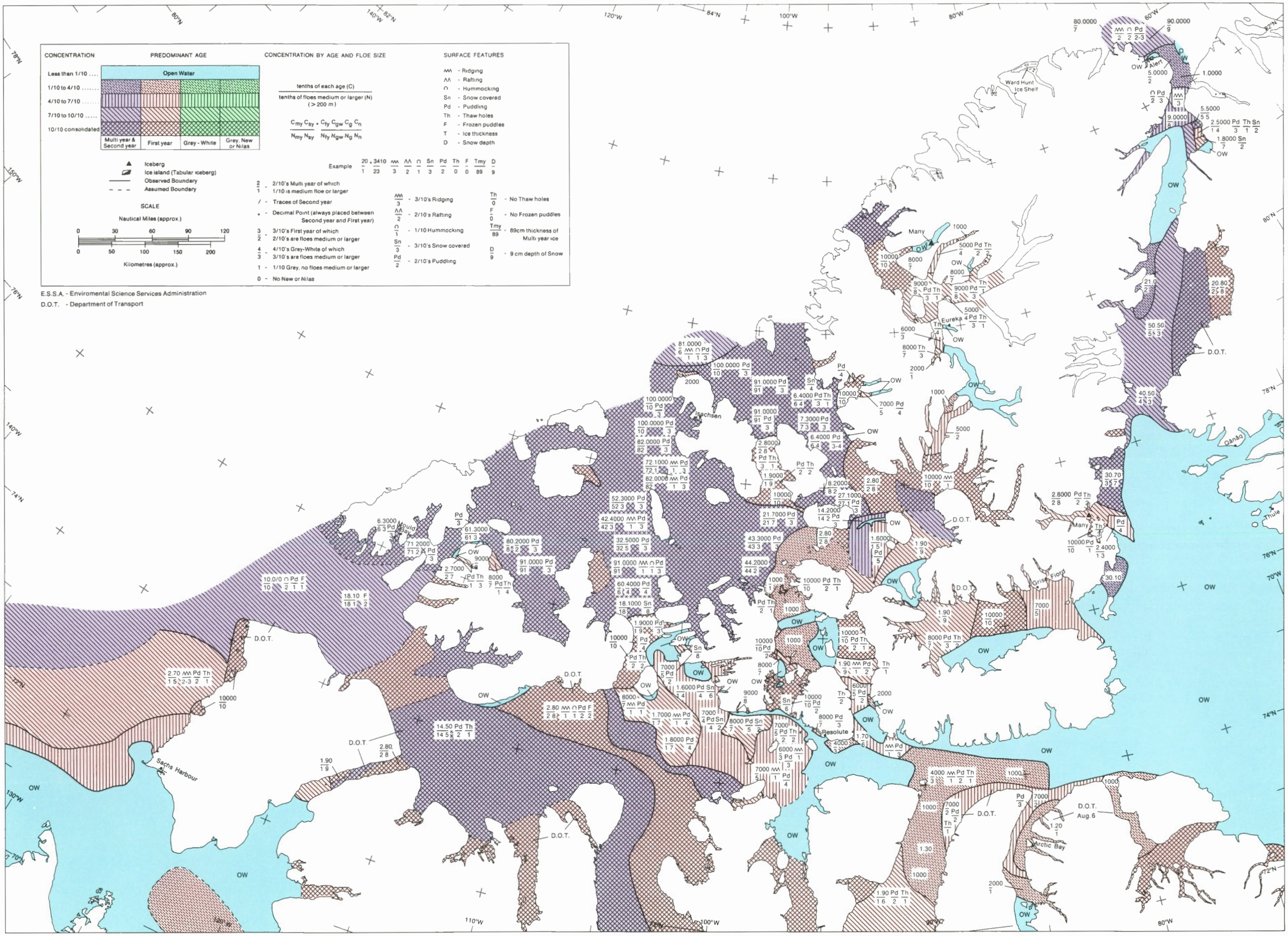
A solid ice cover was observed in Hendriksen Strait on August 9. Usually open water appears in the central part of this strait by this time.

The total ice cover in Wellington Channel usually breaks up all at once and the broken ice rapidly moves south into Lancaster Sound leaving the channel almost ice-free a week after break-up starts. The floe sizes and concentrations noted in Wellington Channel indicated that the ice cover had recently broken and the stream of ice already moving into Lancaster Sound suggested that the southerly export was underway.

A new snow cover masked the ice types near Alert and in the eastern part of Hecla and Griper Bay. The increase in concentrations in Lancaster Sound and northern Prince Regent Inlet likely resulted from ice drifting out of Barrow Strait and Wellington Channel. The ice cover in Smith Bay had recently fractured. This break-up released large numbers of previously trapped icebergs into the western part of Baffin Bay.

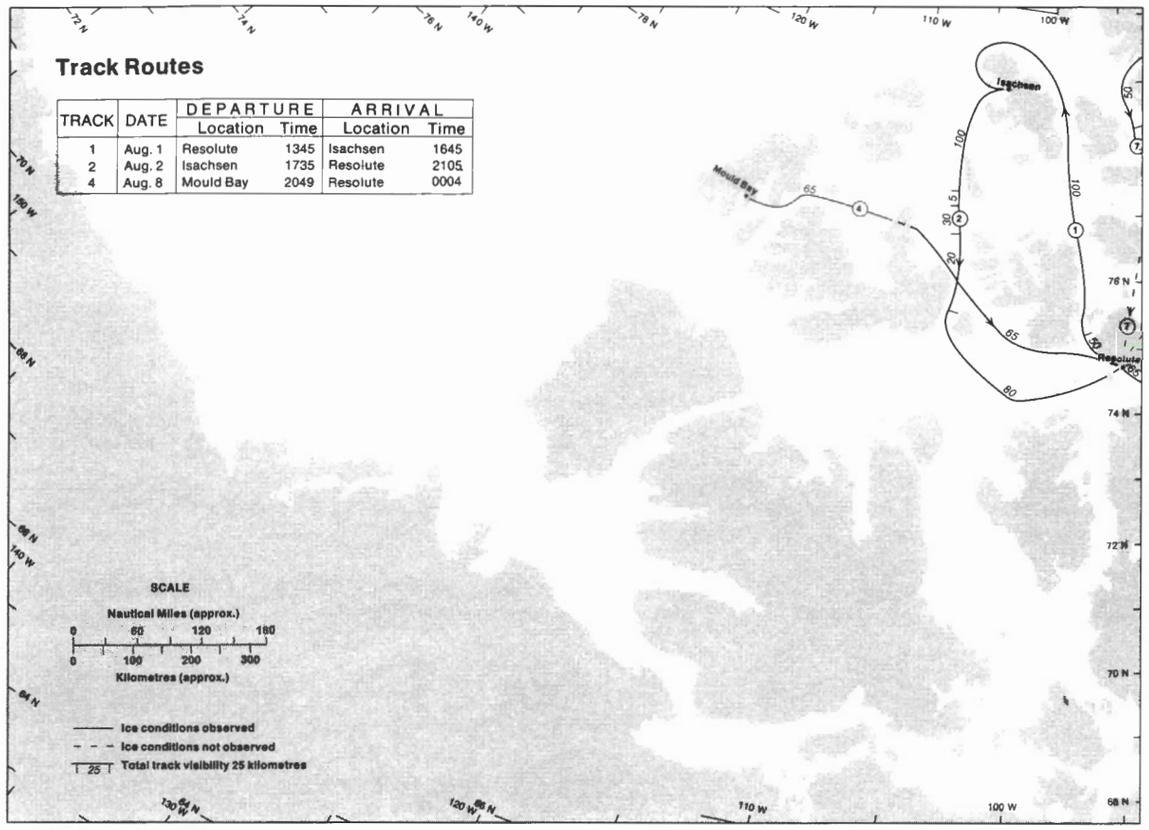
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 5 - 1969 EAST

August 1-9, 1969



MAP 5-1969 West August 1-9

Flight Effectiveness

Delays resulting from poor weather and other demands on the aircraft while it was in the eastern area did not permit time to carry out any surveys in the western area during Flight 5. The available satellite imagery of the western area was not helpful because of extensive cloud. Fortunately, the D.O.T. ice reconnaissance unit was collecting data in the area at the time and Map 5-1969 West is based on this information.

Ice Conditions

While break-up was taking place in the central part of M'Clure Strait and advancing into the southern parts of Kellett Strait and Crozier Strait, the southerly drift of the ice in the Beaufort Sea continued. During the interval between July 27 and August 8 the ice had advanced more than 70 kilometres farther south. Coincident with this invasion, the ice along the north coast of Alaska had moved closer to the coast and the concentrations of ice in this littoral area had increased considerably.

Some ablation and clearing of the ice in Amundsen Gulf had taken place during the two flights and the area was soon to be ice-free. A similar trend was developing throughout the straits separating Victoria Island from the mainland.

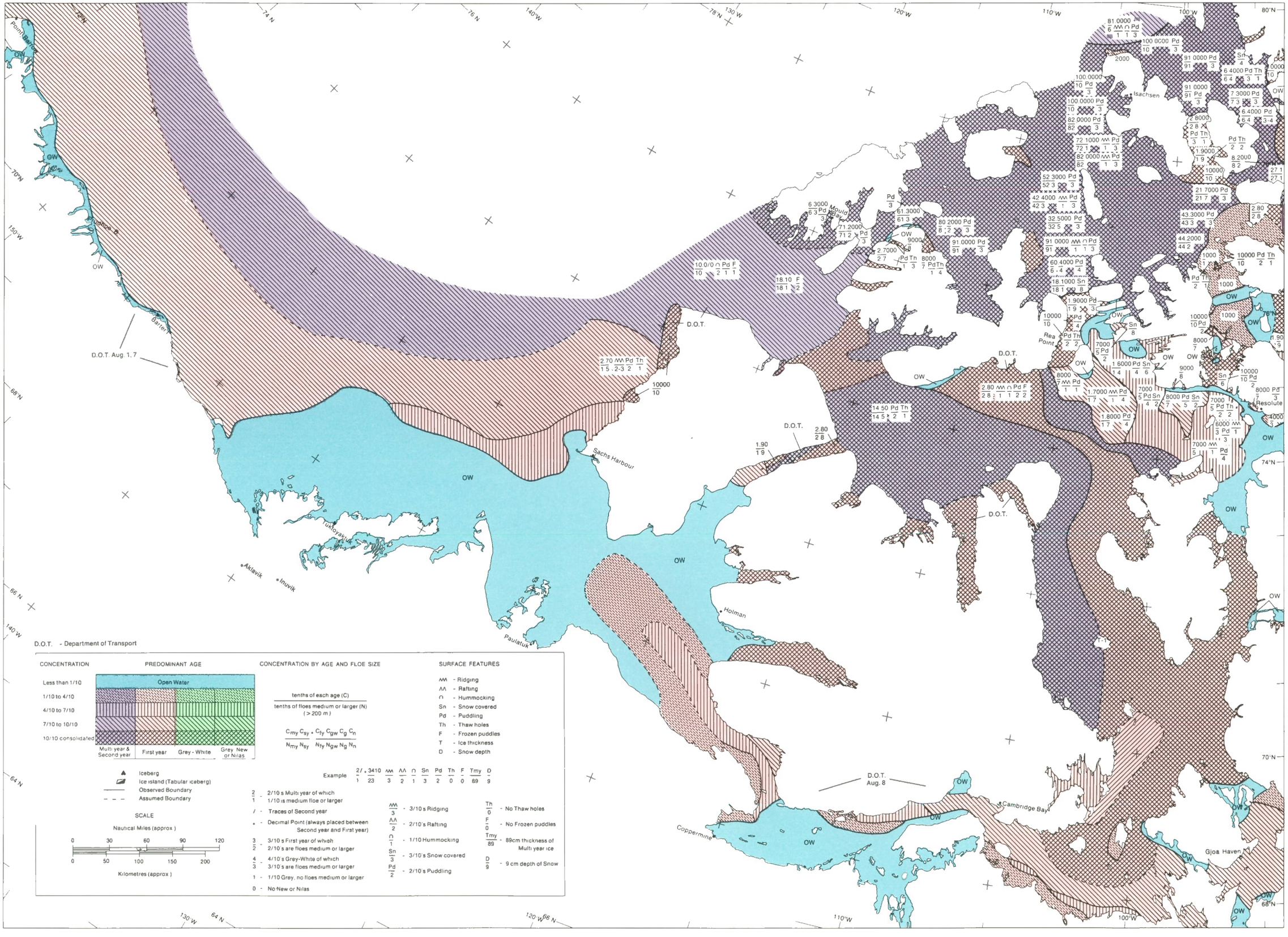
The ice in the southern part of Queen Maud Gulf was starting to move and the solid areas in the northern part would soon break up. The ice cover in Rasmussen Basin had also broken up.

Unobserved Areas

A solid ice cover is shown on Map 5 for Prince Albert Sound and Minto Inlet. Probably these areas had broken up but winds had forced the floes together so that from a distance they might appear solid.

Comments

The large ice island called T-1 was spotted in M'Clintock Channel about 100 kilometres north of Gateshead Island. It was previously located about 25 kilometres south of Cape Stang on October 3, 1966. At this time it was being frozen in for the winter. It was not located in 1967 but it is assumed that no appreciable movement took place. By September, 1968 the ice surrounding the ice island was moving and T-1 drifted east into the central area of M'Clintock Channel where it was seen in August, 1969.



D.O.T. - Department of Transport

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey New or Nilas

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

SURFACE FEATURES

- ʌʌ - Ridging
- ʌʌ - Rafting
- ∩ - Hummocking
- Sn - Snow covered
- Pd - Puddling
- Th - Thaw holes
- F - Frozen puddles
- T - Ice thickness
- D - Snow depth

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

Example $\frac{2/\bullet 3}{1\ \ 2}\ \frac{4}{3}\ \frac{ʌʌ}{3}\ \frac{ʌʌ}{2}\ \frac{∩}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{T_{my}}{89}\ \frac{D}{9}$

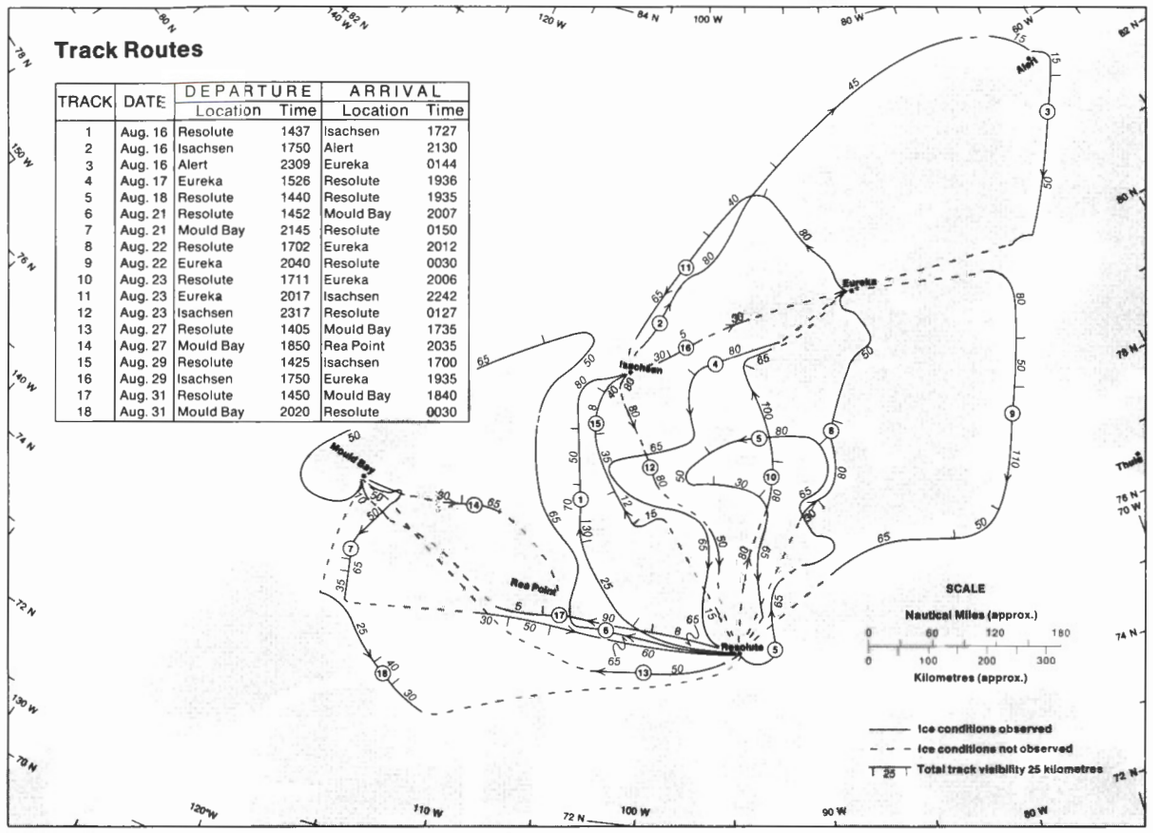
- 2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
- / - Traces of Second year
- • - Decimal Point (always placed between Second year and First year)
- 3/2 - 3/10's First year of which 2/10's are floes medium or larger
- 4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
- 1 - 1/10 Grey, no floes medium or larger
- 0 - No New or Nilas

- ʌʌ/3 - 3/10's Ridging
- ʌʌ/2 - 2/10's Rafting
- ∩/1 - 1/10 Hummocking
- Sn/3 - 3/10's Snow covered
- Pd/2 - 2/10's Puddling

- Th/0 - No Thaw holes
- F/0 - No Frozen puddles
- T_{my}/89 - 89cm thickness of Multi year ice
- D/9 - 9 cm depth of Snow

MAP 5 - 1969 WEST

August 1-9, 1969



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 16	Resolute	1437	Isachsen	1727
2	Aug. 16	Isachsen	1750	Alert	2130
3	Aug. 16	Alert	2309	Eureka	0144
4	Aug. 17	Eureka	1526	Resolute	1936
5	Aug. 18	Resolute	1440	Resolute	1935
6	Aug. 21	Resolute	1452	Mould Bay	2007
7	Aug. 21	Mould Bay	2145	Resolute	0150
8	Aug. 22	Resolute	1702	Eureka	2012
9	Aug. 22	Eureka	2040	Resolute	0030
10	Aug. 23	Resolute	1711	Eureka	2006
11	Aug. 23	Eureka	2017	Isachsen	2242
12	Aug. 23	Isachsen	2317	Resolute	0127
13	Aug. 27	Resolute	1405	Mould Bay	1735
14	Aug. 27	Mould Bay	1850	Rea Point	2035
15	Aug. 29	Resolute	1425	Isachsen	1700
16	Aug. 29	Isachsen	1750	Eureka	1935
17	Aug. 31	Resolute	1450	Mould Bay	1840
18	Aug. 31	Mould Bay	2020	Resolute	0030

MAP 6-1969 East

August 16-31

Flight Effectiveness

Low cloud and fog associated with a semi-stationary low pressure area centred over the arctic islands reduced the effectiveness of most of the surveys conducted over the eastern area during Flight 6. Not only did the poor weather reduce visibility but it grounded the aircraft, thereby increasing the interval required to survey the entire area. Fortunately, data were collected during resupply missions so that the effectiveness of the Flight was increased to about 85 per cent.

Ice Conditions

Break-up was progressing about two weeks ahead of normal, and the patterns of break-up were slightly different from normal in some areas. The ice cover in Maclean Strait and Prince Gustaf Adolf Sea occasionally remains solid throughout the summer season and normally does not break up to the extent shown on Map 6-1969 East until mid-September. Similarly, the ice cover in southern Nansen Sound had fractured earlier. One of the most interesting departures from the normal situation appeared in the vicinity of Ballantyne Strait. Here the ice usually remains solid throughout the season, although a small area of open water may develop between Brock Island and Mackenzie King Island. Rarely does a large amount of open water appear south of Brock Island, and it is unusual for the ice cover around Emerald Island to begin to move before the break-up is completed in Crozier, Kellett and Fitzwilliam Straits. The ice in southern Norwegian Bay and Belcher Channel was more concentrated than is normally expected but the break-up in northern Norwegian Bay and Massey Sound was two weeks ahead of time.

A very rapid clearing had taken place in Peel Sound so that it presented a typical condition for the time of year. The conditions in Prince Regent Inlet were also typical. There had been considerable clearing in Jones Sound but winds had driven the ice into the western end, a rare occurrence.

Normal conditions prevailed in northern M'Clintock Channel and in Penny Strait and Wellington Channel.

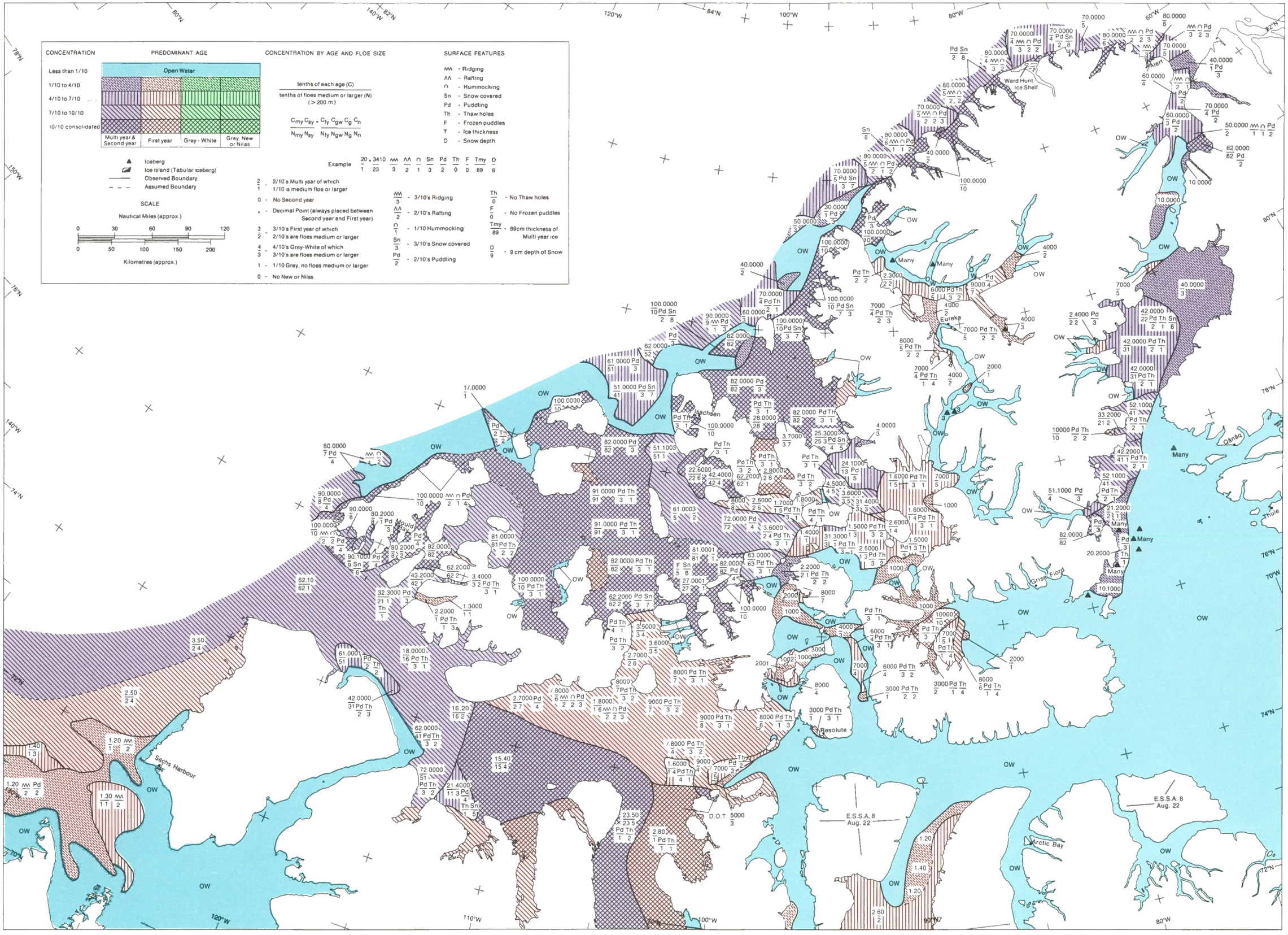
Unobserved Areas

Satellite imagery provided the basic information to interpret the ice conditions in Lancaster Sound and Baffin Bay. Unfortunately, this satellite does not resolve loose concentrations, three tenths or less, and individual floes must be very large to appear on the photograph. It is likely that a few floes existed in the areas indicated as ice-free, but these would not reach concentrations of three tenths nor would they extend across large areas.

Comments

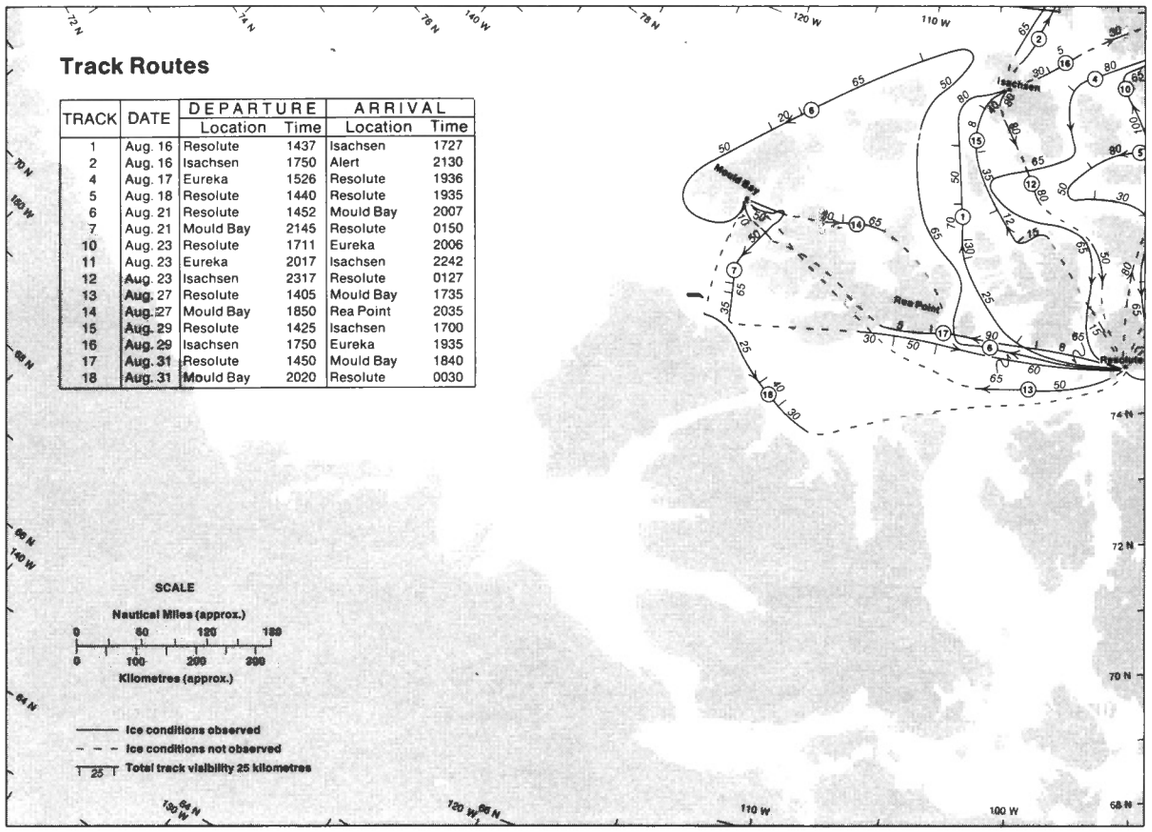
During August very rapid ablation and clearing took place in most areas. Break-up was two weeks ahead of normal but there were some aberrations. The ice cover in McDougall Sound had broken and moved out before the area to the north of Byam Martin Channel fractured. No open water was observed in Danish Strait which is usually half open at this time. Occasionally some open water does appear along the western fringe of the archipelago but it is unusual that the expanse of open water attains the proportions shown on Map 6-1969 East. Although atypical conditions prevailed along the western fringe of the archipelago from Nansen Sound to M'Clure Strait, the distribution and patterns observed between Nansen Sound and Alert were normal.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 6 - 1969 EAST

August 16-31, 1969



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 16	Resolute	1437	Isachsen	1727
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4	Aug. 17	Eureka	1526	Resolute	1936
5	Aug. 18	Resolute	1440	Resolute	1935
6	Aug. 21	Resolute	1452	Mould Bay	2007
7	Aug. 21	Mould Bay	2145	Resolute	0150
10	Aug. 23	Resolute	1711	Eureka	2006
11	Aug. 23	Eureka	2017	Isachsen	2242
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14	Aug. 27	Mould Bay	1850	Rea Point	2035
15	Aug. 29	Resolute	1425	Isachsen	1700
16	Aug. 29	Isachsen	1750	Eureka	1935
17	Aug. 31	Resolute	1450	Mould Bay	1840
18	Aug. 31	Mould Bay	2020	Resolute	0030

MAP 6-1969 West

August 16-31

Flight Effectiveness

No regular surveys were carried out in the western area during Flight 6 because poor weather increased the amount of time needed to map the eastern area and because the aircraft was required to carry out resupply flights in that area.

Ice Conditions

Two contrasting changes had taken place between Flights 5 and 6. The ice-free area in the Beaufort Sea had been invaded by ice ranging in concentrations from three tenths near the coast to eight tenths in the central areas. The southern channels including eastern Amundsen Gulf, Prince of Wales Strait, the straits between Victoria Island and the mainland, Queen Maud Gulf, and Rasmussen Basin which were partially ice-covered on August the 9th were ice-free by August 30.

Break-up had advanced in M'Clure Strait, Viscount Melville Sound in a normal fashion. The conditions noted in M'Clintock Channel appeared to be typical although the clearing in Victoria Strait and Franklin Strait was early.

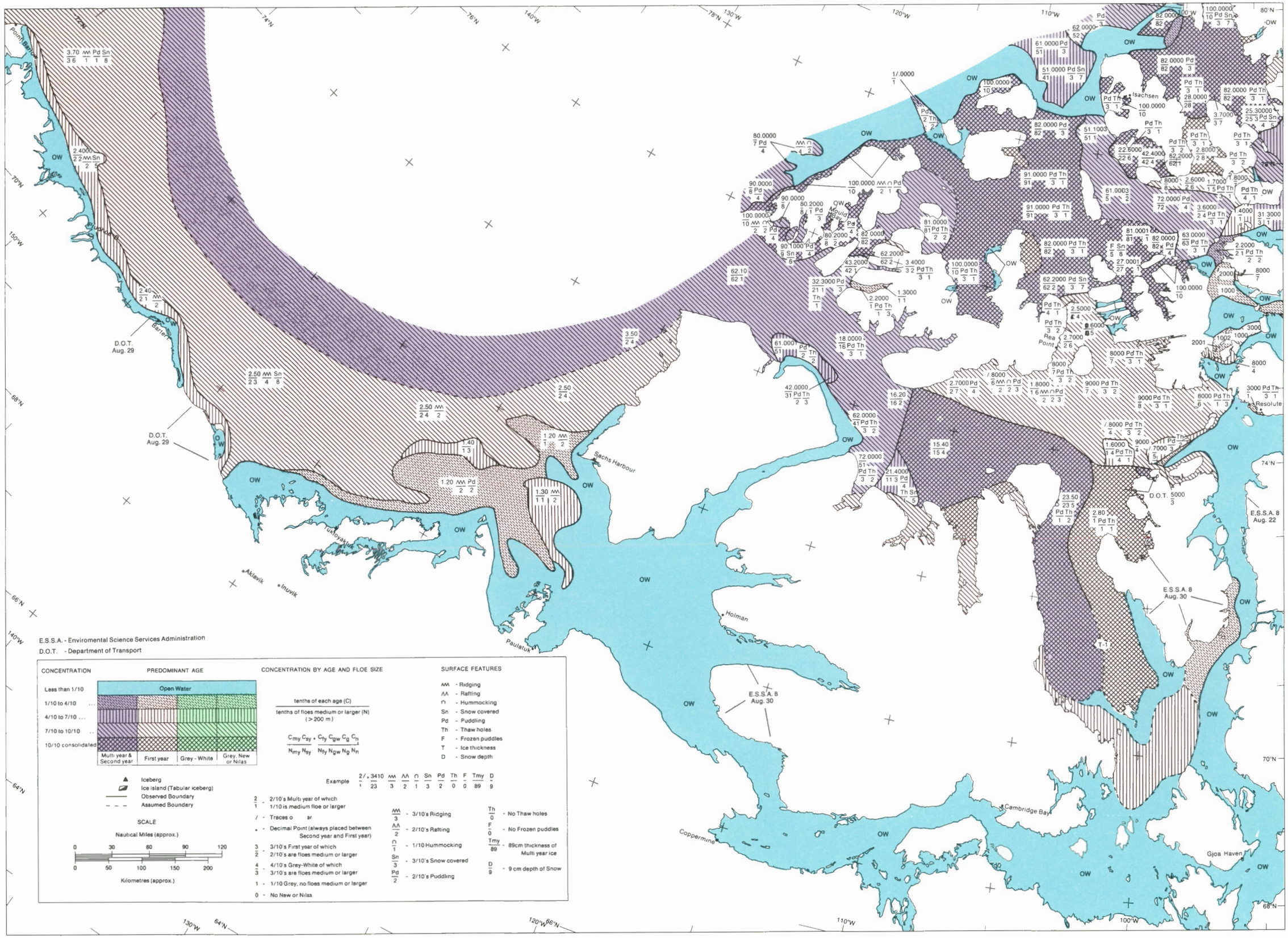
Unobserved Areas

Probably the southern portions of the bays along the north coast of Victoria Island supported smaller concentrations than are shown on the map. Similarly, the solid ice cover shown for M'Clintock Channel, as interpreted from a satellite photograph, likely was crisscrossed with cracks and leads which were too small for the satellite camera to resolve.

Comments

Except for the Beaufort Sea and the offshore areas along the coast of Alaska, the usual patterns of break-up and the typical ice conditions had developed earlier than usual in the areas adjacent to Victoria Island and Prince of Wales Island.

Ice from the Arctic Ocean had continued to move south into the Beaufort Sea. Between August 8 and August 29 the ice had invaded another 60 kilometres and had almost reached the coast. The lack of open water in the Beaufort Sea contrasted with the large ice-free areas along the western fringes of the archipelago. Usually the situation at this time of year is the reverse. A tentative hypothesis to explain this situation assumes a relatively deep semi-stationary low pressure system centred on M'Clure Strait. The winds circulating around this system would tend to move the ice off the coast of the archipelago and force the ice in the Beaufort Sea closer to the mainland and Banks Island.



E.S.S.A. - Enviromental Science Services Administration
D.O.T. - Department of Transport

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N)}\ (>200\ \text{m})}$$

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ \ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2}{1}/\bullet\frac{3410}{23}\ \frac{\wedge\wedge}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

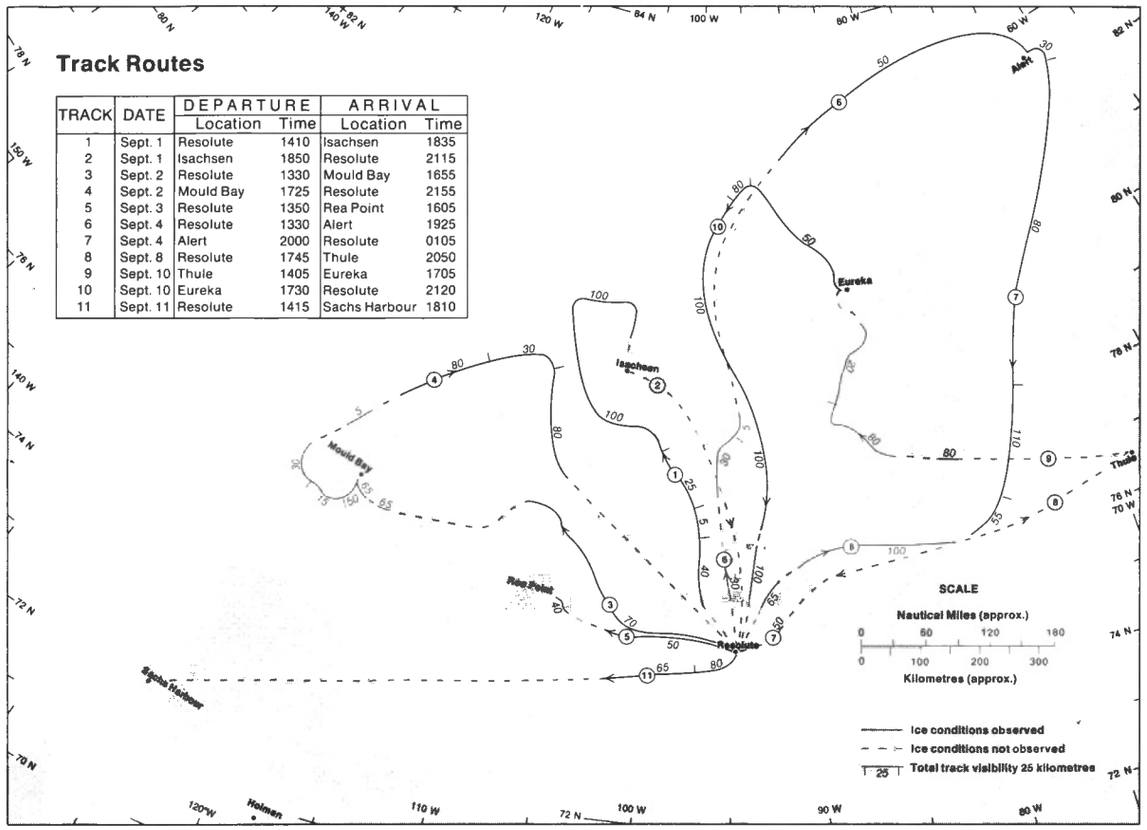
$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces o ar
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{\wedge\wedge}{3}$ - 3/10's Ridging
$\frac{\wedge\wedge}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

∧∧ - Ridging
∧∧ - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Sept. 1	Resolute	1410	Isachsen	1835
2	Sept. 1	Isachsen	1850	Resolute	2115
3	Sept. 2	Resolute	1330	Mould Bay	1655
4	Sept. 2	Mould Bay	1725	Resolute	2155
5	Sept. 3	Resolute	1350	Rea Point	1605
6	Sept. 4	Resolute	1330	Alert	1925
7	Sept. 4	Alert	2000	Resolute	0105
8	Sept. 8	Resolute	1745	Thule	2050
9	Sept. 10	Thule	1405	Eureka	1705
10	Sept. 10	Eureka	1730	Resolute	2120
11	Sept. 11	Resolute	1415	Sachs Harbour	1810

MAP 7-1969 East

September 1-11

Flight Effectiveness

The number of observations made in the eastern region during Flight 7-1969 were reduced due to four days of poor weather which grounded the aircraft and undercast conditions which interrupted the surveys during some part of most of the tracks. In spite of these drawbacks, the horizontal visibility during the workable part of the tracks was very good, given the season. The Flight was judged to be about 85 per cent effective.

Ice Conditions

The ice conditions along the northern coast of Ellesmere Island appeared to be normal. Concentrations and ice types in Nares Strait and Baffin Bay were typical, but the large amount of new ice in Kane Basin was at least two weeks early. Expected patterns of break-up and clearing were observed throughout the entire area to the east of Lougheed Island. The break-up was ahead of its normal rate, but the formation of new ice was also taking place somewhat earlier than usual.

Multi-year ice was beginning to enter the area through Prince Gustaf Adolf Sea. Solid ice covering the northern entrances to Peary Channel, Sverdrup Channel and Nansen Sound stopped the invasion from entering these waters for the moment.

The progression of break-up in the area west of Lougheed Island was unusual. Typically, break-up proceeds toward the north through Byam Martin Channel, Desbarats Strait and to the west of Lougheed Island and finally into Prince Gustaf Adolf Sea. This year the sequence seemed to be reversed.

A similar departure from the usual progression appeared in the Mould Bay area. Usually the solid cover in Kellett Strait and Crozier Strait breaks up first followed by Fitzwilliam Strait and then, if the season is sufficiently advanced, into the area around Emerald Isle. The opposite occurred in 1969.

Large expanses of open water and areas with concentrations less than five tenths were observed along the west coast of the archipelago in the vicinity of Brock Island. Normally this area hosts concentrations of seven tenths or more and the open water is restricted to a sporadic ribbon along the fringes of the archipelago.

The appearance of frozen puddles and new ice indicated that surface ablation in some areas had stopped.

Unobserved Areas

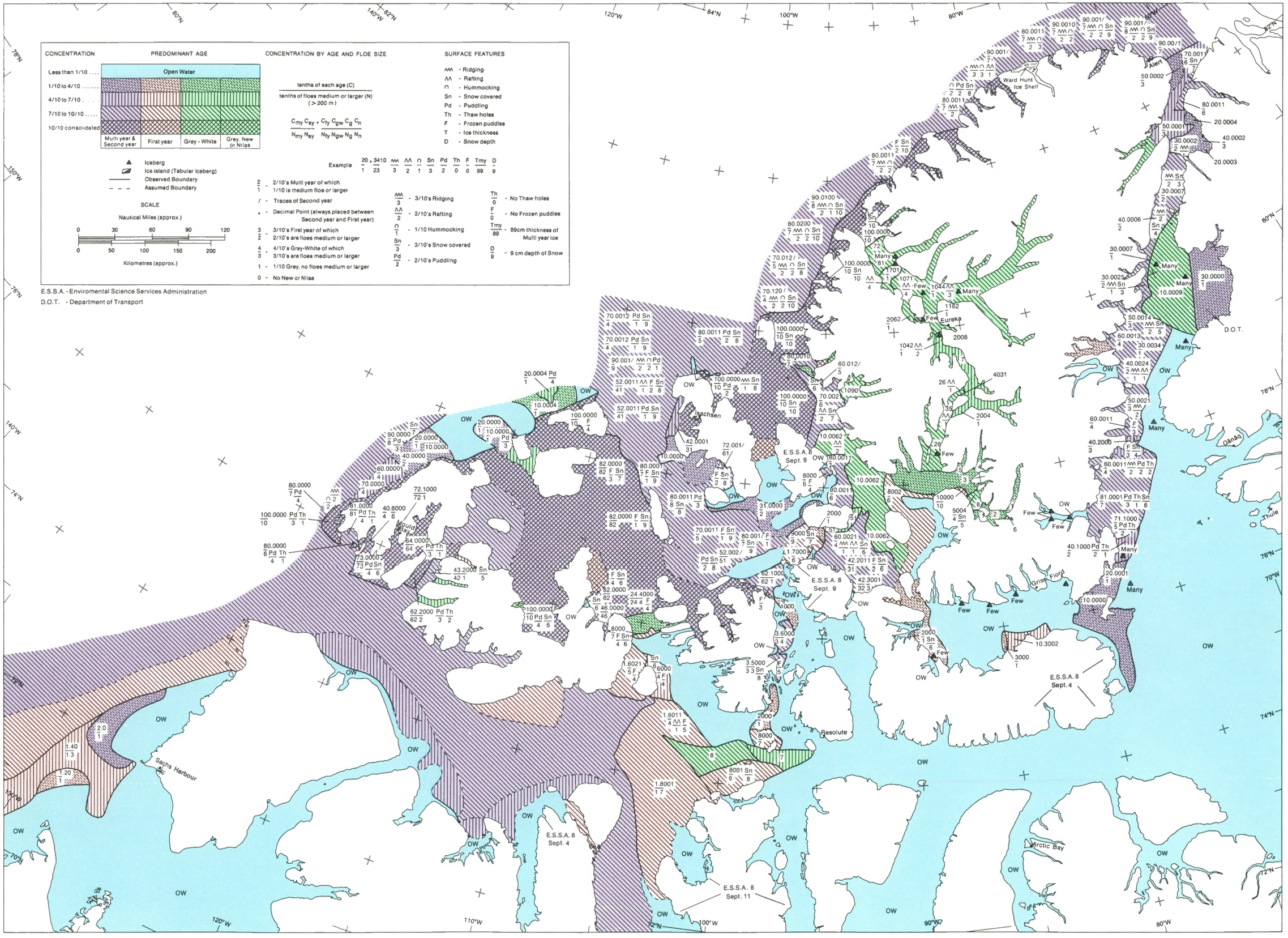
Satellite imagery from E.S.S.A.-8 provided the information for the ice conditions shown in Lancaster Sound, adjoining channels and Baffin Bay. Reports from ships traversing the area between September 1 and 11 confirm that little or no ice remained in these areas.

Comments

Although break-up had occurred about two weeks ahead of normal and gave the impression of a favourable season, the rate of ablation and clearing was closer to the typical situation. Two barges, the "Learmonth" and the "Johnny Norberg", carrying supplies to Rea Point, were caught in the ice, and subsequently sank southwest of Cape Cockburn. Two weeks later the area was ice-free. The "MANHATTAN" entered Lancaster Sound on September 5 but did not encounter ice until south of Resolute on the 6th. Ice conditions, as far as shipping was concerned, worsened toward the west because on September 9th the "MANHATTAN" encountered ice from six to ten feet thick south of Winter Harbour and became stuck in a massive multi-year floe north of Banks Island on September 11. After escaping this floe, the icebreaking tanker headed east and then south to the open water of Prince of Wales Strait.

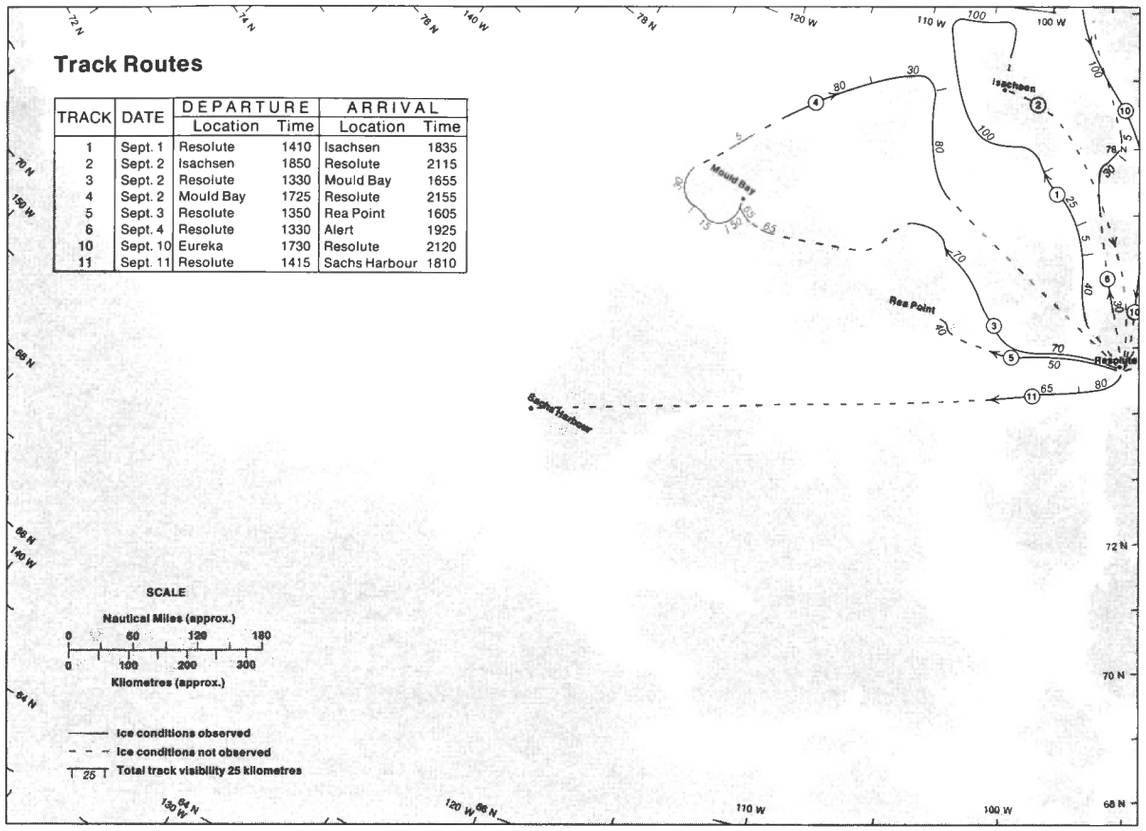
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 7 - 1969 EAST

September 1-11, 1969



Comments

The ice conditions noted in the southern and eastern portions of the Beaufort Sea varied considerably from the normal situation. Usually at this time of year much more open water appears in this area so that an ice-free zone exists south of a line from Sachs Harbour to Herschel Island. The situation was uncommonly poor in the Beaufort Sea.

The ice conditions in the central area between the islands and the mainland were typical. To the east, in the southern part of M'Clintock Channel, the season was much better than usual while the lack of ice in Ommanney Bay was an exceptional departure from the normal situation.

MAP 7-1969 West

September 1-11

Flight Effectiveness

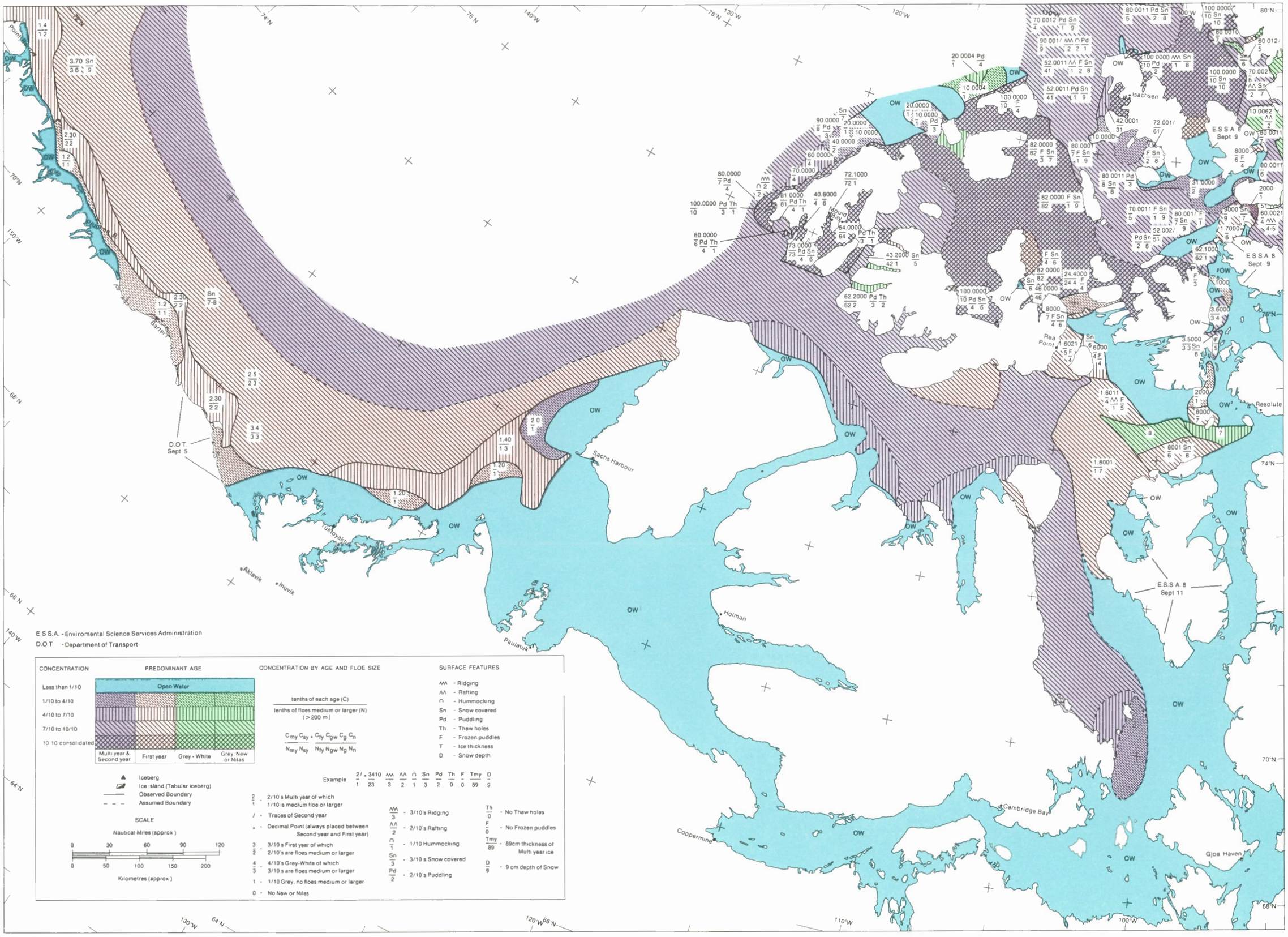
The Polar Continental Shelf Project did not conduct any regular surveys over the western region during Flight 7.

Ice Conditions

A short period separated the dates of observation used to prepare Map 6 and Map 7-1969 West. Consequently, very little change in the overall ice conditions took place in the interval. Only in the eastern portion where 11 days elapsed between observations is there an obvious difference. The ice cover in M'Clintock Channel had broken up and there was some clearing, by melting, of the ice in the southeastern part of M'Clintock and the western part of Franklin Strait. Ice concentrations in these areas were much less than usual for the time of year.

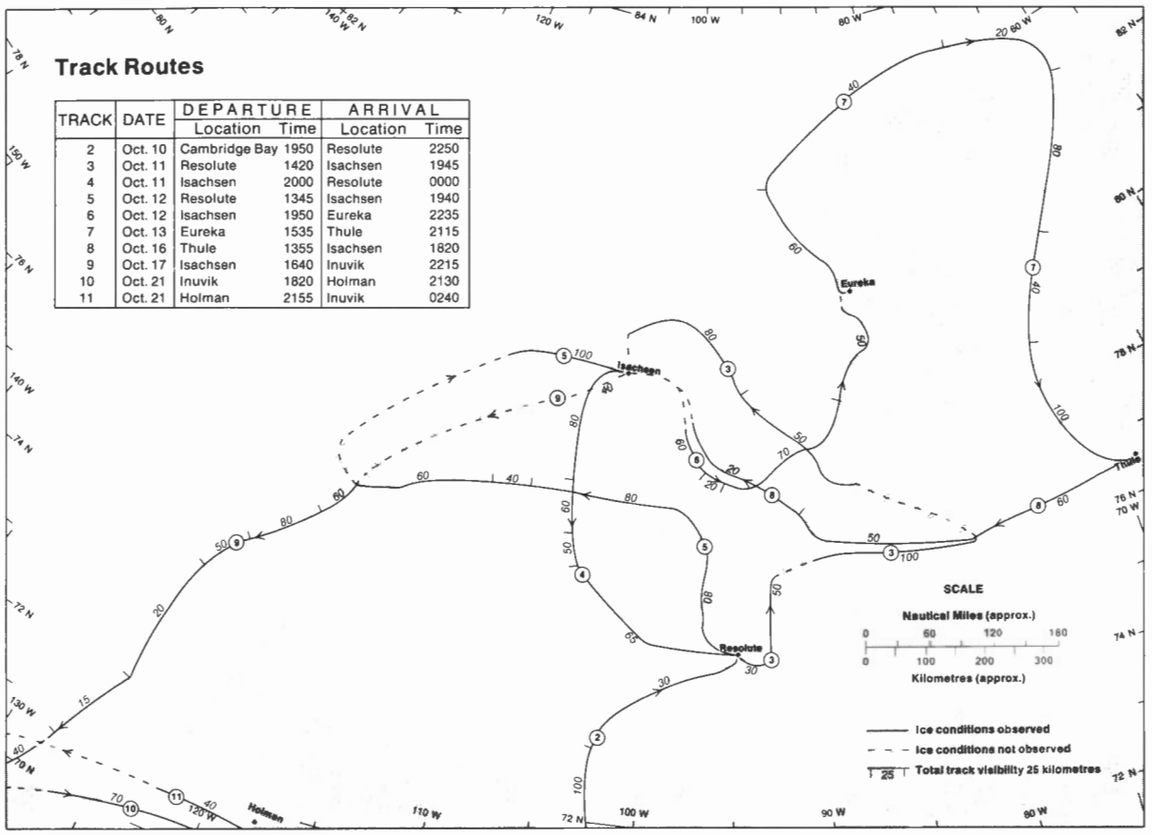
Unobserved Areas

The ice conditions shown on the accompanying map for the large bays along the northern shores of Victoria Island have been interpolated on the basis of conditions observed during similar seasons. The assumed conditions indicated in M'Clintock Channel and Ommanney Bay rely primarily on satellite information. Although a similar distribution in McClintock Channel has appeared in other years, Ommanney Bay seldom becomes totally ice-free. However, the satellite photo was very clear and there were no signs of ice.



MAP 7 - 1969 WEST

September 1-11, 1969



MAP 8-1969 East

October 10-21

Flight Effectiveness

In spite of the usual difficulties encountered during late fall ice reconnaissance surveys including the low sun angle, short periods of daylight, aircraft icing and the return of arctic temperatures, most of the eastern region was observed. The Flight was about 75 per cent effective.

Ice Conditions

During the six-week interval between the ends of Flights 7 and 8, break-up had continued to advance. It reached its maximum extent in mid-October. Nansen Sound was the only northern channel where the ice cover did not break up and, subsequently, permit ice from the Arctic Ocean to move into the archipelago. The major influx came through Prince Gustaf Adolf Sea. Not only is this the largest channel but it broke up much earlier than the rest. Smaller quantities of ice moved south through Peary Channel before it became solid once again. Small amounts would enter through Sverdrup Channel and it is not likely that any appreciable amount moved into the archipelago through Ballantyne Strait.

New ice had started to form in all areas. Many sheltered bays, previously ice-free, had frozen over and would likely remain solid until the next summer. However, movement in the large, northern channels would continue into November and even longer in the main southern straits and sounds.

Unobserved Areas

Likely the concentrations and ice types in the unobserved areas south and east of Ellef Ringnes Island were similar to the conditions noted in the surrounding areas. It is probable that the unobserved parts of Prince Gustaf Adolf Sea, Hazen Strait and Ballantyne Strait supported a moving cover of mainly multi-year ice. Possibly a solid ice cover persisted throughout the season in Wilkins Strait and Hecla and Griper Bay.

The ice conditions along the western fringe of the archipelago had likely returned to normal and resembled the situation observed north of Borden Island.

Comments

Throughout the season a solid ice cover remained on the strait near Mould Bay and on the bays and inlets of northern Bathurst Island. Usually these areas, especially Crozier Strait, break up and to some extent become ice-free. Break-up in 1969 was more advanced than most years, yet both of these areas remained solid.

A solid pattern could be used to show the ice cover on the bay west of Isachsen, but there were a few signs of break-up and movement; thus a broken condition was shown on Map-8.

Between October 10 and 21 the "MANHATTAN" was conducting experiments in the ice in eastern Viscount Melville Sound and in the western portion of Barrow Strait. She tested her strength by gently ramming one small member of a group of ice islands located near the southwest tip of Byam Martin Island and by using various speeds to plough through first-year floes between 1.5 and 2.1 m thick and multi-year floes ranging from 3.5 to 4.3 m thick.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

▲ Iceberg
Ice Island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\,C_{sy} \cdot C_{fy}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy} \quad N_{fy}\,N_{gw}\,N_g\,N_n}$$

Example $\frac{2}{1} / \cdot \frac{3410}{23}$ MM 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{MM}{3}$ - 3/10's Ridging
$\frac{AA}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

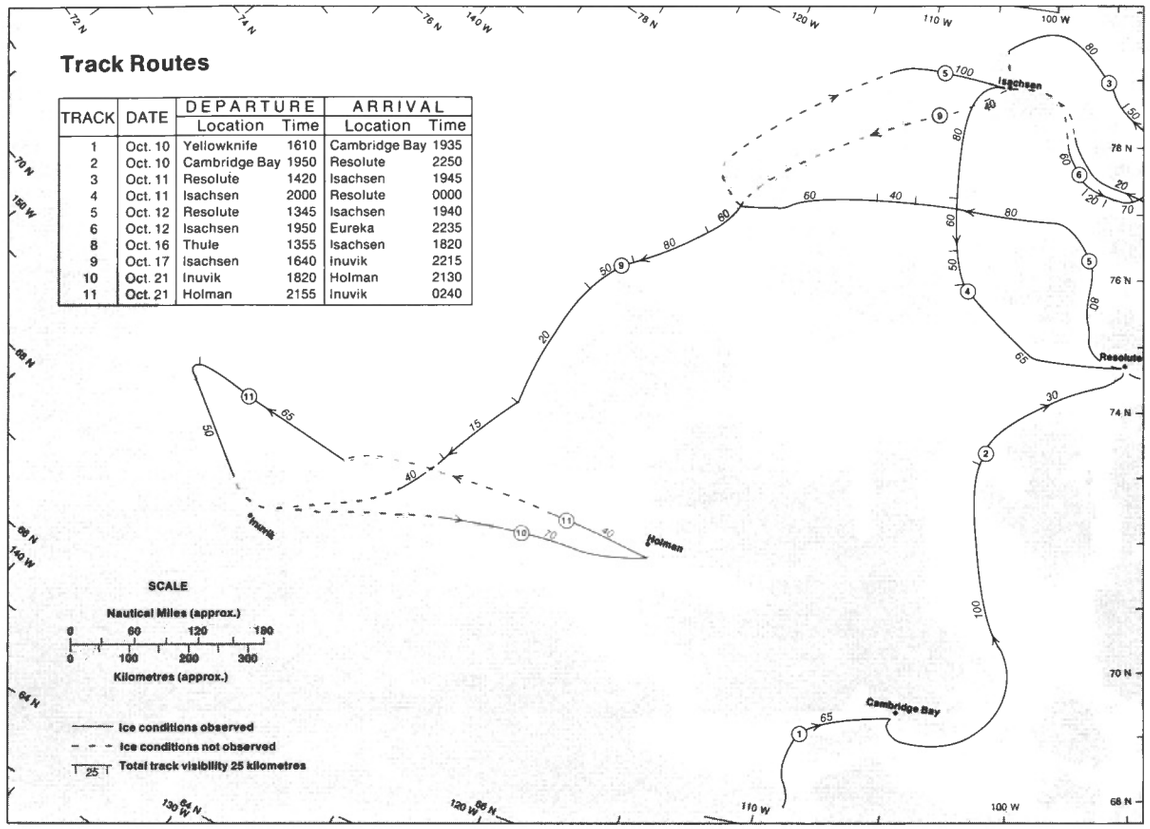
MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

Th 0 - No Thaw holes
F 0 - No Frozen puddles
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow

E S S A - Environmental Science Services Administration
D O T - Department of Transport

MAP 8 - 1969 EAST

October 10-21, 1969



MAP 8-1969 West

October 10-21

Flight Effectiveness

The surveys which were conducted over the western part of the region during Flight 8 were very successful. However, the overall assessment rating for the Flight was only 70 per cent effective because no flights or observations were made in the central part.

Ice Conditions

By the end of Flight 8 the area of open water in the southeastern part of the Beaufort Sea had increased, but it was only half as extensive as it normally appears at this time of year. The concentrations in the central part of the Beaufort Sea were typical, but the amount of multi-year ice in the southern part was less than that noted in other years.

The extent of open water in Amundsen Gulf and the straits separating the islands from the mainland was normal for the second week in October. Much more open water existed in the southern part of M'Clintock Channel than appears in a typical season.

Unobserved Areas

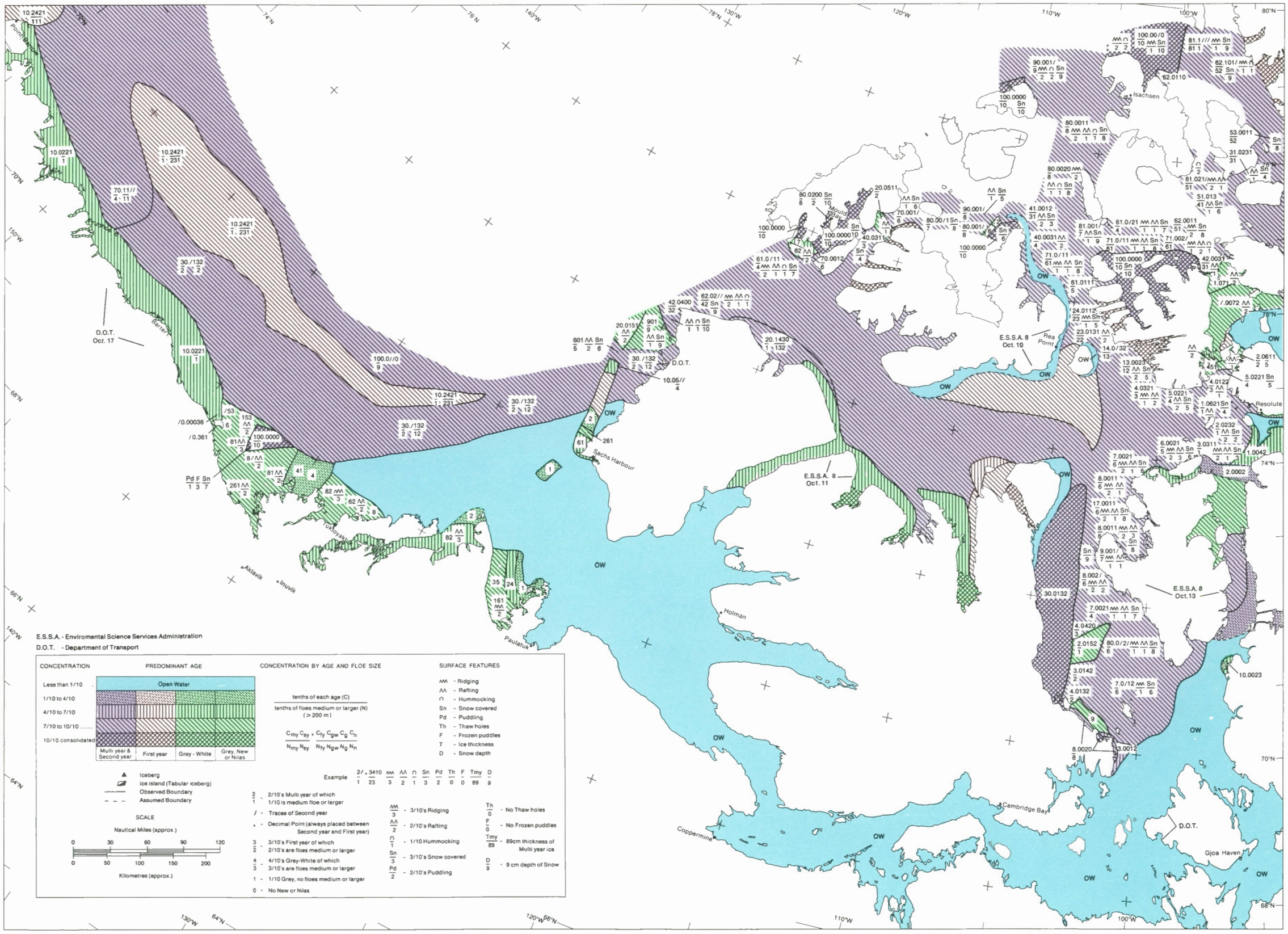
The conditions shown on Map 8 for Amundsen Gulf, Dolphin and Union Strait, Coronation Gulf, Dease Strait and Queen Maud Gulf would prevail until the end of the second week in October.

If the same area was shown in the last week of October new ice would cover southern M'Clintock Channel and would start to appear in the remaining areas.

Comments

A large ice island was sighted in southern M'Clintock Channel half way between Gateshead Island and the east coast of Victoria Island. Likely the mass of ice was T-1 but a low sun angle and a 60 per cent snow cover masked its size. Assuming it was T-1 the island had moved 100 kilometres farther south. The time required for it to move this far is difficult to establish, because the exact date when the ice broke up around it and allowed it to start moving is not known. Judging by the trends and progression of break-up noted in 1969 the ice cover surrounding T-1 had likely started to move by the beginning of September. Thus, in 40 days, the island drifted 100 kilometres further south.

The consolidated area of ice shown on Map 8 along the length of the western part of M'Clintock Channel was a sign of the advancing freeze-up. However, a solid cover would not likely extend throughout M'Clintock Channel until mid-November.



E.S.S.A. - Enviromental Science Services Administration
D.O.T. - Department of Transport

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10 .....
10/10 consolidated

PREDOMINANT AGE

Open Water			
Multi year & Second year	First year	Grey - White	Grey, New or Nilas

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N)}\ (>200\ \text{m})}$$

$$\frac{C_{my}\ C_{sy} \cdot C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ \ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2}{1}/\cdot\frac{3}{2}\frac{4}{3}\frac{10}{\wedge\wedge}\ \frac{\wedge\wedge}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

- $\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
- / - Traces of Second year
- · - Decimal Point (always placed between Second year and First year)
- $\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
- $\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
- 1 - 1/10 Grey, no floes medium or larger
- 0 - No New or Nilas

SURFACE FEATURES

- ^^ - Ridging
- ^^ - Rafting
- ∩ - Hummocking
- Sn - Snow covered
- Pd - Puddling
- Th - Thaw holes
- F - Frozen puddles
- T - Ice thickness
- D - Snow depth

- $\frac{\wedge\wedge}{3}$ - 3/10's Ridging
- $\frac{\wedge\wedge}{2}$ - 2/10's Rafting
- $\frac{\cap}{1}$ - 1/10 Hummocking
- $\frac{Sn}{3}$ - 3/10's Snow covered
- $\frac{Pd}{2}$ - 2/10's Puddling
- $\frac{Th}{0}$ - No Thaw holes
- $\frac{F}{0}$ - No Frozen puddles
- $\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
- $\frac{D}{9}$ - 9 cm depth of Snow

SEASONAL SUMMARY: 1970

The ice conditions during the summer of 1970 were much better as far as break-up and clearing were concerned than most years. However, the 1970 season was not as advanced as 1962 or 1973.

Aside from the fact that the entire 1970 season was better than average, a number of other departures from the normal were noted. At the start, from March to July, it appeared as if the season might be retarded in the eastern part of the region because a solid ice cover extended across Lancaster Sound and Prince Regent Inlet. Typically, the former channel supports a moving ice cover throughout the winter while the latter usually breaks up in May. When the ice cover on both of these channels remained solid and unmoving from March through June it seemed likely that the season would be late.

In the western part of the archipelago the situation was the reverse. The results of early surveys in February and the first regular observations in March indicated a normal distribution although the Bathurst Polynya was slightly larger than most years. A massive westerly drift took place in the Beaufort Sea during April and May and even though some of the ice moved back, the amount of open water present in June was much greater than usual. This ice-free area continued to expand throughout the remainder of the summer, and it reached its greatest extent during the first part of September.

The sequence of break-up in the central archipelago seemed to move along at a normal rate until the middle of July after which it advanced more rapidly especially in Victoria Strait and adjacent channels where ablation and melting progressed much faster than usual.

The ice cover in Prince Gustaf Adolf Sea and the channels connecting it with Parry Channel only breaks up every other year, but in 1970 it broke up much earlier than usual. Even with this early break-up in late August, very little multi-year ice moved south through it and into the archipelago. Similarly, only small amounts of multi-year ice moved into Parry Channel through M'Clure Strait.

In the central, eastern and northern portions of the archipelago two main factors appear to control the ensuing summer sea-ice conditions: these are the amount of multi-year ice present and the amount of insolation which manages to cause ablation. In the western area, specifically the Beaufort Sea, the wind must also be considered when trying to predict subsequent summer ice conditions. In the Beaufort Sea, winds can move vast quantities of ice away from the land leaving large areas of open water much before the time that melting could create the same situation. Map 3-1969 West provides an excellent example of the effect of offshore winds. At the other extreme, onshore winds are responsible for driving the pack ice toward the coast thereby reducing the area of open water, see Map 7-1969 West. Although the general ice regime in the Beaufort Sea has been fairly well established, it is not yet feasible to make long-range predictions for more than one month ahead because it is impossible to forecast the winds that far in advance. The degree of influence the wind has on the ice varies considerably depending on a number of variables but all ice covers are affected in some measure by the wind.

During the spring of 1970 winds moved the ice in the southeastern part of the Beaufort Sea about 200 kilometres to the west allowing the formation of a large area of new ice which ablated early in the summer and left a considerable area ice-free several weeks before usual. A camp established on the ice in the Beaufort Sea moved a net distance of about 180 kilometres during the period from March 28 to April 25.

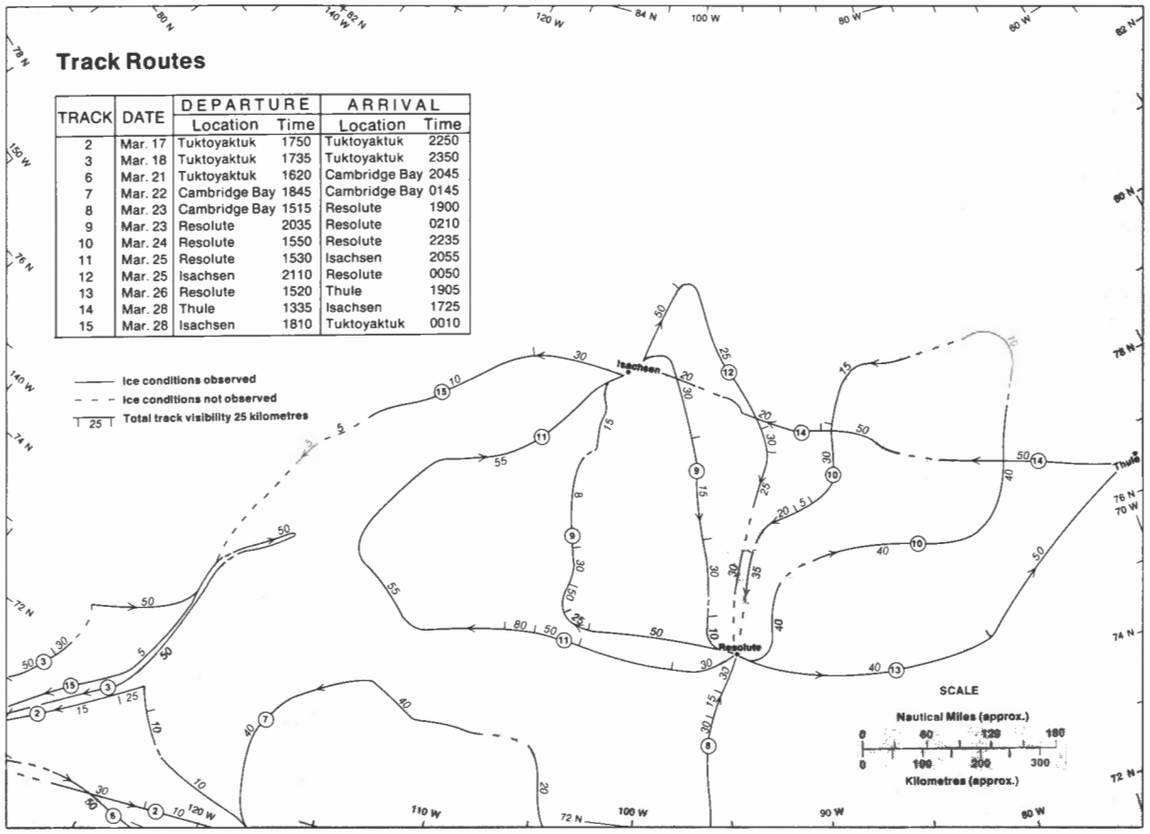
In the future, especially in the central and northeastern parts of the archipelago, it may be possible to predict the general type of ice conditions and the type of ice year, a few weeks in advance, by observing the ice conditions in a few specific indicator areas. From the data gathered during the 1970 season it is evident that neither Lancaster Sound nor Prince of Wales Strait can be relied on to indicate the subsequent ice conditions. If it were assumed that because these areas remained solid much longer than usual, the ice concentrations during the following summer would be worse (more concentrated) than usual; the assumption would be totally incorrect.

In 1970 the season was much better (much melting and more open water) than normal.

Occasionally, the weather systems affecting the archipelago during the fall seem to cross the region at regular intervals. If a flight is conducted between systems the visibilities are good and the results, like Flight 7-1970, are very good. More often, however, an autumn flight is made when one of the systems is crossing the area so that visibilities are restricted and the results are relatively poor as in Flight 6-1970 East. Although considerable effort is made to make the surveys between systems they are so frequent in the fall that visibilities and general observing conditions are not as good as those in the spring.

The ice island, T-1, located in the southern part of M'Clintock Channel, moved a net distance of 18 kilometres to the east from a position at 70° 43'N, 101° 35'W on July 5 to 70° 40'N, 101° 05'W where it was centred on October 14. During the summer of 1970 large portions broke away from the main ice island and its size was reduced from an estimated 24 by 30 kilometres on July 5 to 13 x 16 kilometres on October 14, thus losing about 75 per cent of its total area during the four-month interval.

The ice-breaking tanker "MANHATTAN" returned to the arctic and carried out trials in the ice of Pond Inlet from May 15 until May 24. These tests were conducted in first-year ice averaging 170 cm thick.



MAP 1-1970 East

March 17-28

Flight Effectiveness

The overall results of the surveys carried out over the ice in the eastern part of the archipelago during Flight 1 were not favourable compared with the first surveys conducted in other years. Horizontal visibility during most tracks was reduced by low cloud and/or haze. Aircraft instrument problems combined with drifted landing strips reduced the effectiveness to about 75 per cent.

Ice Conditions

A solid and unmoving ice cover extended across the majority of the channels in the eastern part of the archipelago. Even Hell Gate was almost totally covered. Usually at this time of year the ice in Lancaster Sound is in motion as far west as a line from Limestone Island north to Devon Island. Occasionally the ice cover in the northern part of Prince of Wales Strait is in motion at this time of year. The solid cover over both these channels was unusual. However, a thin snow cover and a fresh zig-zag ridging pattern in central Barrow Strait south of Griffith Island indicated that the ice floes in this area had recently frozen together to form a solid ice cover. Probably a similar condition developed in Prince of Wales Strait and Lancaster Sound.

The snow cover in all areas observed during Flight 1-1970 East was ten tenths unless shown as otherwise on the accompanying map.

Unobserved Areas

The ice conditions in Eureka Sound, Nansen Sound and Nares Strait shown on Map 1-1970 were based on those observed in these areas during the second Flight. It is very unlikely that any major changes in the ice conditions in these channels took place during the interval between the two surveys. The ice conditions along the northern fringe of Ellesmere Island would be almost identical to those shown on Map 2-1970 East. Along the north coast of Axel Heiberg Island the moving pack of the Arctic Ocean gradually moved southward along the fringe of landfast ice which extended less than a kilometre along the shore from the main headlands.

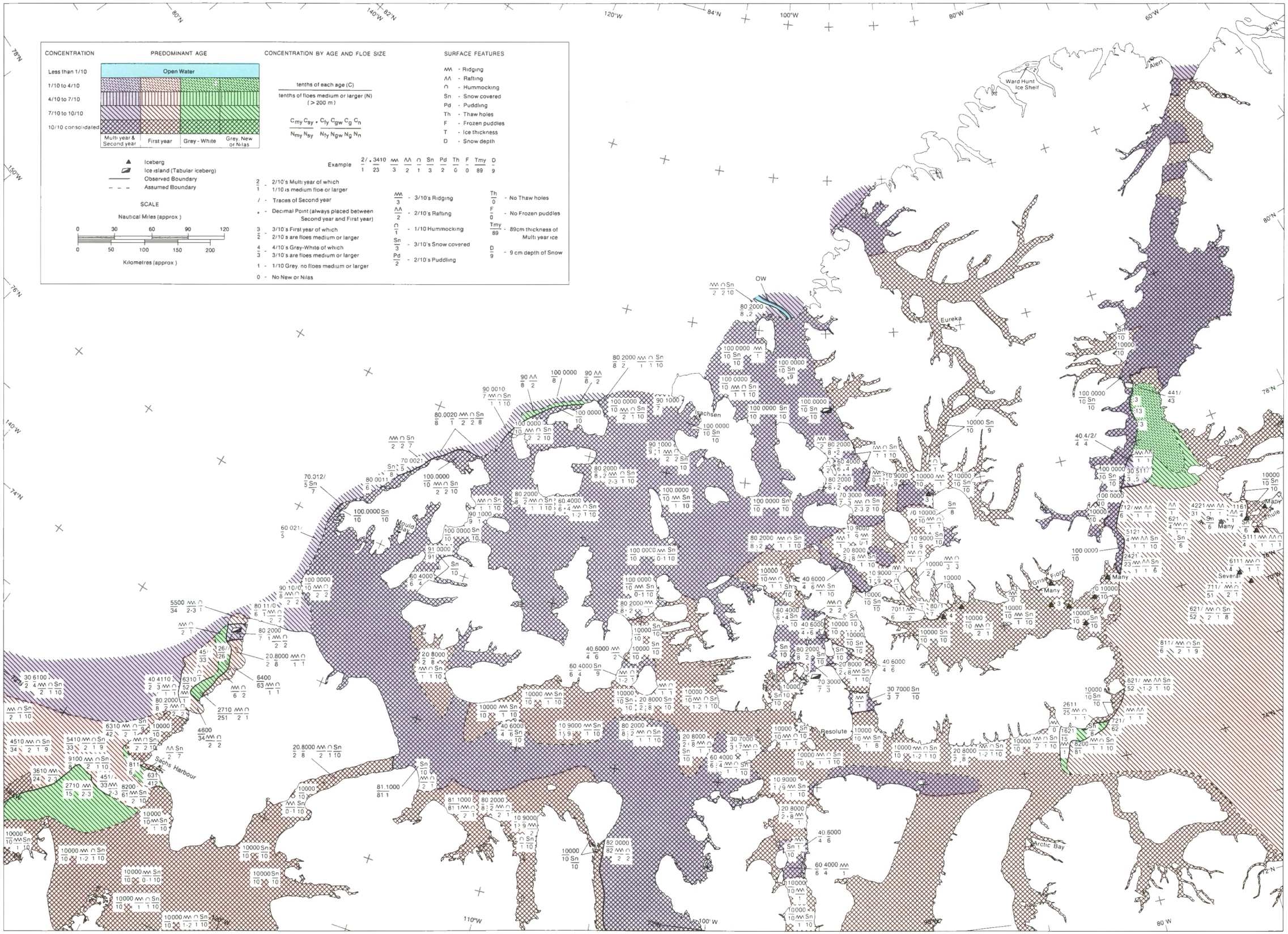
The fractions indicating the ice types and the surface features in Prince Gustaf Adolf Sea cover the remains of two featureless pieces of ice shelf which were observed about 40 kilometres west of Mackenzie King Island. The diameter of each of these pieces did not likely exceed two kilometres. The ice island noted in Massey Sound had an area slightly greater than 100 metres square and a number of smaller pieces accompanied it.

Comments

Freeze-up during the fall of 1969 was relatively quiet and, although some movement did result after Flight 8-1969, no unexpected changes took place. A comparison of Map 8-1969 East with Map 1-1970 East shows that the ice north of Byam Martin Channel stopped moving and allowed most of the multi-year ice in the channel to drift south through it. A similar sequence of events might explain the differences in ice distributions in the vicinity of Penny Strait.

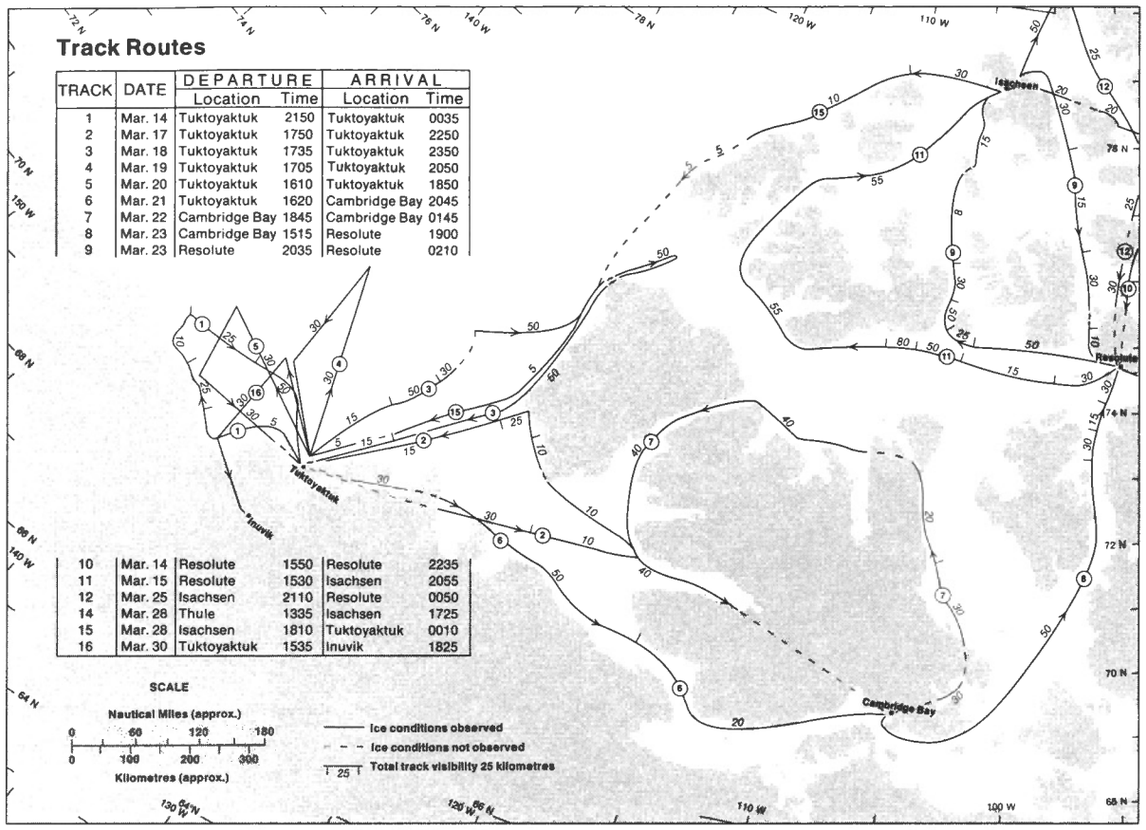
There were several aberrations noted during the course of Flight 1-1970 East. No areas of open water were observed in Hell Gate, Cardigan Strait, or to the north of Baillie-Hamilton Island. The most obvious deviation appeared in Lancaster Sound and to some extent Prince Regent Inlet where a solid, unmoving ice cover extended throughout these channels.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 1 - 1970 EAST

March 17-28, 1970



MAP 1-1970 West

March 14-30

Flight Effectiveness

Low cloud and haze restricted visibility during most of the surveys carried out over the western region during the first Flight of the 1970 season. The results of the Flight were good despite the weather because more than the usual number of tracks were completed. The Flight was 85 per cent effective.

Ice Conditions

The area of first-year ice noted in the Beaufort Sea was much larger than might be expected considering the extent and distribution of multi-year ice shown on Map 8-1969 West. However, in the Beaufort Sea, it is normal to observe mostly multi-year ice in the fall and mainly first-year ice in the spring. The concentration of multi-year ice observed in the northern part of the sea was much greater than normal.

Other departures from the normal were relatively minor. For instance, it is unusual to find a broken ice cover in the eastern parts of Amundsen Gulf in March. The amount of movement in these areas would be very slight and would soon cease as new ice formed to consolidate the ice cover once again. Typically, a band of unmoving, landfast ice extends along the entire length of the west coast of Banks Island. This solid fringe was present only in the south. Later in the season the landfast area developed and reached its normal width. See Map 3-1970 West.

Typically, Bellot Strait remains ice-free most of the year; the condition shown on Map 1-1970 was likely a temporary one.

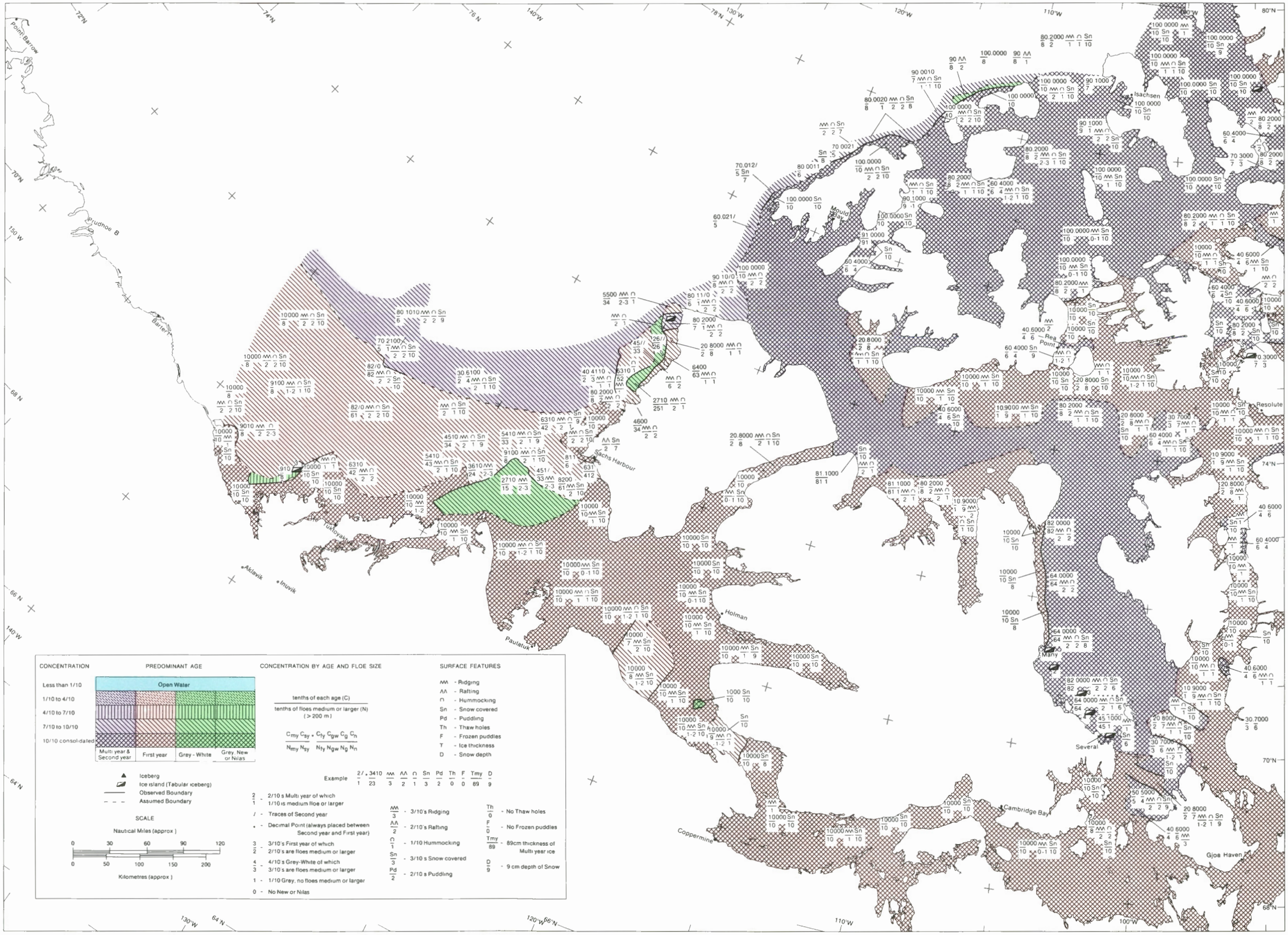
Unobserved Areas

Numerous ice islands and fragments were observed some of these not being shown on Map 1-1970 West. The three small pieces, each the size of a football field, shown 65 kilometres northwest of Pullen Island, were accompanied by a number of smaller chunks. Another group of small fragments were noted on March 18 about 90 kilometres north of Tuktoyaktuk at 72° 10'N, 134° W.

The ice island shown near the northwest tip of Banks Island was triangular and measured about one kilometre per side.

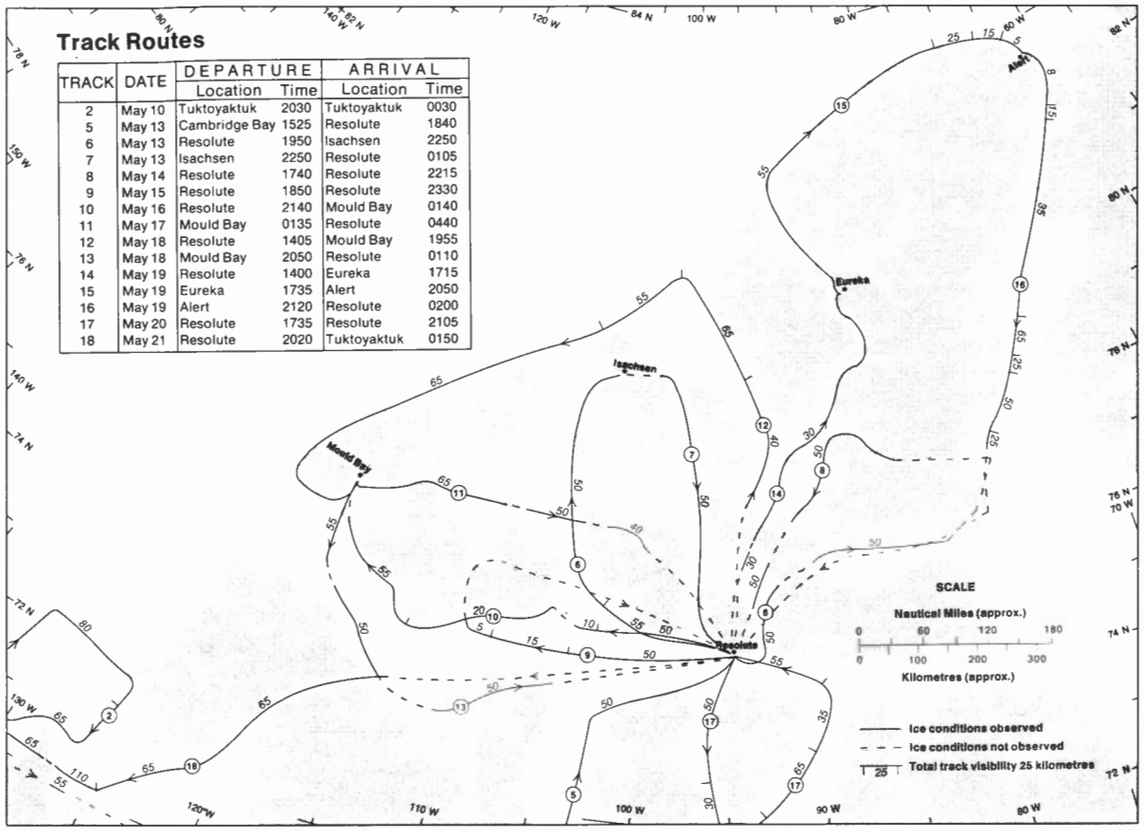
Comments

As in previous seasons the Polar Continental Shelf Project established a camp on the ice in the Beaufort Sea to serve as a base for hydrographic surveys. Camp 200-1970 was established on an ice floe 3.6 m thick on February 24 at 72° 54'N, 135° W. The program completed, the camp was evacuated 60 days later on April 25th when it was located at 72° 38'N, 142° 02'W. The overall drift was in a westerly direction, a net distance of 446 kilometres and a gross distance of 469 kilometres. The rate of drift varied considerably. During a 24-hour interval spanning March 6 and 7, the floe travelled quickly to cover a distance of 32 kilometres. Other days practically no drift occurred. The mean net drift rate throughout the two-month interval was seven kilometres per day which is slightly faster than other drifts noted at similar times in the same area.



MAP 1 - 1970 WEST

March 14-30, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	May 10	Tuktoyaktuk	2030	Tuktoyaktuk	0030
5	May 13	Cambridge Bay	1525	Resolute	1840
6	May 13	Resolute	1950	Isachsen	2250
7	May 13	Isachsen	2250	Resolute	0105
8	May 14	Resolute	1740	Resolute	2215
9	May 15	Resolute	1850	Resolute	2330
10	May 16	Resolute	2140	Mould Bay	0140
11	May 17	Mould Bay	0135	Resolute	0440
12	May 18	Resolute	1405	Mould Bay	1955
13	May 18	Mould Bay	2050	Resolute	0110
14	May 19	Resolute	1400	Eureka	1715
15	May 19	Eureka	1735	Alert	2050
16	May 19	Alert	2120	Resolute	0200
17	May 20	Resolute	1735	Resolute	2105
18	May 21	Resolute	2020	Tuktoyaktuk	0150

MAP 2-1970 East May 10-21

Flight Effectiveness

The overall results of Flight 2-1970 East were very useful in spite of the low clouds and fog patches which reduced visibility during some part of most of the tracks. The Flight was at least 85 per cent effective.

Ice Conditions

Very few changes had taken place in the eastern region since the previous flight. Those changes which did develop in the interval normally occur at this time each season. An area of open water developed in the southern parts of Hell Gate and Cardigan Strait. The area of new ice associated with North Water in Smith Sound and northern Baffin Bay expanded. Small areas of open water developed in Penny Strait and along the north shore of Baillie-Hamilton and Dundas Islands. Normally open areas appear earlier in the season at the latter two sites.

The solid ice cover over Lancaster Sound was a considerable departure from normal. Usually a moving ice cover of nine tenths or less occupies this channel at this time of year. When Prince Regent Inlet was observed on May 20 it appeared to be completely solid. Pilot reports prior to this survey indicated that a lead had formed in the southern part of the channel. See Map 2-1970 West. Normally the ice in this area is unstable and large floes may break off from the main body and drift a few kilometres south before moving back to their original position a few days later. The southerly movement can take place because the ice cover in the Gulf of Boothia usually remains in motion throughout the winter and northerly winds may concentrate this ice sufficiently to allow the lead to appear across the southern part of Prince of Wales Strait and then disappear when the winds change.

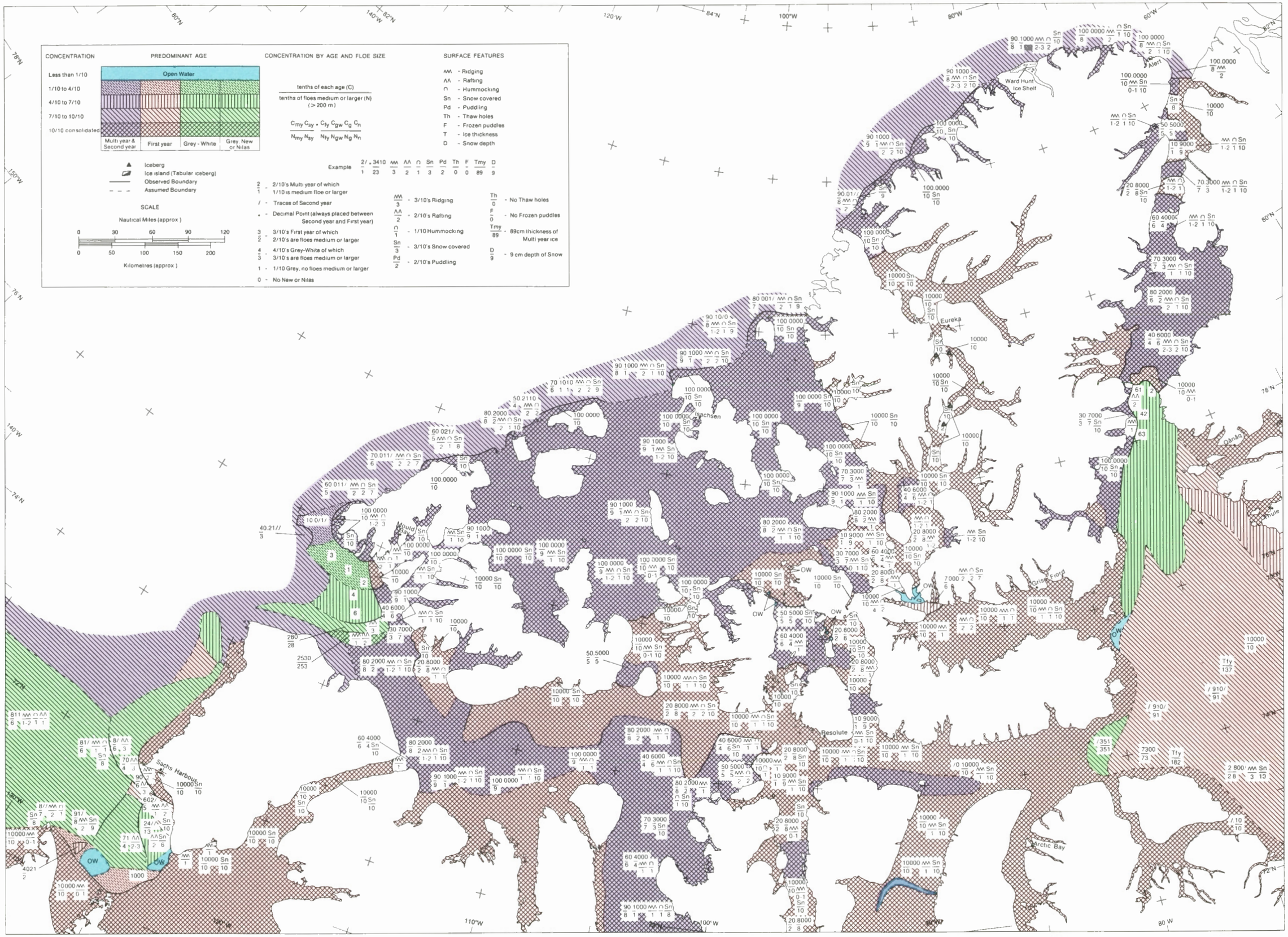
Unobserved Areas

The ice conditions in Baffin Bay were derived from E.S.S.A.-8 satellite photos on May 15 and on shipboard observations made onboard the "MANHATTAN" as she crossed Baffin Bay and headed for Lancaster Sound and Pond Inlet. Observations from the ship indicated that the average thickness of the ice in Baffin Bay was approximately 150 cm.

The icebergs shown in Jones Sound on Map 1-1970 East were not observed during Flight 2-1970 East and so they do not appear on the accompanying map even though they remained in the same place. One iceberg was observed 20 kilometres east of Bellot Strait but could not be shown on Map 2-1970 East because it was observed south of the border of the map.

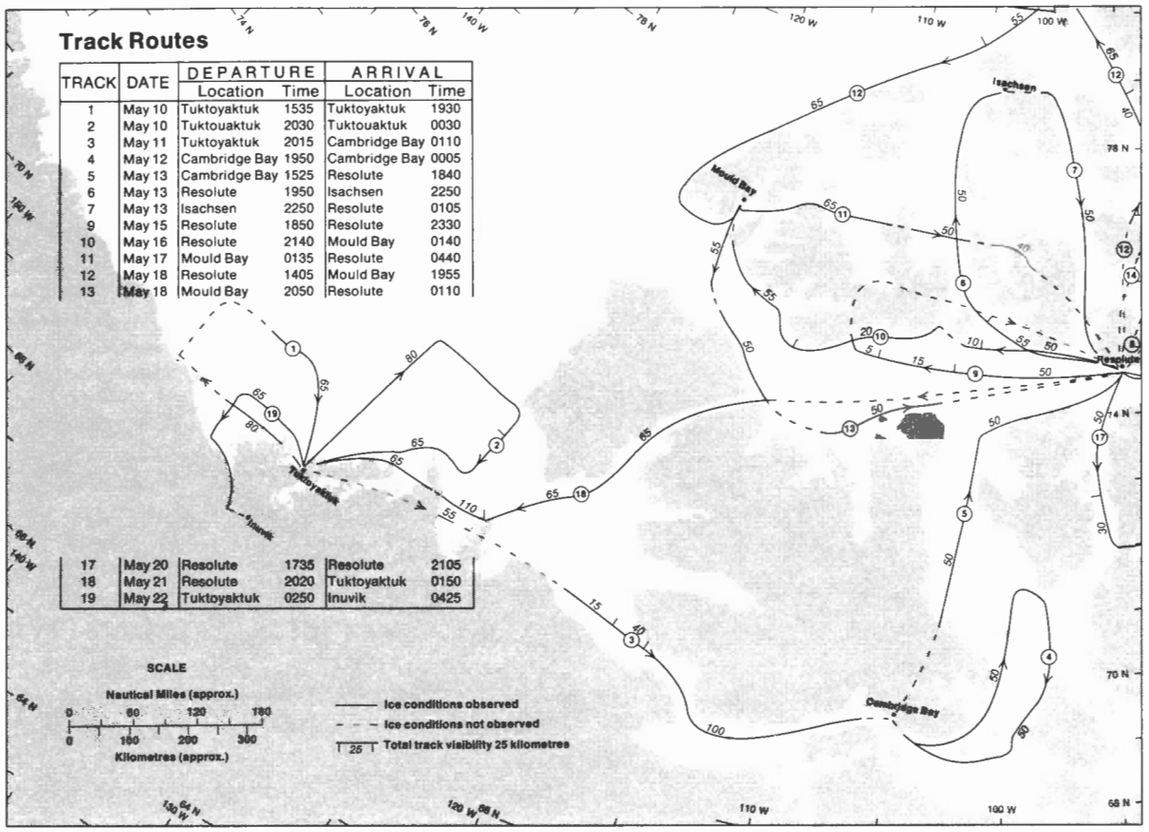
Comments

The icebreaking tanker "MANHATTAN" entered Baffin Bay on April 10 to undergo her second set of ice trials in the Canadian Arctic Archipelago. The northbound route through the ice along the Greenland coast continued until April 30 when she headed due west across Baffin Bay toward Lancaster Sound. After moving about 80 kilometres into the eastern entrance of the sound she turned around on May 5 and moved along the east coast of Bylot Island and entered Pond Inlet on May 14. The thicknesses of ice encountered varied considerably: the eastern part of Lancaster Sound was 76 cm thick and to the west of Bylot Island it ranged from 1.2 to 2.1 metres. Tests were conducted in Pond Inlet from May 15 to 23 in ice ranging from 91 cm to two metres thick. The mean mid-May thickness in the eastern part of Pond Inlet was 1.7 m while the mean thickness for the same area in early March was 1.4 m. The "MANHATTAN" departed from Pond Inlet on May 24, moved east across Baffin Bay, turned south along the coast of Greenland on June 4 and left Baffin Bay on June 7.



MAP 2 - 1970 EAST

May 10-21, 1970



MAP 2-1970 West May 10-22

Flight Effectiveness

The ice conditions in a few parts of the western half of the archipelago remained unobserved at the end of Flight 2. The few areas not observed due to low cloud, fog and aircraft icing only slightly reduced the overall effectiveness of Flight 2-1970 West which was judged to be almost 90 per cent effective.

Ice Conditions

Considerable unexpected changes in ice conditions had occurred in the Beaufort Sea and M'Clure Strait during the interval between March 28 and May 10. In both areas, especially the Beaufort Sea, large amounts of new ice had appeared. Other changes such as the eastward expansion of the Bathurst Polynya and the development of an ice-free area in Dolphin and Union Strait were anticipated and were growing in a normal manner and at the usual rate. The areas of moving ice in eastern Amundsen Gulf and western Dolphin and Union Strait had frozen again and had stopped shifting. No changes in the surface ice conditions, including ridging and snow cover, had occurred on the channels between Amundsen Gulf and Cambridge Bay during the interval from March 21 to May 11.

Unobserved Areas

The ice conditions in M'Clure Strait and along the west coast of Banks Island were not observed during the routine sea ice reconnaissance surveys, but the information shown was collected by pilots during regular supply flights to scientific field parties.

A number of ice island fragments were observed along the west coast of Victoria Island in the northwest part of Victoria Strait.

On May 21 the ice conditions on the Mackenzie River were observed. A ten tenths cover of thick first-year ice extended from the mouth to the bend at Tununuk. From this point a nine tenths concentration of thick first-year ice bounded by one tenth of open water along the shore lines extended to Point Separation.

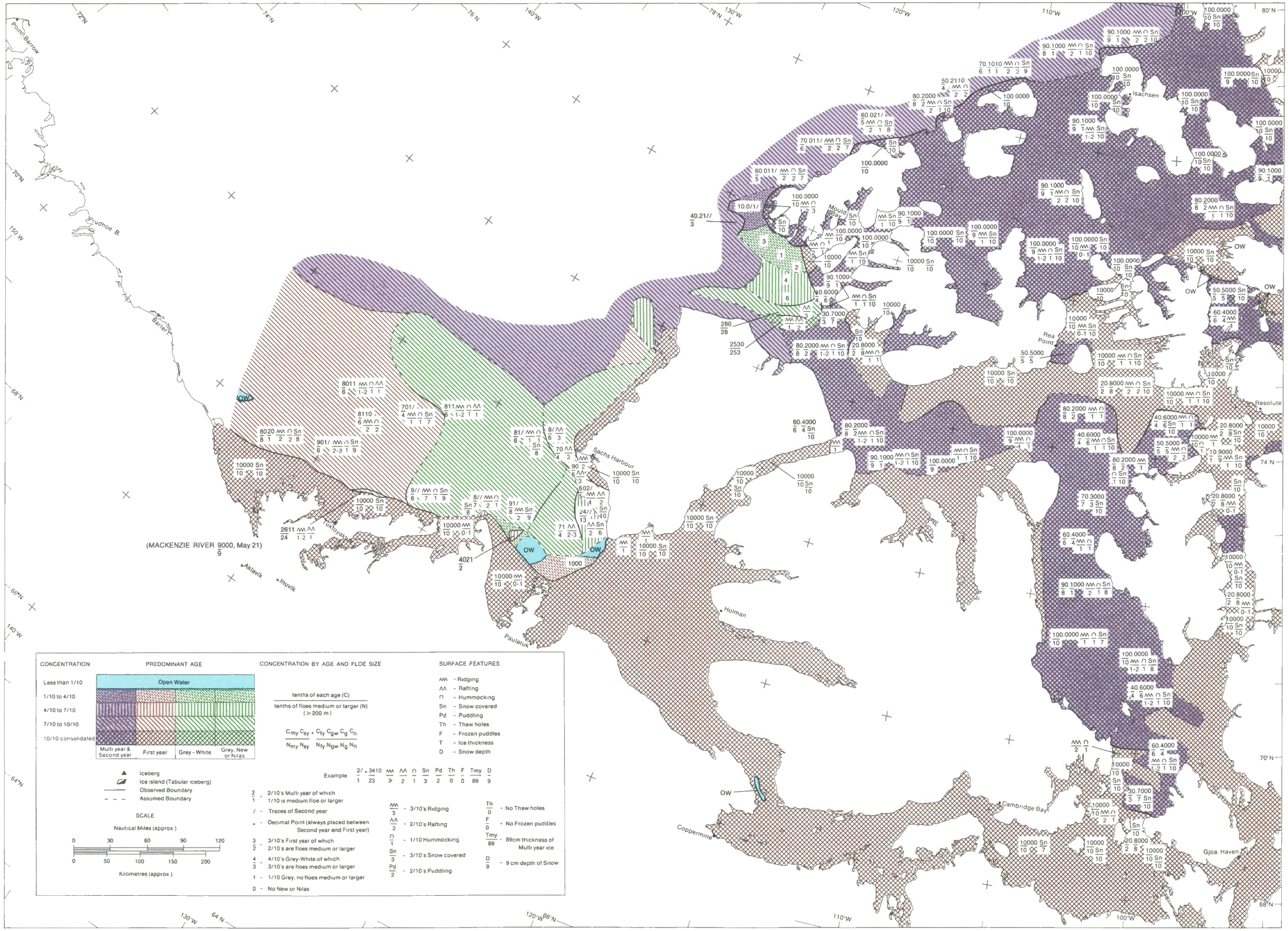
The solid ice cover shown on Bellot Strait was interrupted by two small open areas along the northern side and in the central part of the strait. These areas were too small to show on Map 2-1970 West.

Comments

The rapid development of the large area of new ice in the Beaufort Sea between March 28 and May 10 was unusual and it is difficult to accept this expansion without identifying some additional evidence to back up the observer. This evidence is available from the drift of Camp 200; see comments in the description for Map 1-1970 West. During the interval between March 28 and April 25 the ice floe carried this camp due west almost 180 kilometres. This distance equates to the westward extent of the new ice formed during the same interval.

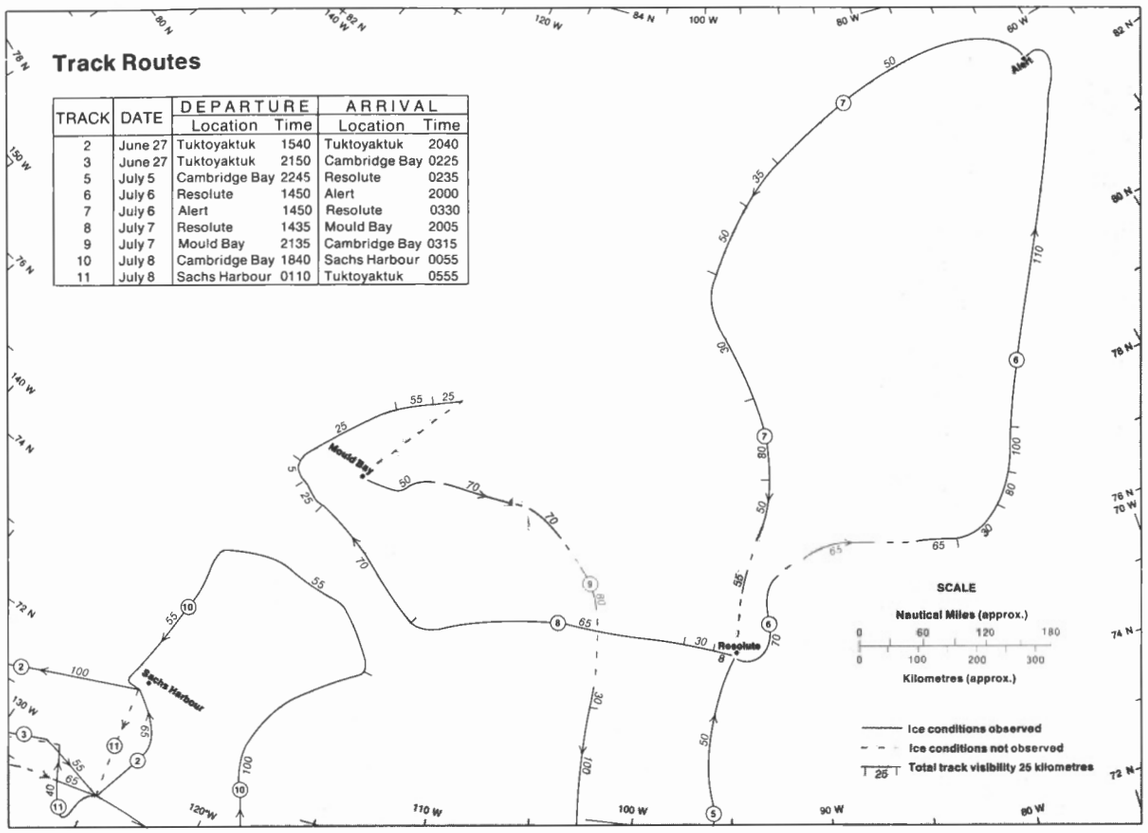
The eastward break-up into M'Clure Strait had advanced 60 kilometres further than usual for this time of year.

The large ice island in the southern part of M'Clintock Channel was playing hide-and-seek with the ice observer; the two tracks conducted in this area passed on either side of the island and it was not seen. Subsequent surveys showed that it was midway between the northern tip of Gateshead Island and the east coast of Victoria Island.



MAP 2 - 1970 WEST

May 10-22, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	June 27	Tuktoyaktuk	1540	Tuktoyaktuk	2040
3	June 27	Tuktoyaktuk	2150	Cambridge Bay	0225
5	July 5	Cambridge Bay	2245	Resolute	0235
6	July 6	Resolute	1450	Alert	2000
7	July 6	Alert	1450	Resolute	0330
8	July 7	Resolute	1435	Mould Bay	2005
9	July 7	Mould Bay	2135	Cambridge Bay	0315
10	July 8	Cambridge Bay	1840	Sachs Harbour	0055
11	July 8	Sachs Harbour	0110	Tuktoyaktuk	0555

MAP 3-1970 East

June 27-July 9

Flight Effectiveness

Only four tracks were conducted over the eastern part of the archipelago during Flight 3. Although good results were achieved during each track, many areas remained unsurveyed at the end of the Flight and the Flight was 50 per cent effective.

Ice Conditions

During the interval between Flights 2 and 3 puddling had developed in all areas. In some of the southern and eastern channels including Jones Sound, Wellington Channel and Barrow Strait puddling had already reached its maximum and was beginning to decline as thaw holes formed to drain the surface melt water. In the northern areas near Alert puddling had just started. The north-to-south graduation in concentrations of puddling shows well on Map 3-1970 East. Near Yelverton Bay, northern Ellesmere Island, the puddling was one tenth; further south it was two tenths off Axel Heiberg Island, three tenths in Sverdrup Channel, four tenths near Strand Bay and up to five tenths east of Hendriksen Strait. Once puddling reaches a maximum and the water begins to drain, the puddling will decline and stabilize at three tenths until break-up occurs or thaw holes develop.

The greatest change between the two flights occurred in the northern part of Baffin Bay which had become ice-free. Other developments also indicated that the season was advancing in a normal fashion. Small ice-free areas had developed in their usual location at the north end of Kane Basin. The usual arc of open water was beginning to develop in Belcher Channel. Probably, small open areas were forming in Hendriksen Strait and in the small channels near Alexandra Fiord.

Rarely does Lancaster Sound maintain a solid ice cover for very long even during the winter. For it to remain solid until July 9 is highly unusual. Normally, at this time of year Lancaster Sound is almost open water and Prince Regent Inlet is less than five tenths covered.

Unobserved Areas

The ice conditions shown for the northern channels and along the fringe of the archipelago next to the Arctic Ocean are based on those observed during subsequent surveys carried out during Flight 4-1970 East.

Comments

The open area in Belcher Channel first appears and proceeds to develop in the same manner from the same spot in the central part of the channel each year. Probably a shoal near the open area is responsible for altering water circulation patterns and causing the weak area.

The solid ice cover in Lancaster Sound probably reflects a spring season during which no severe storms swept the area with sufficient force to break the ice cover. However, the signs of imminent break-up had appeared with the formation of the open area at the western end of the sound.

The clearing of the landfast ice which normally extends across Smith Bay and along the coast of Ellesmere Island from Cape Combermere to Cape Faraday was not typical and North Water had advanced further into Kane Basin than usual at this time. Despite the late break-up in Lancaster Sound and Prince Regent Inlet the ablation season in other areas was advancing slightly ahead of normal.

SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
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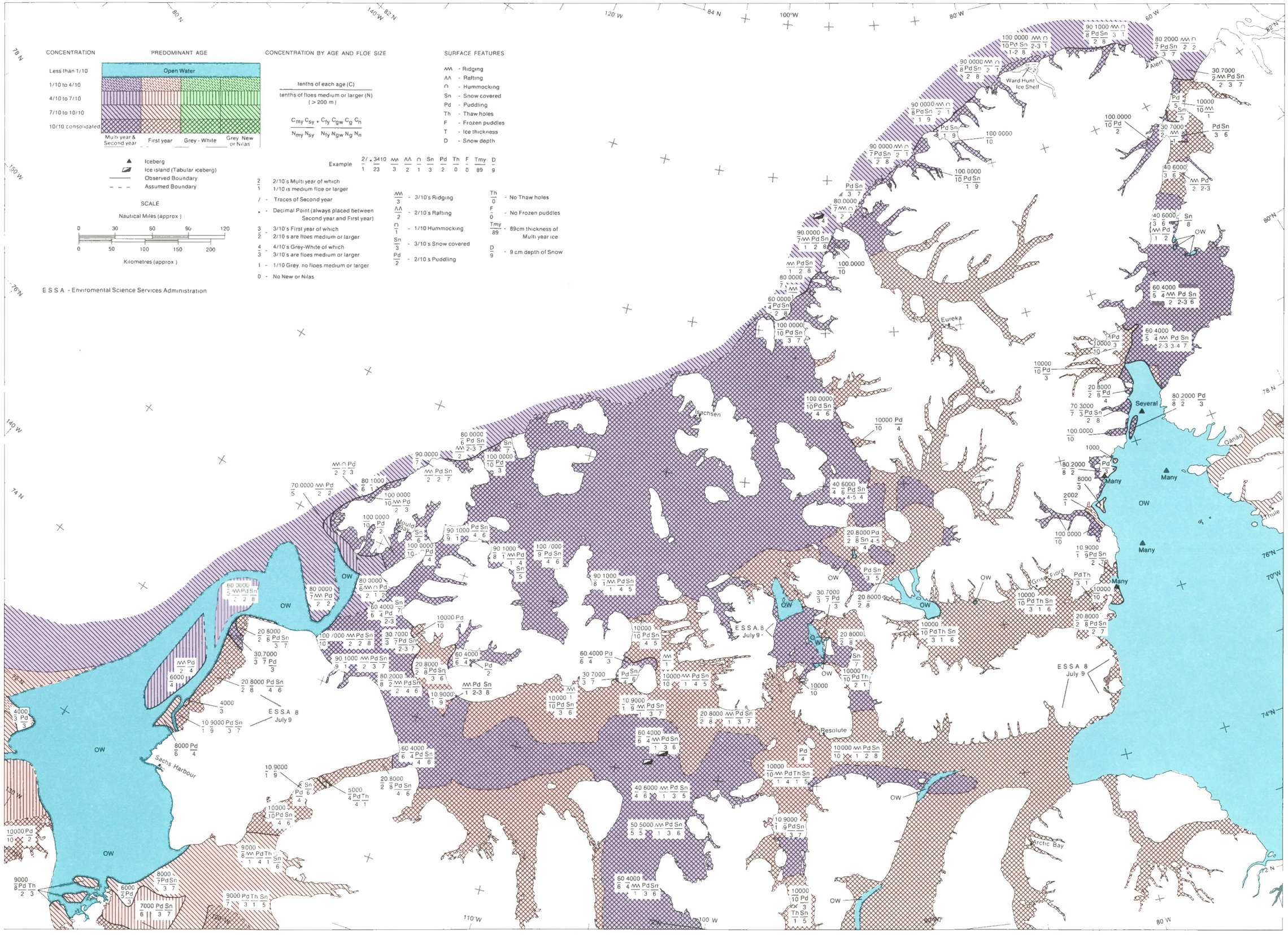
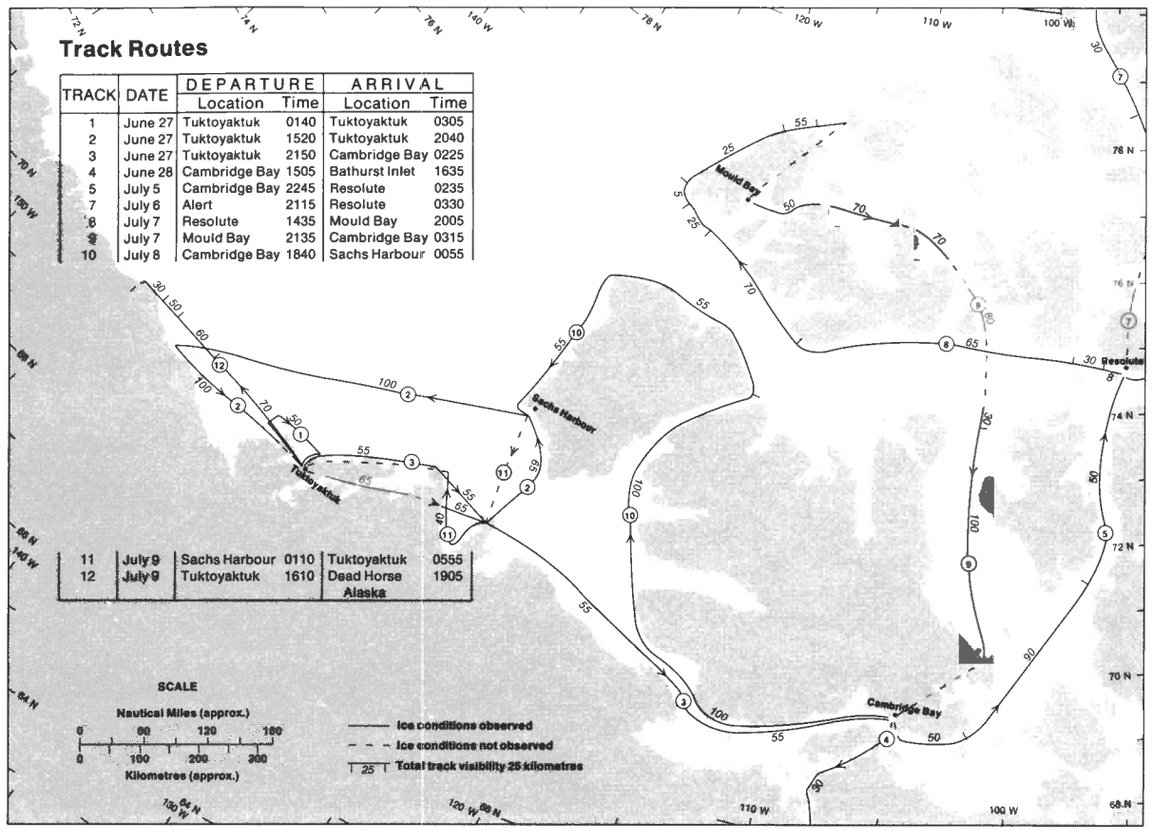


MAP 3 - 1970 EAST

June 27 - July 9, 1970



MAP 3-1970 West

June 27-July 9

Flight Effectiveness

With the exception of track 11 the weather and visibility during the 9 tracks conducted in the western part of the region ranged from very good to excellent. The Flight was very effective. If the central part of Viscount Melville Sound and M'Clure Strait as well as the area around King William Island had been surveyed the Flight would have been 100 per cent effective.

Ice Conditions

The rapid appearance and expansion of the open water in Amundsen Gulf and into the Beaufort Sea was slightly ahead of normal. The ice-free area in M'Clure Strait was unusually large. In the other parts of the region the season seemed to be advancing in a normal manner. Puddling had appeared in all areas and thaw holes were beginning to develop. The break-up in Amundsen Gulf was well underway and the solid areas which remained would soon disappear.

Many cracks crisscrossed the solid ice cover in the eastern part of Coronation Gulf and throughout the length of Dease Strait. Small areas of open water were developing near Cambridge Bay and in Bathurst Inlet.

A limited area of sheet puddling was noticed in the northern part of Peel Sound near Aston Bay. This situation develops when a thin layer of rain or melt water completely covers a large area where the top surface of the ice is uniformly flat. This type of puddling seldom lasts more than one or two days before it drains to the sea through a seal hole or a crack.

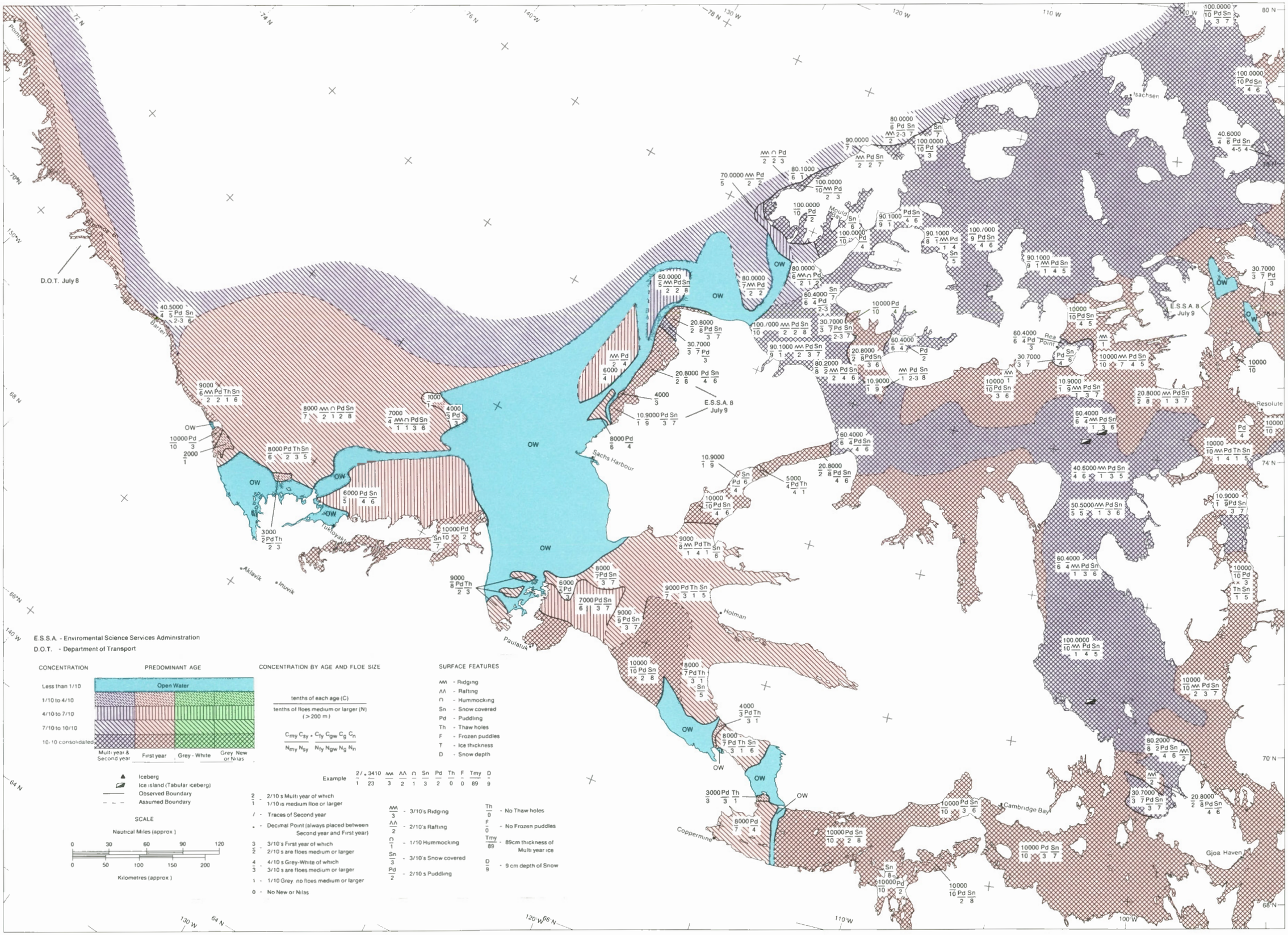
Unobserved Areas

Probably the conditions in the channels surrounding King William Island resembled those near Cambridge Bay. Small areas of open water had likely developed in the narrow channels and bays associated with Rasmussen Basin and Chantrey Inlet.

Comments

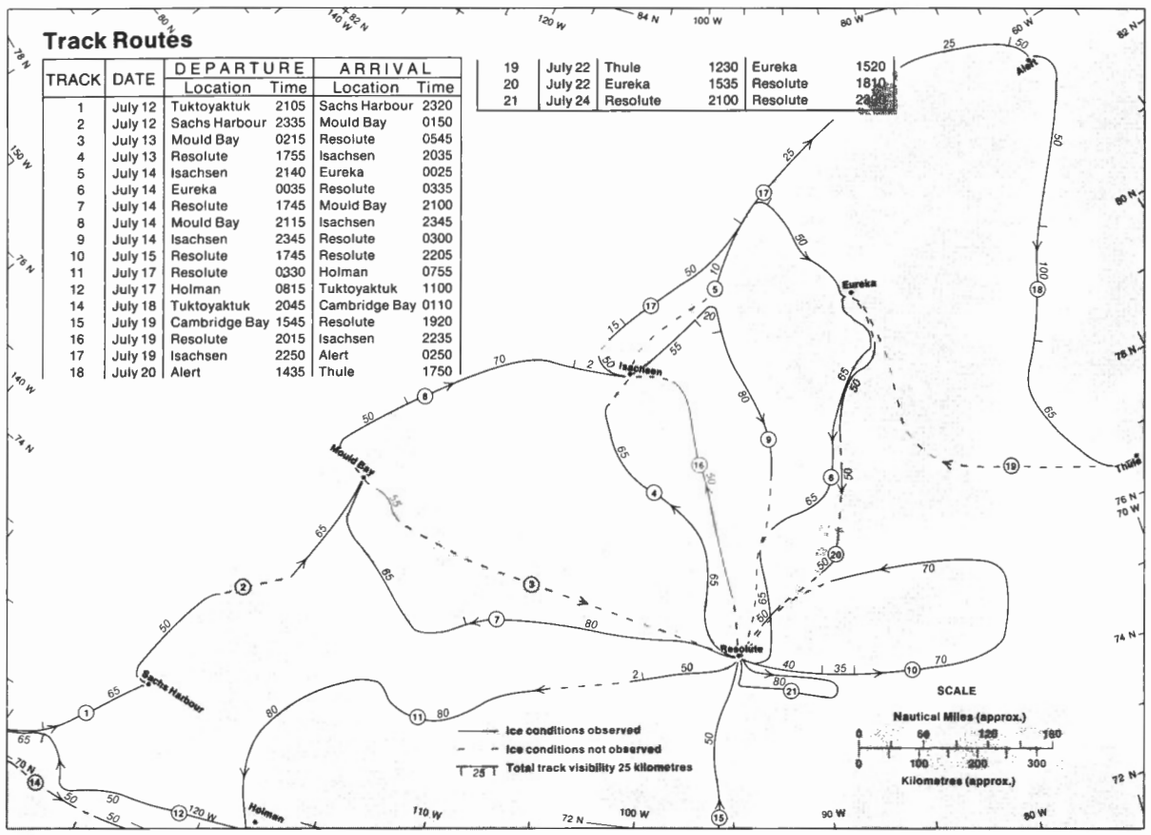
A number of minor departures from the usual situation were observed during Flight 3. The open area at the western entrance to Dolphin and Union Strait was much larger than normal. No thaw holes were seen in Coronation Gulf or Dease Strait. A small area of open water had developed in Victoria Strait immediately north of the Royal Geographical Society Islands. This development had never been seen before. The fraction describing the ice conditions in the area on the map covers the open part. The large ice-free area in the Beaufort Sea developed as the new ice which had formed in April rapidly melted in the June sun.

The large ice island, T-1, was located, measured and photographed at 70° 49'N, 101° 30'W or about 50 kilometres west-northwest of Gateshead Island. The main mass of ice and the host of associated fragments covered an area 25 by 30 kilometres. The main piece of ice had a well-developed trellis drainage pattern. A recent crack had reduced the size of the island by one eighth of its previous area.



MAP 3 - 1970 WEST

June 27 - July 9, 1970



MAP 4-1970 East July 12-24

Flight Effectiveness

Thirteen separate tracks were carried out in the eastern part of the archipelago during Flight 4-1970. The weather and visibility during the majority of the tracks were very good. Only two areas in the vicinity of Hazen Strait and Prince Regent Inlet remained unsurveyed and the Flight was judged to be 90 per cent effective.

Ice Conditions

The main changes between the ice conditions noted during Flights 3 and 4 appeared in Lancaster Sound, Prince Regent Inlet, Nares Strait and Barrow Strait where the ice cover had broken up. In Lancaster Sound, the ice probably broke up on or about July 12 because the floe sizes were still quite large when track 10 passed over the sound on July 15. The sequence of break-up in Nares Strait can also be followed on the basis of floe sizes. First to break up in this strait was the central part of Kennedy Channel followed by the ends of the channel and then the northern part of Kane Basin. Floe sizes indicated for these areas on Map 4-1970 East show the largest floes in northern Kane Basin and the smallest in central Kennedy Channel. Judging by these floe sizes, break-up likely started in central Kennedy Channel on July 10. The ice cover on the southern part of Kane Basin would probably break up before July 25 while the ice in Robeson Channel would remain solid until the first week in August.

In the eastern half of Barrow Strait break-up was between July 18 and July 23. Fracturing in this strait generally occurs from east to west but occasionally progresses in the opposite direction. In 1970 it advanced from west to east. South of Griffith Island, the ice broke up on July 18 or 19, while the cover in the remaining part of the strait likely fractured and started to move on July 22 or 23.

Other developments included the expansion of open water in the area around Penny Strait and Hell Gate and the appearance of two new ice-free patches in Crozier Strait and in the small strait separating Truro Island from Bathurst Island.

Unobserved Areas

Although it does not appear on Map 4-1970 East the area of open water previously observed in Belcher Channel during Flight 3 still existed and had probably expanded toward the north and south. Patches of open water were probably developing in Hendriksen Strait and in the narrows of the fiords near Alexandra Fiord. Thaw holes were most likely developing in Admiralty Inlet, Navy Board Inlet and Pond Inlet and areas of open water were appearing at constricting parts of these inlets.

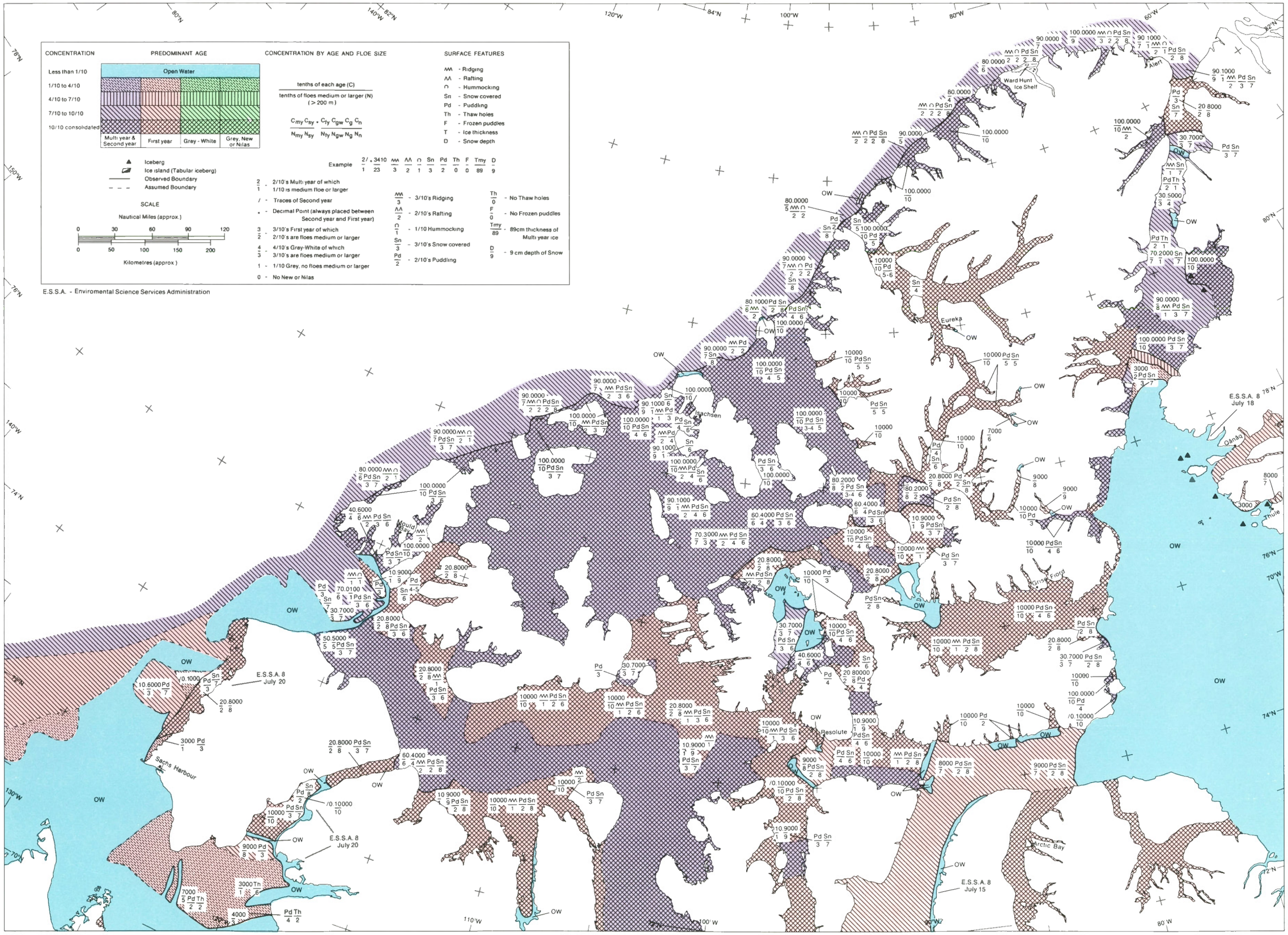
Comments

The ice conditions shown for Barrow Strait on Map 4-1970 East indicate the situation on July 20. By July 23 the ice cover throughout the eastern half of the strait was in motion. Overall, in Lancaster Sound and Barrow Strait, about 400 miles of solid ice broke up and started to move during a two-week interval following July 12.

A number of icebergs not shown on this map were spotted along the north, east and south coast of Devon Island during track 10 on July 15.

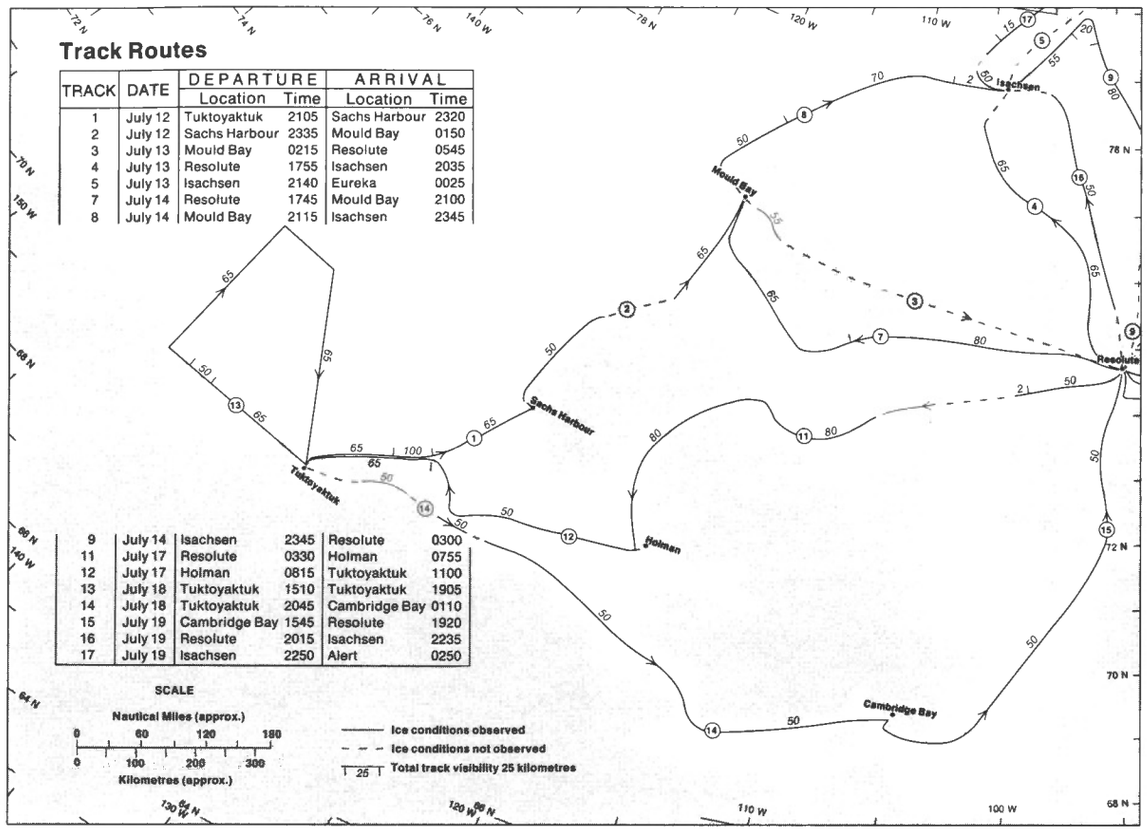
Cracks had appeared through the ice cover in most of the eastern areas. One crack in particular, to the south from Cape Cockburn on Bathurst Island, appeared about two weeks earlier than normal. Apart from this, there were no obvious indications that the season would be more advanced than usual.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 4 - 1970 EAST

July 12-24, 1970



MAP 4-1970 West July 12-20

Flight Effectiveness

The weather and observing conditions during the surveys made during Flight 4-1970 West were very good. Although a few areas were not surveyed, the Flight was about 75 per cent effective.

Ice Conditions

During the interval between the ends of Flights 3 and 4 large areas of ice had melted. The rate of clearing in the Beaufort Sea was rapid but the channels from Amundsen Gulf to Rasmussen Basin were losing their ice cover even faster. When the ice conditions in these channels, including Rasmussen Basin, Queen Maud Gulf, Dease Strait, Coronation Gulf, Dolphin and Union Strait and the eastern half of Amundsen Gulf, were established for the first week in July, the overall concentration was greater than nine tenths and a solid ice cover extended across half of the area. Less than two weeks later no solid ice remained in any of the channels and the overall concentrations were five tenths or less. The rate of ablation and clearing was remarkable and it showed signs that it would continue at the same rate. Thaw holes, which appear when puddles melt through the ice, are the main indicators of imminent break-up. From one to two tenths of the ice surface in the Beaufort Sea was comprised of thaw holes while up to six tenths of the ice remaining in the channels separating the islands of the archipelago from the mainland was thaw holes. Normally thaw holes seldom exceed two tenths of the surface before the ice is weakened to such an extent that it breaks up and the thaw holes cease to exist as distinct features. Thus, concentrations of thaw holes up to six tenths are very rarely seen and indicate that the ice is in an advanced state of disintegration.

The boundary between the solid ice cover and the moving ice or open water in M'Clure Strait remained in the same position as observed during the previous flight and multi-year ice continued to drift into the area.

The leads and lanes of open water in Queen Maud Gulf were temporary, they do not indicate a recurring pattern. Two or three hours later the shifting ice would change the pattern and these temporary channels of open water would close.

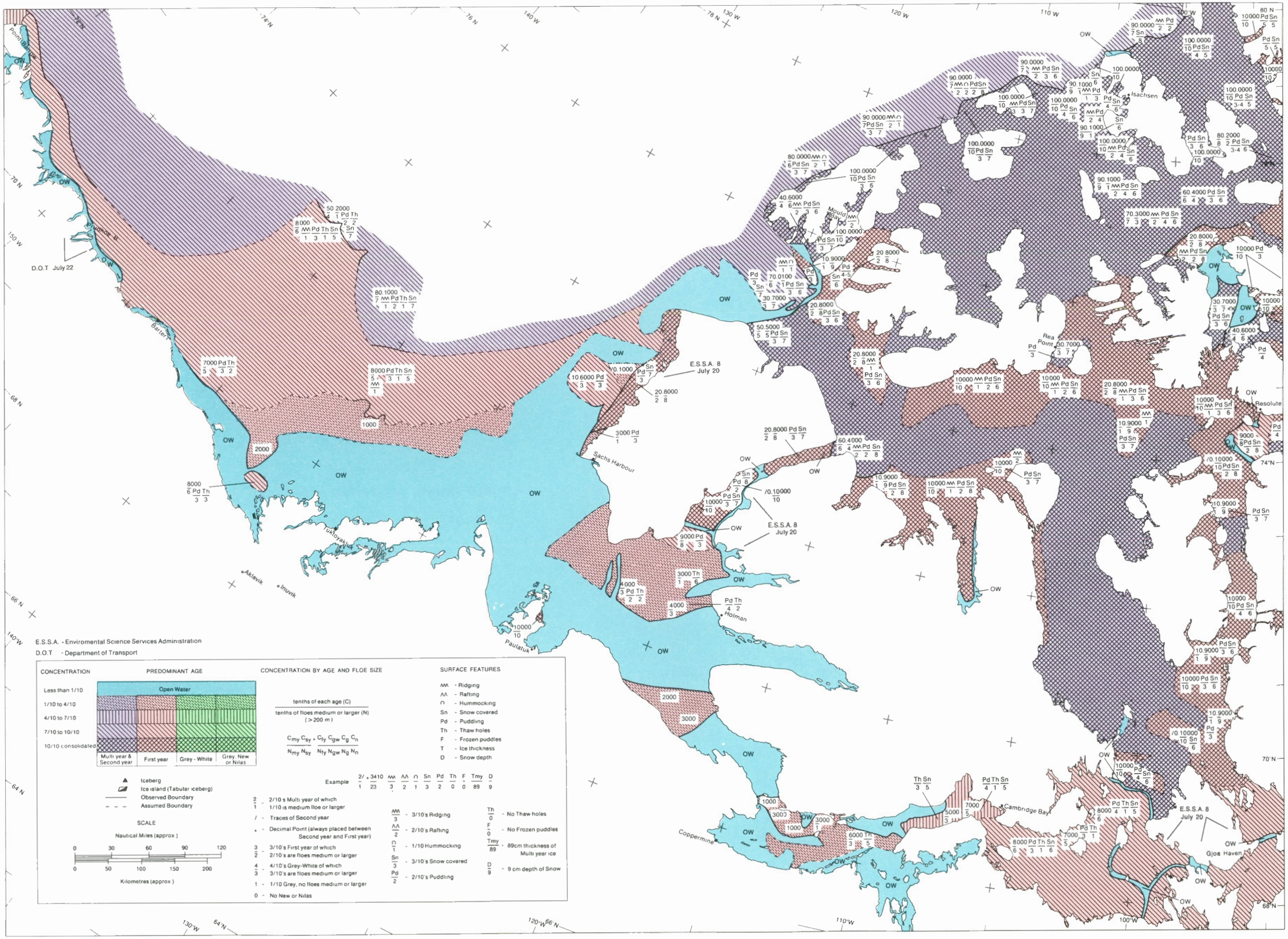
Strings and small floes seldom reaching concentrations greater than a few tenths were drifting back and forth through Bellot Strait.

Unobserved Areas

Probably small areas of open water were developing in Goldsmith Channel and near the heads of the bays west of Hadley Bay.

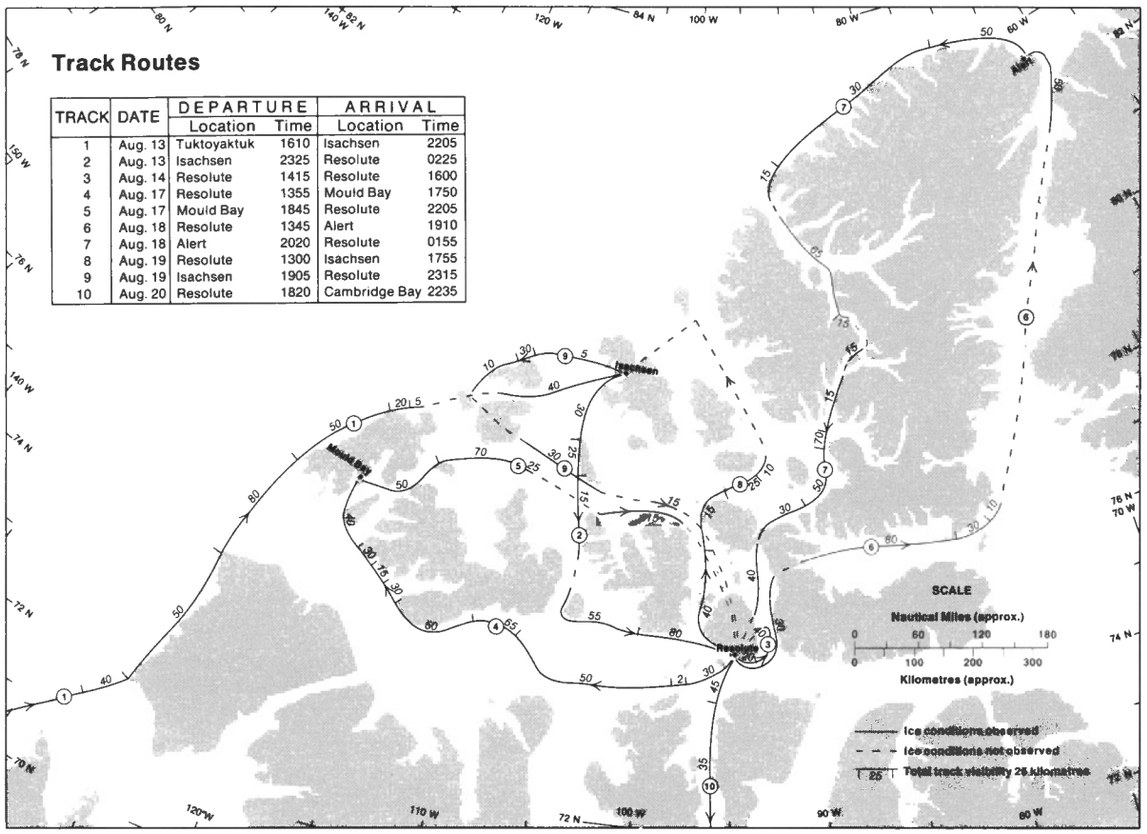
Comments

The speed at which the ice in the southern channels ablates and disappears in July is remarkable. On July 12 a four-tenths concentration of first-year ice with up to five tenths of thaw holes was observed along the Tuktoyaktuk Peninsula from Kugmallit Bay to Cape Bathurst. The ice extended 40 kilometres offshore. Five days later, on July 17, the area was ice-free as observed during track 12. By mid-July the season was at least two weeks ahead of normal and there were no signs that the rate of advance would diminish.



MAP 4 - 1970 WEST

July 12-20, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 13	Tuktoyaktuk	1610	Isachsen	2205
2	Aug. 13	Isachsen	2325	Resolute	0225
3	Aug. 14	Resolute	1415	Resolute	1600
4	Aug. 17	Resolute	1355	Mould Bay	1750
5	Aug. 17	Mould Bay	1845	Resolute	2205
6	Aug. 18	Resolute	1345	Alert	1910
7	Aug. 18	Alert	2020	Resolute	0155
8	Aug. 19	Resolute	1300	Isachsen	1755
9	Aug. 19	Isachsen	1905	Resolute	2315
10	Aug. 20	Resolute	1820	Cambridge Bay	2235

MAP 5-1970 East

August 13-20

Flight Effectiveness

The series of surveys conducted in the eastern part of the region during Flight 5-1970 were not very good. Low cloud and fog restricted visibility for some portion of each of the tracks which resulted in only about half of the coverage being acquired. However, this type of weather was expected and the tracks were planned to cover the main areas where changes were expected. The Flight was about 60 per cent effective.

Ice Conditions

Substantial changes had taken place during the four-week interval between the completion of Flight 4 and the end of Flight 5. A rapid clearing had taken place in Lancaster Sound, Prince Regent Inlet, Admiralty Inlet, Navy Board and Pond Inlet as well as McDougall Sound, Penny Strait and Jones Sound.

The pattern of break-up and the formation of open areas in Belcher Channel, Norwegian Bay and Eureka Sound were normal but had taken place earlier than usual. The break-up sequence north of Penny Strait and west of Cornwall Island did not take place in the normal fashion. Typically, the ice cover adjacent to the western end of Belcher Channel breaks up before the ice farther to the west starts to move.

Multi-year floes from the recently fractured area to the north had started to drift south through Penny Strait and on into Queens Channel. The ice in Wellington Channel was moving into Barrow Strait at a much slower rate than had been observed in other years. Generally the entire channel becomes ice-free within two weeks after break-up takes place.

Frozen puddles were noted in most of the northern areas and some snow had recently fallen. New ice had started to appear in the form of slush.

Unobserved Areas

The ice conditions along the western coast of the archipelago from Borden Island to Nansen Sound were likely very similar to those shown on Map 4-1970 East.

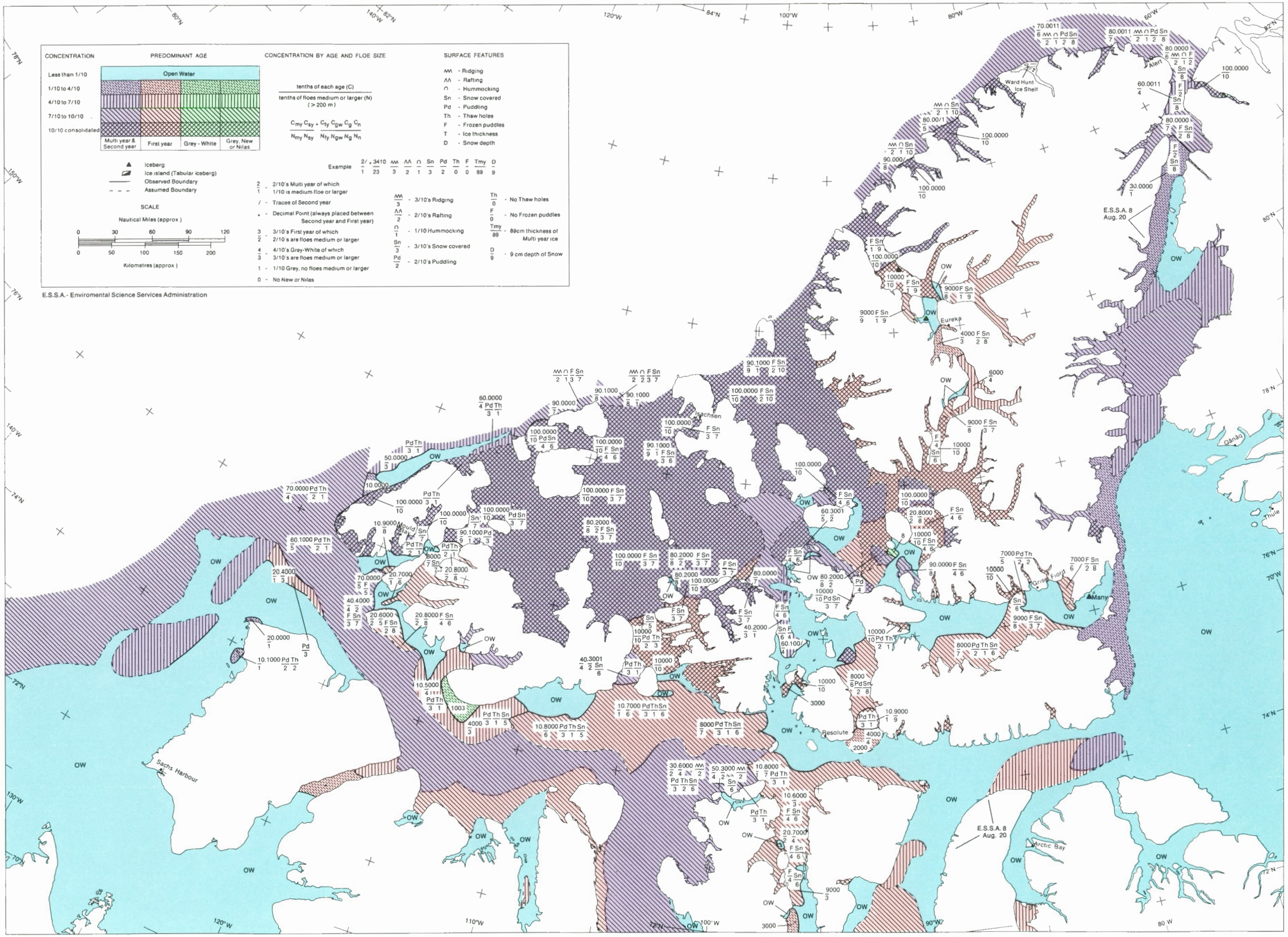
Comments

Break-up in McDougall Sound probably took place during the second week in August. Normally the ice cover on this sound breaks up during the first week in September and in some years it remains solid throughout the entire summer.

Considerable ice was observed in the central portions of Eureka Sound during track seven on August 18; usually, by this time the area is almost ice-free.

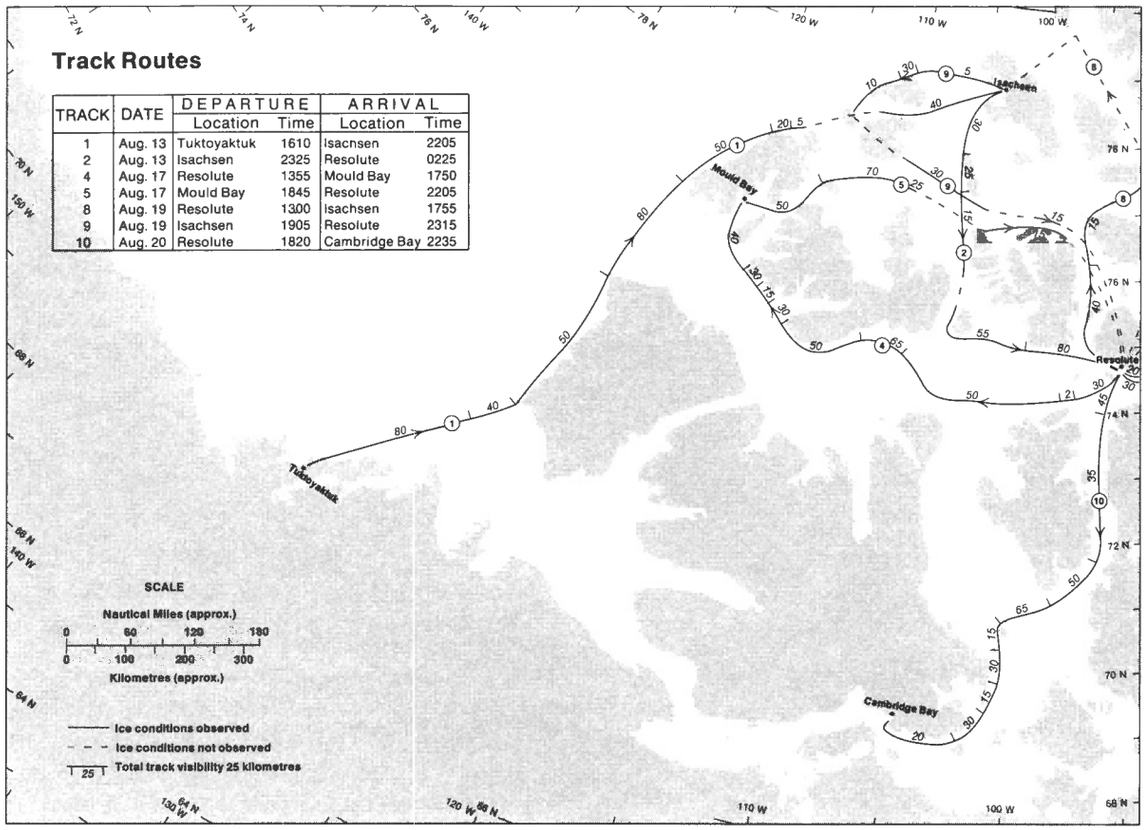
Multi-year ice was drifting south through Nares Strait. The overall distributions and concentrations shown for this area on Map 5-1970 typify the normal situation for this time of year.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 5 - 1970 EAST

August 13-20, 1970



MAP 5-1970 West

August 13-20

Flight Effectiveness

The results of the two tracks carried out in the western part of the region during Flight 5 were good. Although major portions of the area remained unsurveyed, the Flight was 75 per cent effective.

Ice Conditions

During the four-week interval between Flights 4 and 5 extensive changes took place. The ice cover in M'Clintock Channel, M'Clure Strait and Viscount Melville Sound broke up. The ice cover in Peel Sound had partially disappeared and all the ice in Rasmussen Basin and all connecting channels west to the Beaufort Sea had melted away. In the same period the ice-free area in the Beaufort Sea had almost doubled in size.

Once a channel becomes ice-free it is difficult to judge how fast the season is advancing. In the case of the southern channels the problem is magnified by the fact that the final date of clearing was not established. However, the rate of advance of the season in Victoria Strait, Peel Sound and M'Clintock Channel indicated that in these areas the season was two to three weeks ahead of normal. Occasionally the ice cover along the length of M'Clintock Channel and Victoria Strait remains unbroken throughout the season. Although the season was ahead of normal the patterns of break-up, ablation and clearing appeared to have followed the usual sequence.

Unobserved Areas

Sometimes, and in specific zones, the ice conditions can be determined in general on the basis of conditions in adjacent areas because a situation will not develop in one area before the same situation has already developed in another area. The sequence of break-up and clearing in the southern channels between Victoria Island and the mainland is such that they always become ice-free before Queen Maud Gulf. Therefore, if Queen Maud Gulf is observed to be ice-free, it follows that no ice would be found in the other channels.

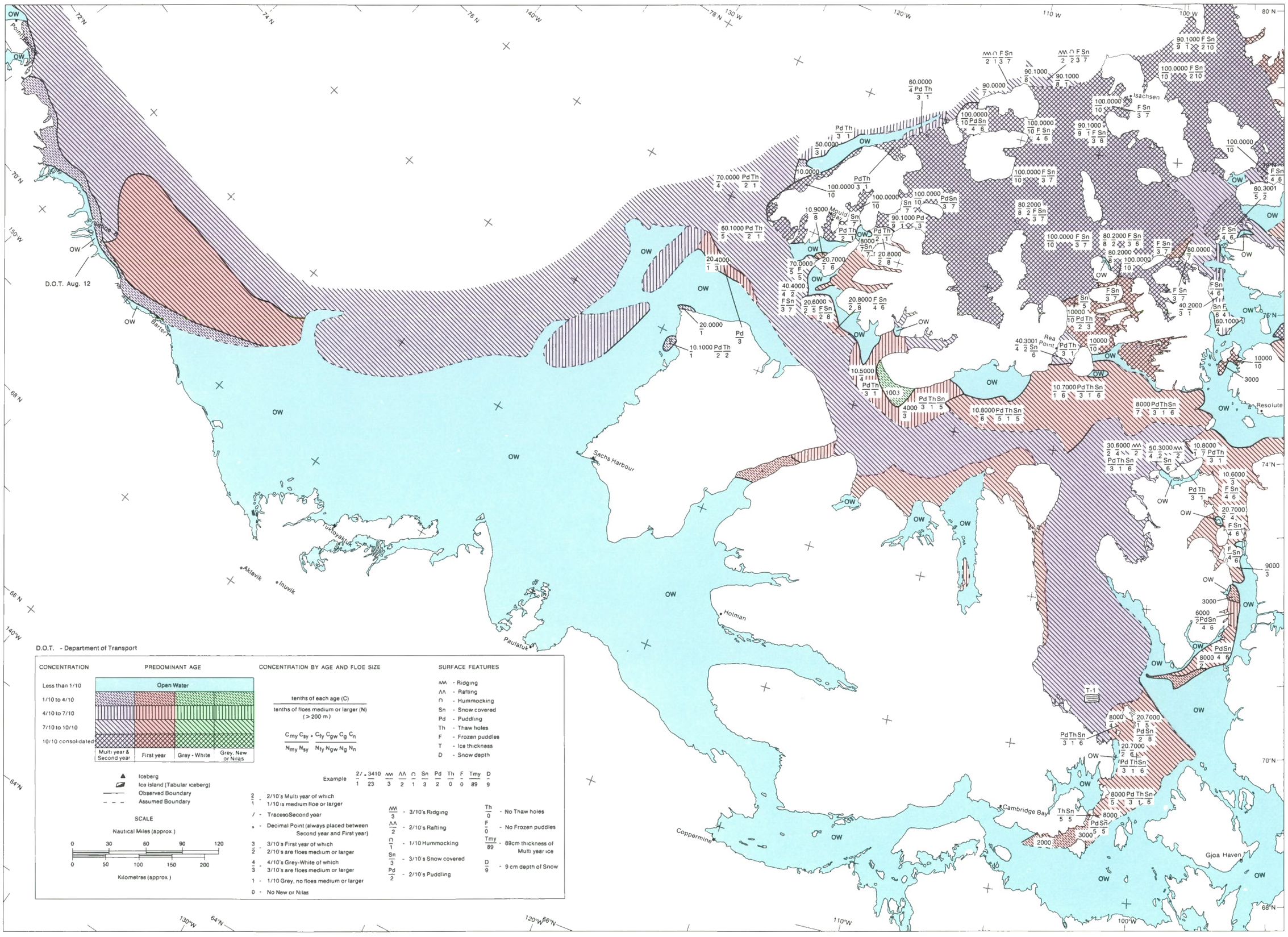
The general ice conditions in the remaining areas were interpreted from satellite photographs. Subsequent observations combined with a knowledge of the general patterns of break-up were used to determine the ice conditions in M'Clintock Channel and the southern part of Viscount Melville Sound.

Comments

The large ice island, T-1, was still intact in southern M'Clintock Channel when it was seen on August 20 at 70° 50'N, 102° W.

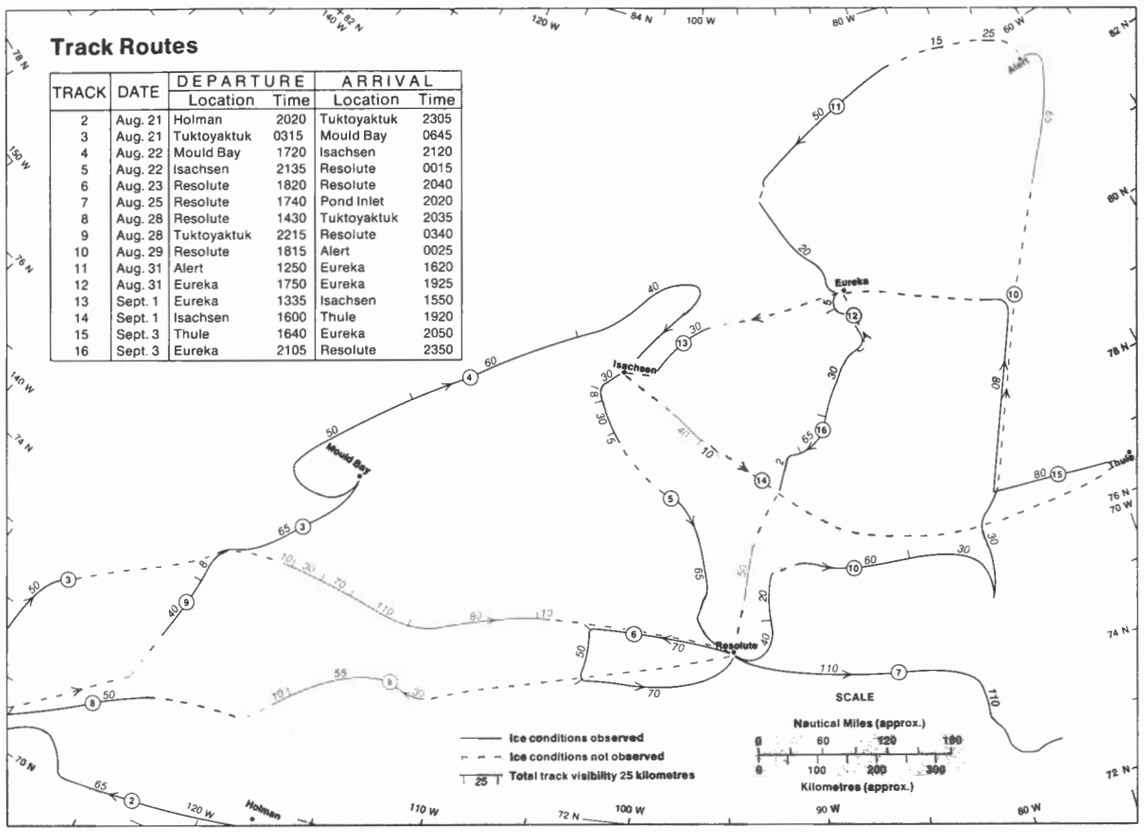
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 5 - 1970 WEST

August 13-20, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	Aug. 21	Holman	2020	Tuktoyaktuk	2305
3	Aug. 21	Tuktoyaktuk	0315	Mould Bay	0645
4	Aug. 22	Mould Bay	1720	Isachsen	2120
5	Aug. 22	Isachsen	2135	Resolute	0015
6	Aug. 23	Resolute	1820	Resolute	2040
7	Aug. 25	Resolute	1740	Pond Inlet	2020
8	Aug. 28	Resolute	1430	Tuktoyaktuk	2035
9	Aug. 28	Tuktoyaktuk	2215	Resolute	0340
10	Aug. 29	Resolute	1815	Alert	0025
11	Aug. 31	Alert	1250	Eureka	1620
12	Aug. 31	Eureka	1750	Eureka	1925
13	Sept. 1	Eureka	1335	Isachsen	1550
14	Sept. 1	Isachsen	1600	Thule	1920
15	Sept. 3	Thule	1640	Eureka	2050
16	Sept. 3	Eureka	2105	Resolute	2350

MAP 6-1970 East

August 21-September 3

Flight Effectiveness

Usually a certain amount of unfavourable weather which reduces the effectiveness of the surveys is encountered at this time of year. The weather encountered during Flight 6-1970 East was even more unsuitable than anticipated. Of all the tracks attempted for this flight, only three provided very good data, four gave fair coverage while the remaining six efforts resulted in little or no information. Overall, the Flight was considered to be only about 60 per cent effective.

Ice Conditions

Many changes occurred during the brief interval, about seven days, which separated the tracks carried out over almost the same areas during Flights 5 and 6. The most obvious was the expansion of the area of open water around Byam Martin Island and in the area around the southern part of Ellef Ringnes Island. Less noticeable, but equally significant, changes had taken place in a number of areas where concentrations declined. These reductions occurred in M'Clure Strait, Viscount Melville Sound, Kane Basin, and Peel Sound; the latter became completely ice-free.

The puddles had continued to freeze over until only the areas observed southeast of Resolute and southwest of Mould Bay remained uncovered. Snow had fallen in many of the areas and new ice in the form of slush was making its appearance in the northern part of the region.

The pattern of break-up was advancing in its regular fashion. Northern Norwegian Bay had recently broken as had the large sea east of Lougheed Island. Cracks had already appeared across the solid ice cover in the northern channels. Maclean Strait would likely break up within a few days, followed by Byam Martin Channel, eastern Hazen Strait and finally Prince Gustaf Adolf Sea. A southerly drift through these channels would begin once the ice cover had given way and had developed into smaller floes.

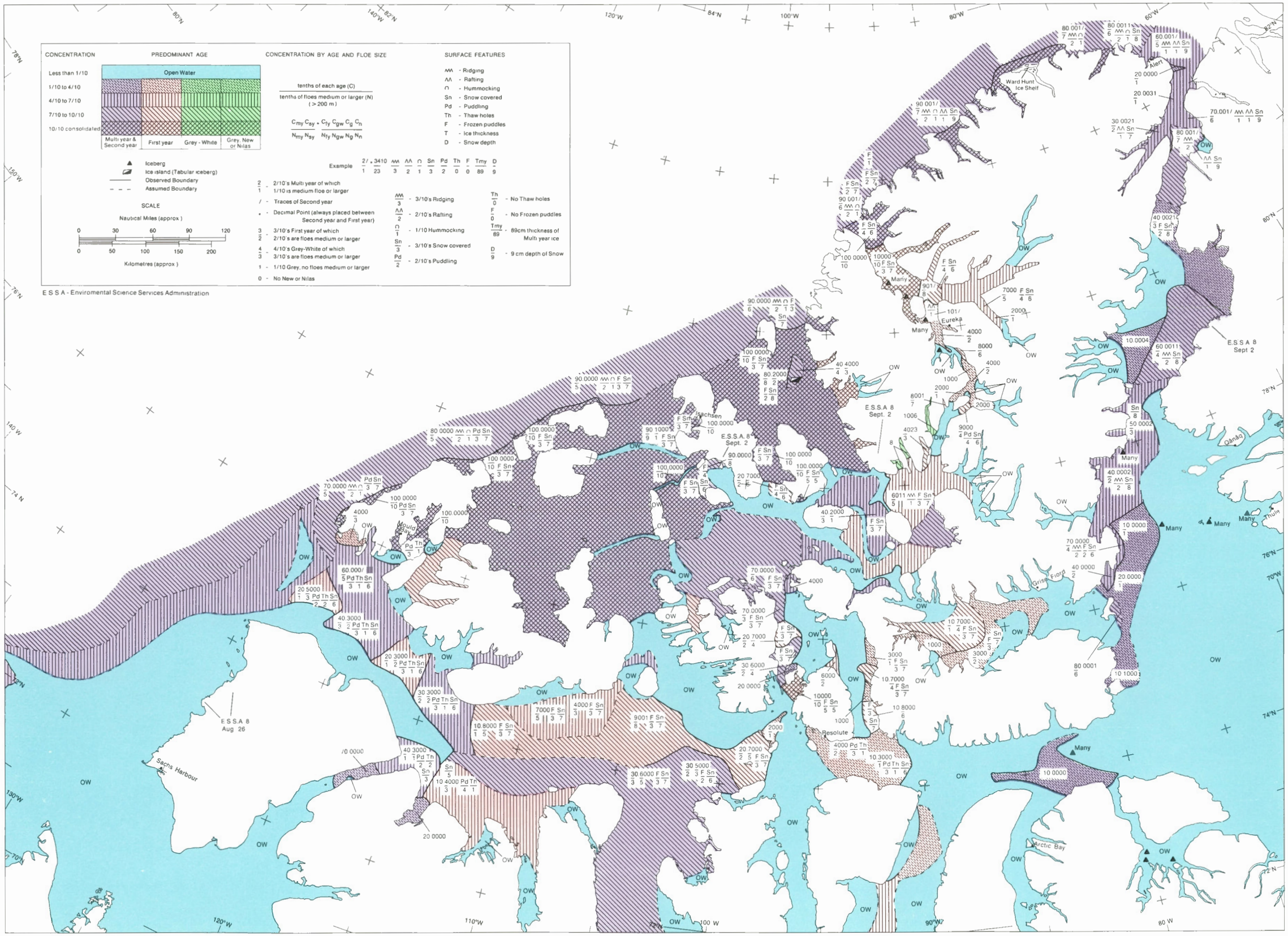
Although the narrow extremities of all the fiords joining Eureka Sound were ice-free, most of the waters of this region, including the main part of these channels, Eureka Sound, Tanquary Fiord, and Jones Sound, were partly ice covered. Concentrations and distributions such as these are expected in an average year. It would seem that the summer season in the Eureka Sound area was about average while conditions were up to three weeks more advanced in many of the remaining areas in the archipelago.

Unobserved Areas

The ice conditions along the northwest coast of Axel Heiberg Island were probably very similar to those shown on Map 7-1970 West.

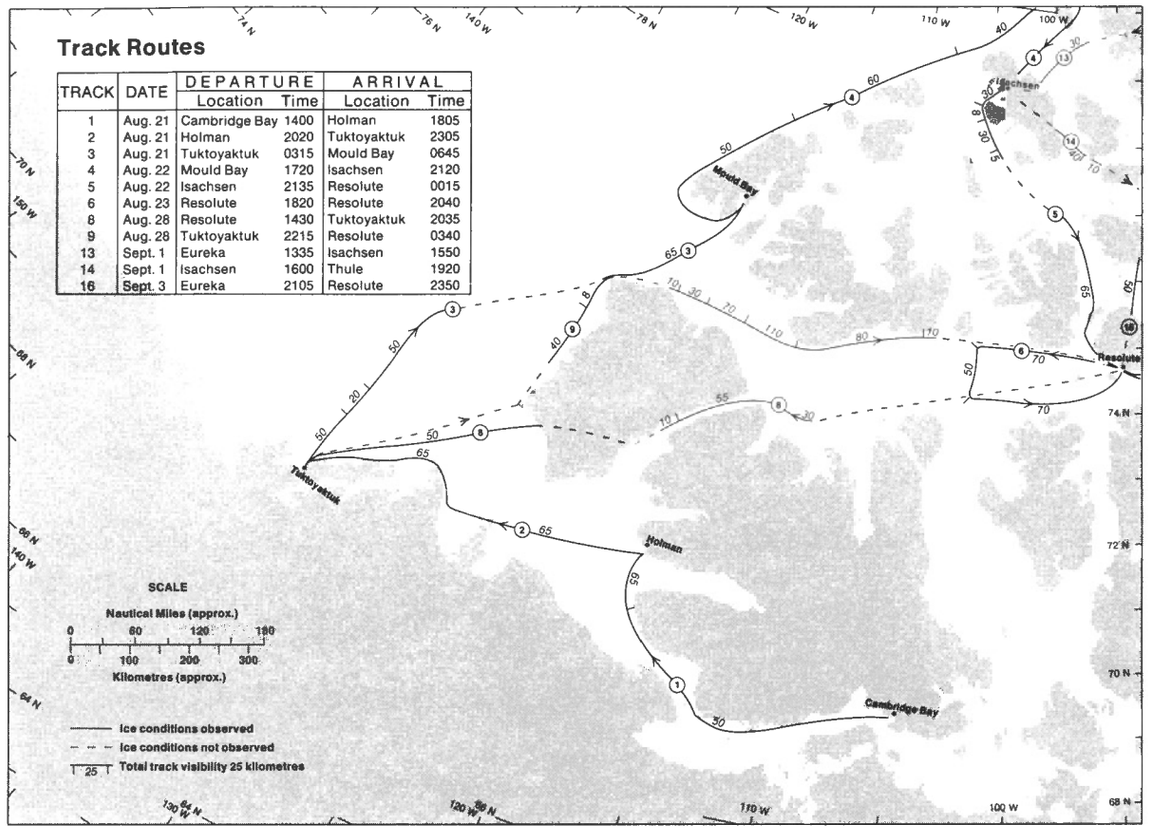
Comments

Three small pieces of ice island were observed at the following locations on August 22 during track four: the first was located at 78° 47'N, 111° 20'W, or about 15 kilometres northwest of Cape Malloch, the second was sighted at 79° 04'N, 108° 40'W, at 60 kilometres northwest of Cape Malloch and the third was sighted 60 kilometres north of Cape Isachsen at 79° 57'N, 104° 00'W.



MAP 6 - 1970 EAST

August 21-September 3, 1970



MAP 6-1970 West
August 21-September 3

Flight Effectiveness

Observing conditions during three of the tracks carried out during Flight 6-1970 West were very good. The conditions during the other three were only fair. No observations were made over Peel Sound and M'Clintock Channel. Overall, the Flight was nearly 65 per cent effective.

Ice Conditions

The ice in M'Clure Strait, southern Viscount Melville Sound, M'Clintock Channel and the Beaufort Sea continued to ablate. The remaining ice cover supported frozen puddles indicating that the rate of melting was gradually being reduced. The fact that little new ice was observed indicated that surface water temperatures had not yet returned to the freezing point.

The greatest change occurred in Peel Sound. During the nine days between observations in this area all the ice disappeared. The area of open water also increased in Austin Channel, western Barrow Strait, M'Clure Strait, M'Clintock Channel and Victoria Strait, as well as in the Beaufort Sea. Although most of these areas supported more open water than they usually do at this time of year, the normal sequence of break-up and clearing had occurred. Usually there is more open water along the south coast of Melville Island.

The conditions in Prince of Wales Strait and along the west coast of Prince of Wales Island were typical for this type of year.

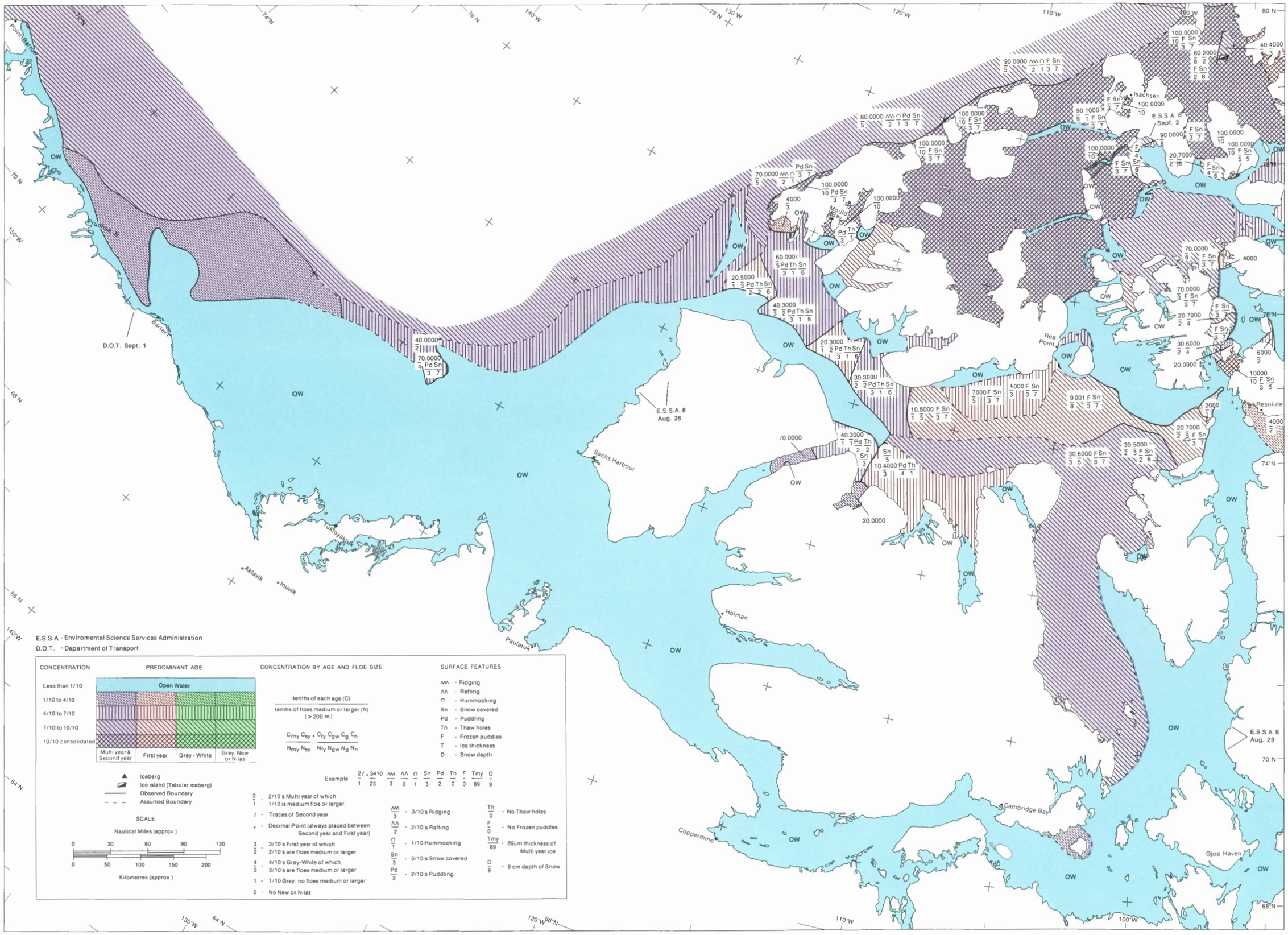
Unobserved Areas

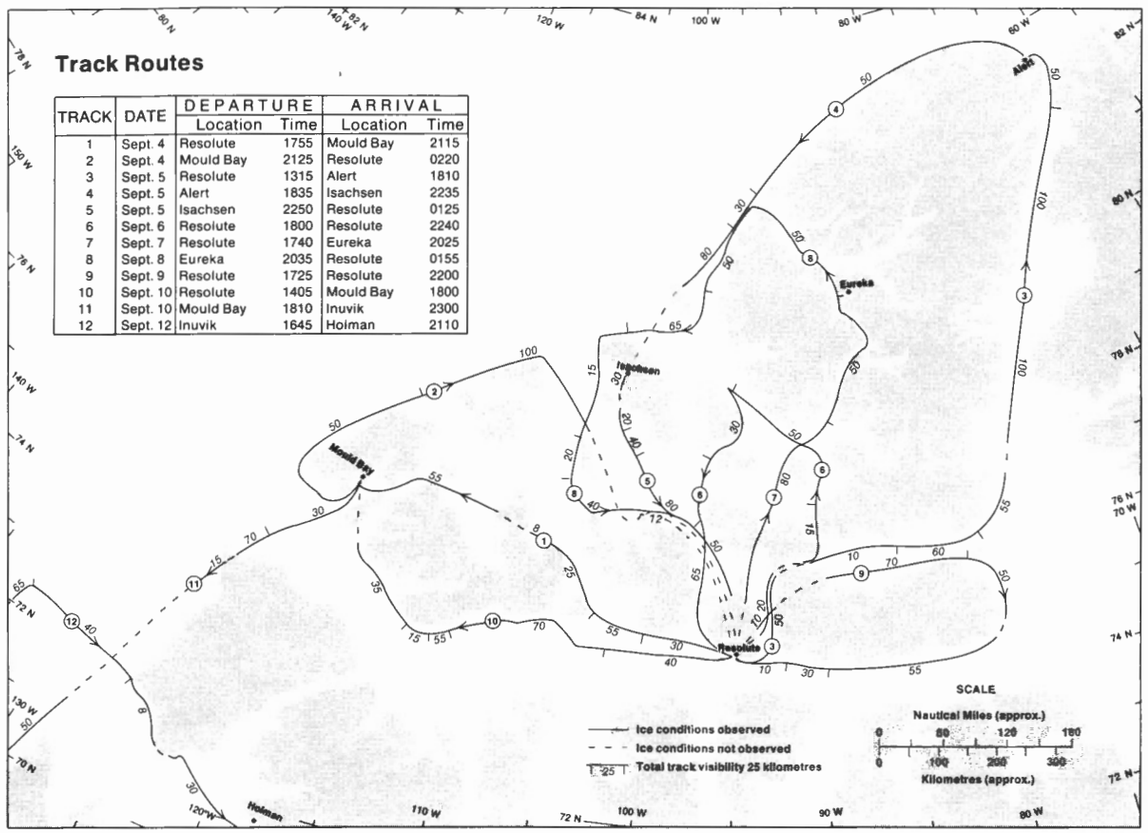
At the end of the Flight both Peel Sound and M'Clintock Channel remained unobserved. Although satellite information provided data about the conditions in Peel Sound, the situation shown for M'Clintock Channel was interpolated from data of previous Flights and from conditions noted at the same time in other years.

Comments

It was unfortunate that M'Clintock Channel remained unobserved during Flight 6 and the two subsequent Flights. The ice conditions in this area are not well known and the patterns of break-up and movement, although partially understood, have not been well established.

A small fragment of an ice island was observed at 74° 14'N, 112° 35'W nearly 20 kilometres south of Cape Providence. In the fall of 1962, T-1 reached a position about 125 kilometres further east at the same time of year. Whether or not the small fragments would follow the same route as T-1 or drift south into Prince of Wales Strait or west into M'Clure Strait would depend on the winds.


Point Barrow
Barter I.
Prudhoe B.
D.O.T. Sept. 1
E.S.S.A. 8 Aug. 26
Sachs Harbour
Tuktoyaktuk
Aklavik
Inuvik
Paulatuk
Holman
Coppermine
Cambridge Bay
Gjoa Haven
Resolute
Isachsen
E.S.S.A. 8 Sept. 2
Mould Bay
Rea Point
E.S.S.A. 8 Aug. 29
OW
E.S.S.A.- Enviromental Science Services Administration
D.O.T. - Department of Transport
CONCENTRATION
PREDOMINANT AGE
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice Island (Tabular Iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N)
(> 200 m)
SURFACE FEATURES
Ridging
Rafting
Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Example
2/ . 3410 Sn Pd Th F Tmy D
2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
. - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas
3/10's Ridging
2/10's Rafting
1/10 Hummocking
3/10's Snow covered
2/10's Puddling
No Thaw holes
No Frozen puddles
89cm thickness of Multi year ice
9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Sept. 4	Resolute	1755	Mould Bay	2115
2	Sept. 4	Mould Bay	2125	Resolute	0220
3	Sept. 5	Resolute	1315	Alert	1810
4	Sept. 5	Alert	1835	Isachsen	2235
5	Sept. 5	Isachsen	2250	Resolute	0125
6	Sept. 6	Resolute	1800	Resolute	2240
7	Sept. 7	Resolute	1740	Eureka	2025
8	Sept. 8	Eureka	2035	Resolute	0155
9	Sept. 9	Resolute	1725	Resolute	2200
10	Sept. 10	Resolute	1405	Mould Bay	1800
11	Sept. 10	Mould Bay	1810	Inuvik	2300
12	Sept. 12	Inuvik	1645	Holman	2110

MAP 7-1970 East

September 4-12

Flight Effectiveness

Nine tracks were carried out over the eastern part of the archipelago during Flight 7. The results of the Flight were much better than might be expected because all the surveys were completed in the brief interval between the systems that bring weather to the area. The Flight was nearly 100 per cent effective. This was the most successful of all flights conducted in this area at this time of year since the Polar Continental Shelf Project sea-ice reconnaissance surveys were started in 1961.

Ice Conditions

Flight 7 started immediately after the previous series of surveys were completed. On the average about 10 days separated the surveys of Flights 6 and 7 over a given area. During this interval a number of changes took place. Jones Sound and Wellington Channel became ice-free. More multi-year ice was observed in M'Clure Strait and Viscount Melville Sound but concentrations between Ellef Ringnes Island and Penny Strait were reduced. The most ominous change was the complete break-up of the ice cover in Prince Gustaf Adolf Sea.

If the winds persisted from the proper quadrant, this break-up would permit multi-year ice from the Arctic Ocean to move into the archipelago to replace ice ablated during the melt season. By the end of Flight 7-1970, this invasion had not started.

New ice was beginning to form in many areas. Puddles had frozen over and a ten tenths snow cover had appeared in the northern half of the area.

Unobserved Areas

The ice conditions in Admiralty Inlet, Navy Board Inlet, Pond Inlet and the central, western part of Baffin Bay were derived from satellite photographs. Fog prevented a survey of Hazen Strait, but the information gathered during track 1 and track 8 indicated that the ice cover remained solid.

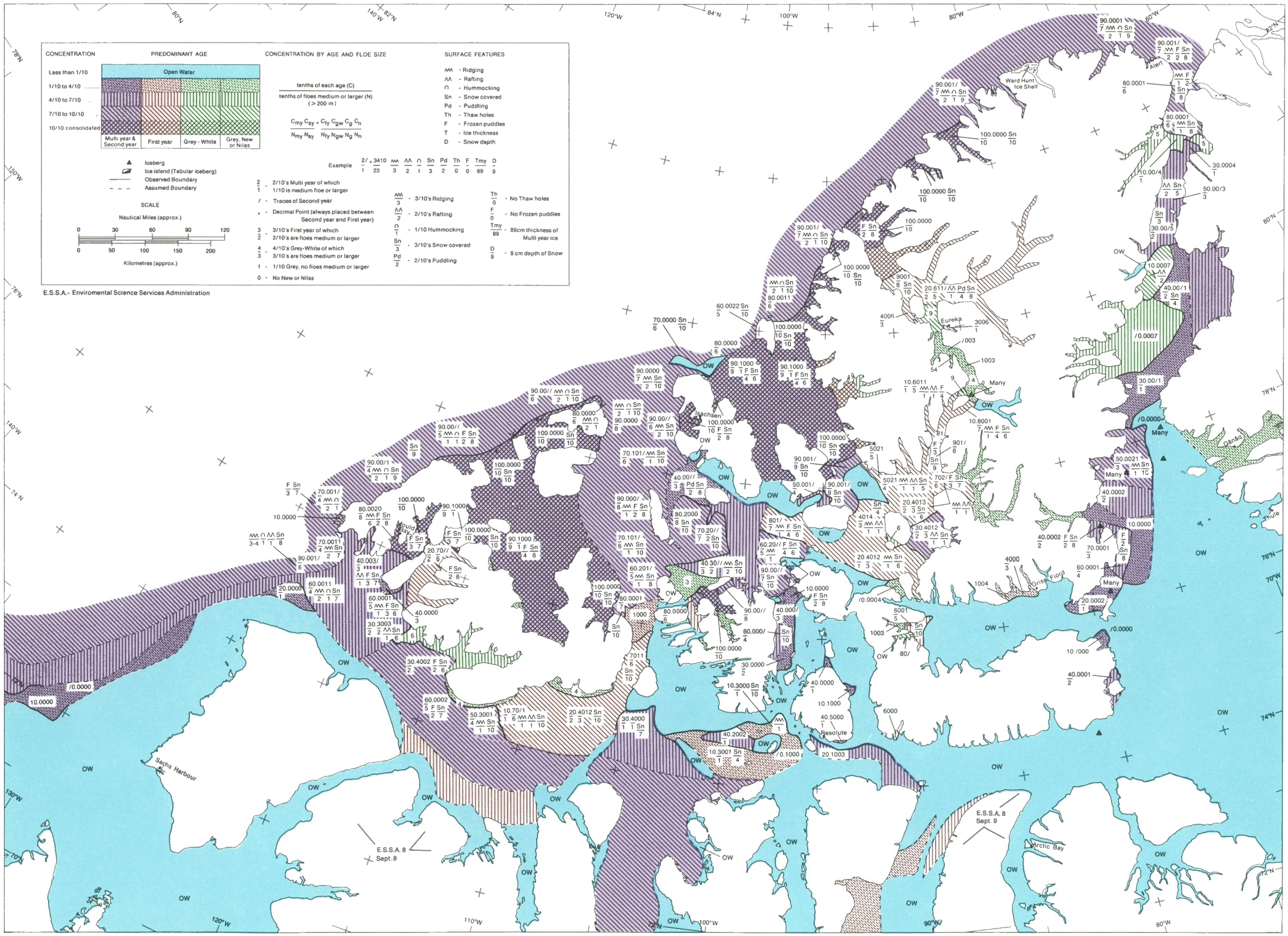
Comments

The concentrations of multi-year ice in M'Clure Strait and Viscount Melville Sound had increased during the interval between the two flights. Multi-year ice was not moving through Byam Martin Channel so this increase must have come from the Arctic Ocean through M'Clure Strait. Occasionally this type of movement will result if winds persist from the required direction and the ice in the channels is in motion.

An ice island about 1½ by 3 kilometres in size was located about 50 kilometres northwest of Bukken Fiord at 81° 03′N, 98° 20′W.

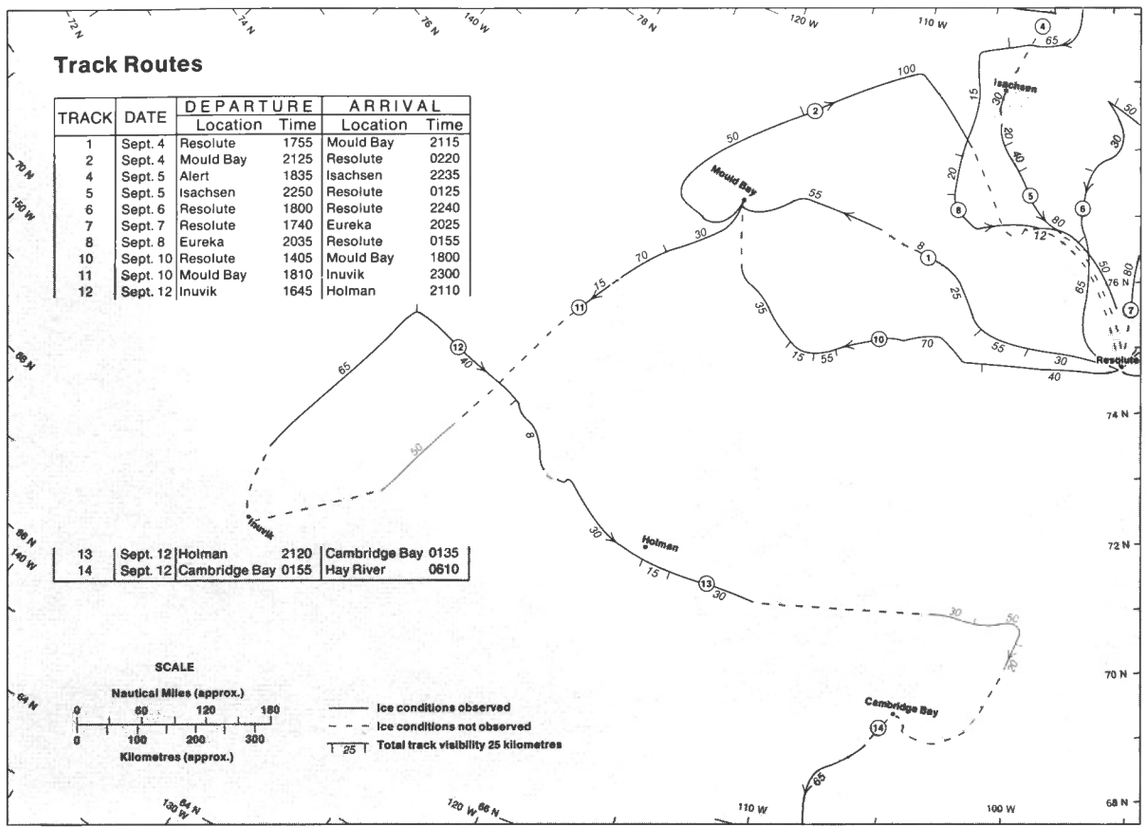
Although there was a considerable increase in the area of new ice observed during Flight 7, the overall concentration of the total ice cover remained the same as that shown on Map 6. This indicates that older ice continued to melt in some areas while new ice was forming in others.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 7 - 1970 EAST

September 4-12, 1970



half drifted south to melt as it moved through Victoria Strait and Queen Maud Gulf.

The ice in the central part of the Beaufort Sea moved about 30 kilometres closer to the mainland coast. This movement took place during the 22-day interval between August 21 and September 12.

Unobserved Areas

Information from satellite photographs and subsequent flights were used to estimate the ice conditions in Peel Sound, and northern M'Clintock Channel. Once they become ice-free, the southern channels separating Victoria and Banks Islands from the mainland remain open until new ice starts to form in protected areas during the first weeks of October.

Comments

A large fragment, about one eighth of the size of the original island, had broken from T-1 during the summer. This piece was located at 70° 43′N, 102° 05′W. The main island was located about 10 kilometres further east at 70° 35′N, 101° 30′W.

The zone separating freezing from non-freezing air masses was gradually moving south. Severe aircraft icing encountered during track 11 on September 10 indicated the zone was located near the 73°N parallel of latitude.

MAP 7-1970 West

September 4-12

Flight Effectiveness

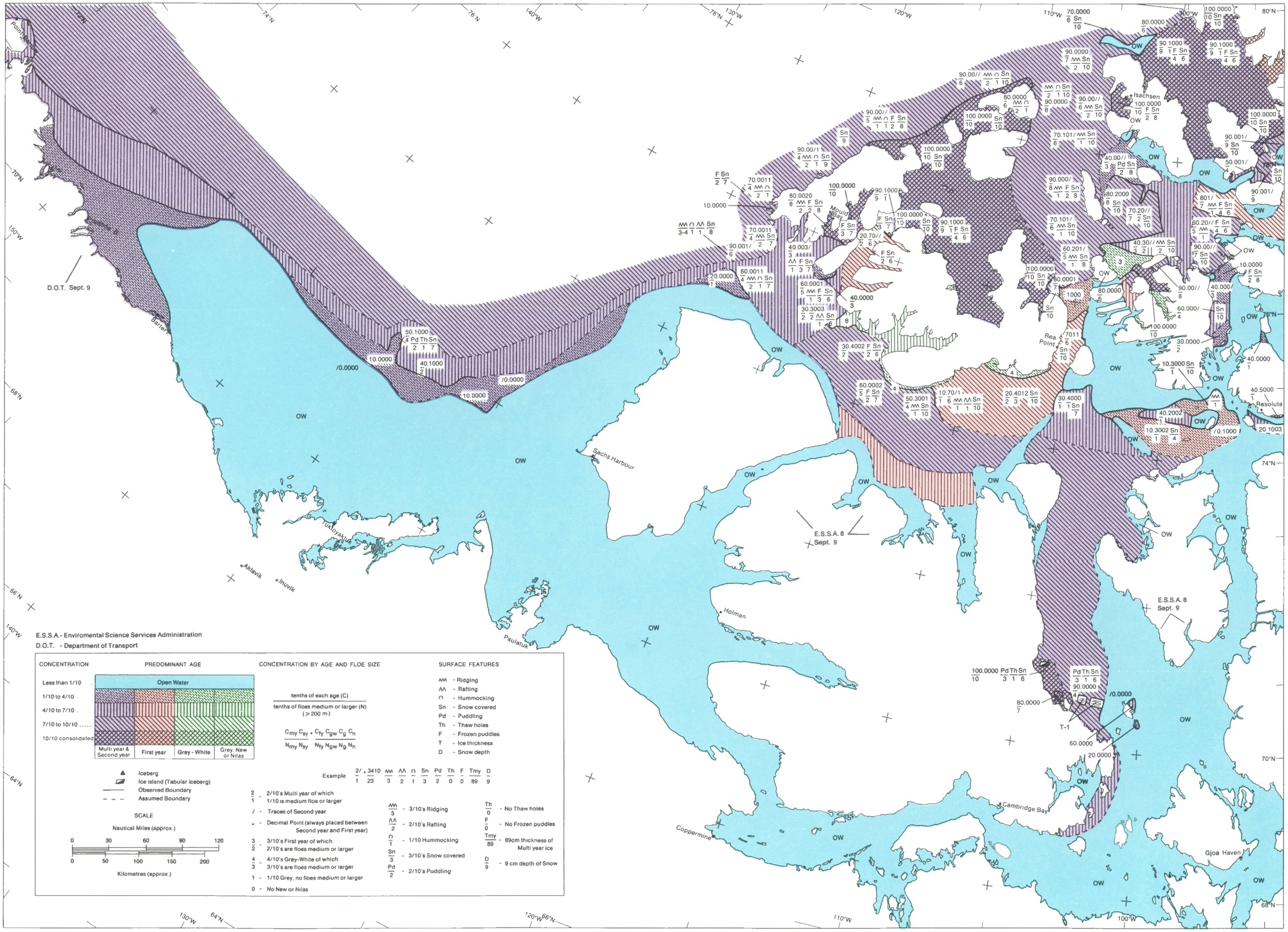
The degree of success for Flight 7 West ranged from fair to very good. Generally, some low cloud interrupted observations during a part of each track. Severe aircraft icing significantly reduced the effectiveness of track 11. The Flight was about 60 per cent effective which is usual for this time of year.

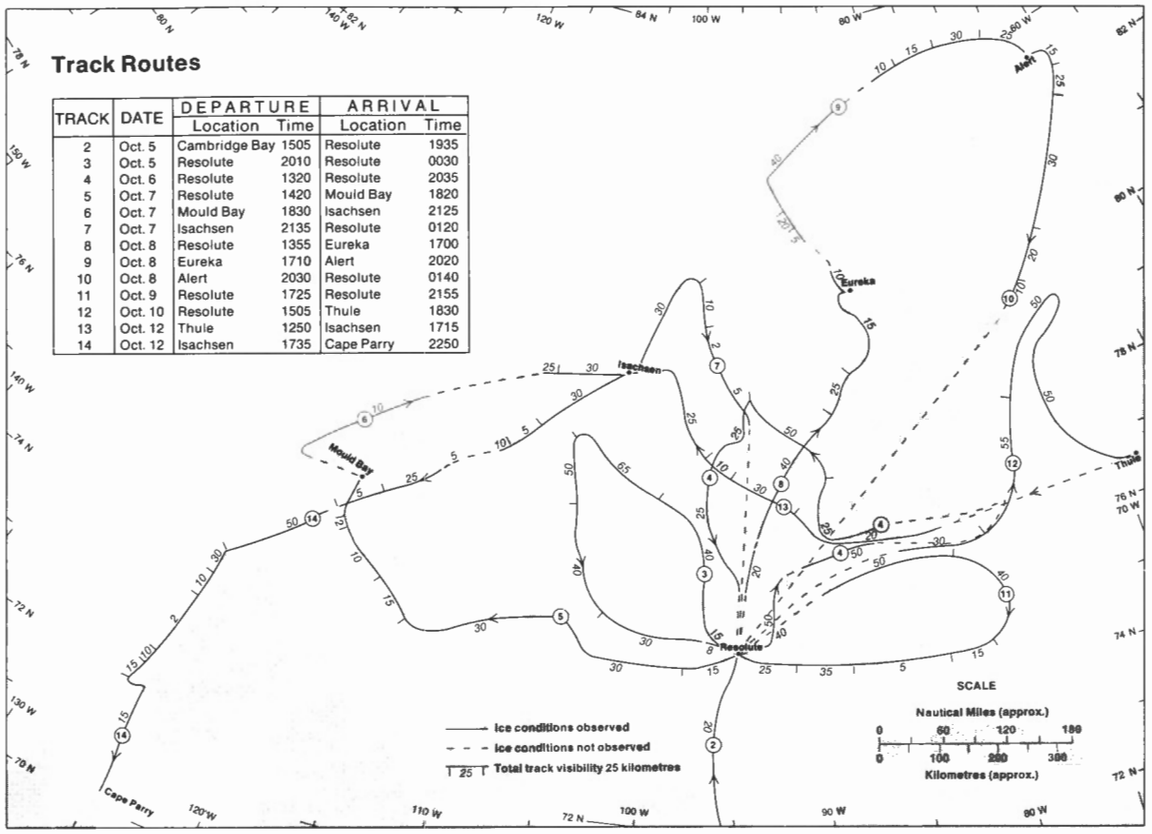
Ice Conditions

Probably the greatest extent of open water in the Beaufort Sea in 1970 occurred near the beginning of September, although this amount of open water was not unusually large. The greatest ice-free extent in the interior channels likely occurred on or slightly before September 15. However, the extent of the ice-free area in M'Clintock Channel and the adjacent area was remarkable considering that in some years the ice cover in M'Clintock Channel and Victoria Strait does not break up and in most years the freezing season starts before the overall ice cover has been reduced to nine tenths.

Although freezing conditions prevailed in the northern parts of the archipelago, the puddles in the channels to the south of Parry Channel remained unfrozen and new ice had not yet started to appear.

Between Flights 6 and 7 clearing had continued in the southern half of M'Clintock Channel. Probably half of the ice disappeared by melting in situ while the other


Point Barrow
Barter I.
D.O.T. Sept. 9
Sachs Harbour
Ukkoyaktuk
Aklavik
Inuvik
Holman
Paulatuk
Isachsen
Mould Bay
Rea Point
Resolute
Cambridge Bay
Coppermine
Gjoa Haven
E.S.S.A. 8 Sept. 9
E.S.S.A. 8 Sept. 9
T-1
OW
E.S.S.A.- Enviromental Science Services Administration
D.O.T. - Department of Transport
CONCENTRATION
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
PREDOMINANT AGE
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N) (> 200 m)
SURFACE FEATURES
Ridging
Rafting
Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Example
2/ • 3410 3 2 1 3 2 0 0 89 9
2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas
3/10's Ridging
2/10's Rafting
1/10 Hummocking
3/10's Snow covered
2/10's Puddling
No Thaw holes
No Frozen puddles
89cm thickness of Multi year ice
9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	Oct. 5	Cambridge Bay	1505	Resolute	1935
3	Oct. 5	Resolute	2010	Resolute	0030
4	Oct. 6	Resolute	1320	Resolute	2035
5	Oct. 7	Resolute	1420	Mould Bay	1820
6	Oct. 7	Mould Bay	1830	Isachsen	2125
7	Oct. 7	Isachsen	2135	Resolute	0120
8	Oct. 8	Resolute	1355	Eureka	1700
9	Oct. 8	Eureka	1710	Alert	2020
10	Oct. 8	Alert	2030	Resolute	0140
11	Oct. 9	Resolute	1725	Resolute	2155
12	Oct. 10	Resolute	1505	Thule	1830
13	Oct. 12	Thule	1250	Isachsen	1715
14	Oct. 12	Isachsen	1735	Cape Parry	2250

MAP 8-1970 East

October 5-12

Flight Effectiveness

Low cloud ceilings, fog, aircraft icing and darkness exerted their combined influence on the tracks carried out during Flight 8 over the eastern part of the region. Although the weather during the previous set of surveys over this area was much better than usual, the weather encountered during Flight 8 was normal and the Flight was judged to be 40 to 45 per cent effective.

Ice Conditions

During the month-long interval between Flights 7 and 8, the solid ice cover remained across Ballantyne Strait and Hazen Strait, Peary Channel and Hassel Sound, Sverdrup Channel and Massey Sound as well as Nansen Sound. No multi-year ice entered the archipelago through these channels. Changes ranged from the important development of the young ice types to minor variations in the ice regime. A few of the latter would include the break-up in the northern half of Peary Channel and the rapid freezing and formation of a cover of thin first-year ice on Eureka Sound.

An increase in the concentrations of multi-year ice in the western part of M'Clure Strait indicated that more ice had moved into the strait. Movement south through Byam Martin Channel seemed to progress in sporadic pulses with the result that relatively small quantities of multi-year ice had drifted into Viscount Melville Sound. Most of the southerly movement during the interval between the two flights was through Nares Strait. Here the currents are much stronger than in the two other areas where winds are the main cause of movement.

Unlike the previous ones, Map 8 East does not show the overall ice conditions for the entire area because in the interval between Flights 7 and 8 the existing patterns and distributions were completely changed because of movement and the rapid formation of the new ice types. Moreover, because many of the same areas remained unobserved after Flight 9, there was no data available to confirm or justify any type of extrapolation or assumptions on Map 8 East.

Unobserved Areas

It is probable that the ice conditions in the small unobserved areas adjacent to the observed places were similar. A solid cover of mainly multi-year ice likely extended across Hecla and Griper Bay, Hazen Strait, Ballantyne Strait and Wilkins Strait. A similar situation probably prevailed in the channels between Axel Heiberg Island and Ellef Ringnes Island. The central channels east from Sabine Peninsula to Ellesmere Island maintained a moving cover of mostly multi-year ice. A moving cover consisting of the various types of young ice had developed in the channels south and east of Resolute. These ice conditions as well as those in Nansen and Greely Fiord and Baffin Bay would likely resemble the conditions shown on Map 9-1970 East.

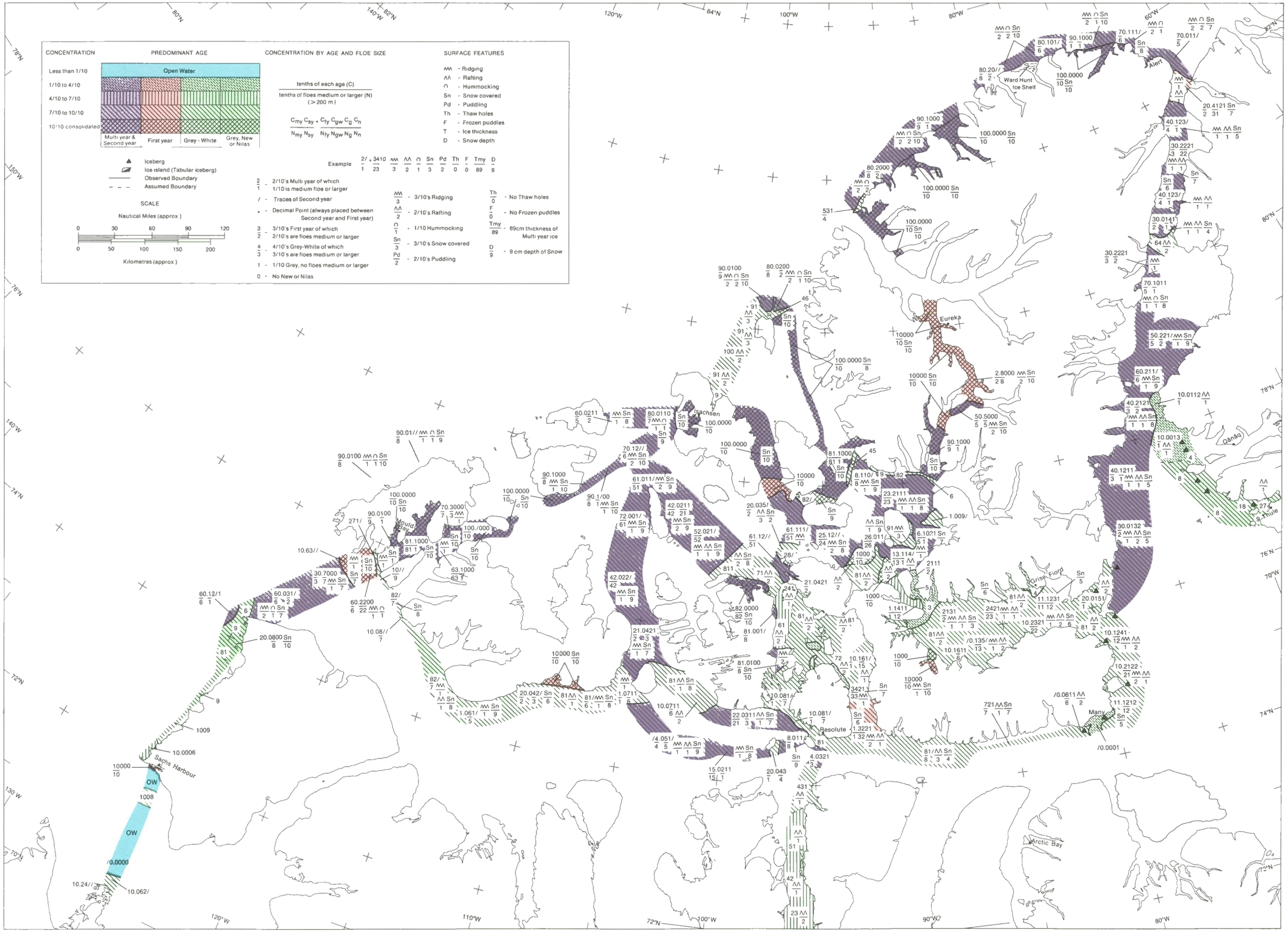
Comments

At this time of year, a four-week interval between flights is too long. The schedule of flights in later years would be changed to increase the coverage during this critical period.

The ice has a birthday on October 1. Any first-year ice remaining unmelted is then considered second-year and any second-year ice which remains is referred to as multi-year ice. Of course the young ice types are referred to as first-year ice when the thickness is 15 cm or more.

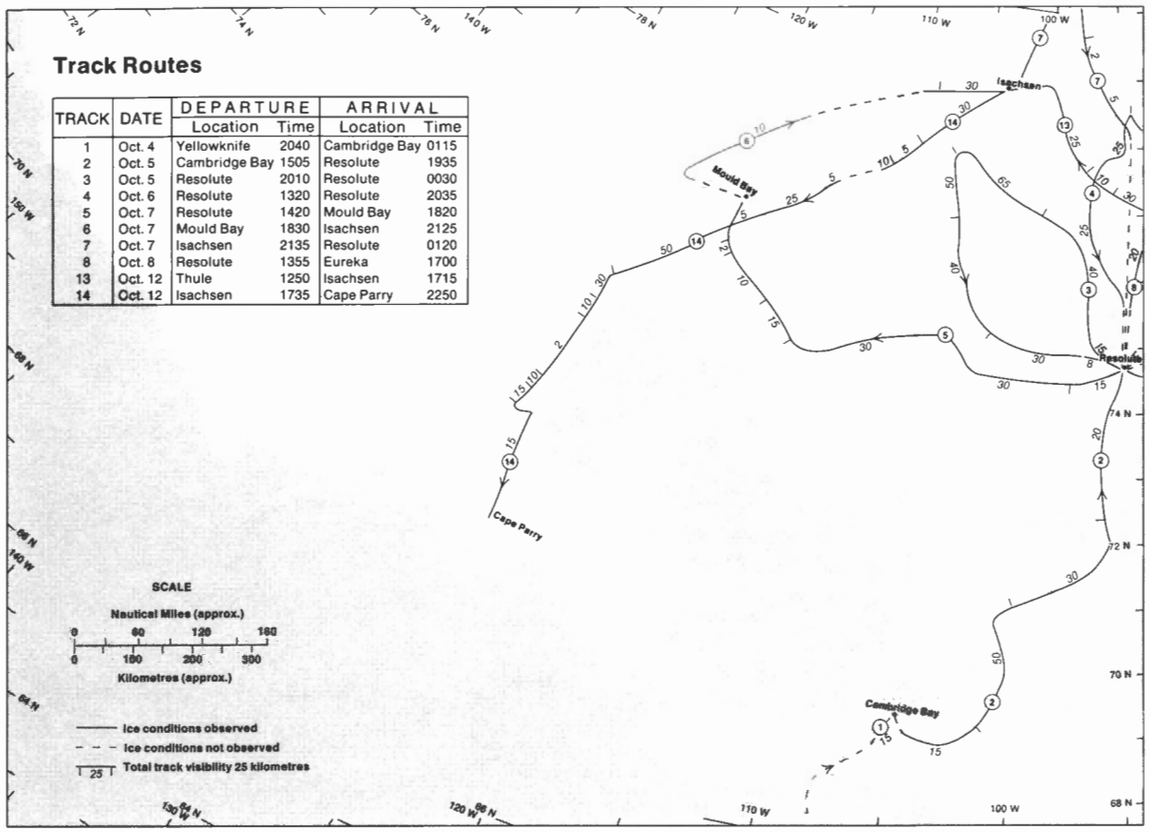
The last ship left Resolute on October 6.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 8 - 1970 EAST

October 5-12, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 4	Yellowknife	2040	Cambridge Bay	0115
2	Oct. 5	Cambridge Bay	1505	Resolute	1935
3	Oct. 5	Resolute	2010	Resolute	0030
4	Oct. 6	Resolute	1320	Resolute	2035
5	Oct. 7	Resolute	1420	Mould Bay	1820
6	Oct. 7	Mould Bay	1830	Isachsen	2125
7	Oct. 7	Isachsen	2135	Resolute	0120
8	Oct. 8	Resolute	1355	Eureka	1700
13	Oct. 12	Thule	1250	Isachsen	1715
14	Oct. 12	Isachsen	1735	Cape Parry	2250

MAP 8-1970 West

October 4-12

Flight Effectiveness

The two tracks completed over the western area were marginally successful; satellite coverage was good but was not used because of the lack of definition of young ice types. The Flight effectiveness was less than 40 per cent.

Ice Conditions

Based on the limited observations on the periphery of the area, considerable change had taken place between Flights 7 and 8. The main difference was the growth of a new ice cover over most of the areas which were previously ice-free. In Viscount Melville Sound and M'Clure Strait, a band of mainly grey and new ice had developed along the south coast of Melville Island. Other changes, hinted at by the observed conditions, seem to be an increase in the concentrations of multi-year ice in M'Clure Strait as well as in the southeastern part of Viscount Melville Sound.

Unobserved Areas

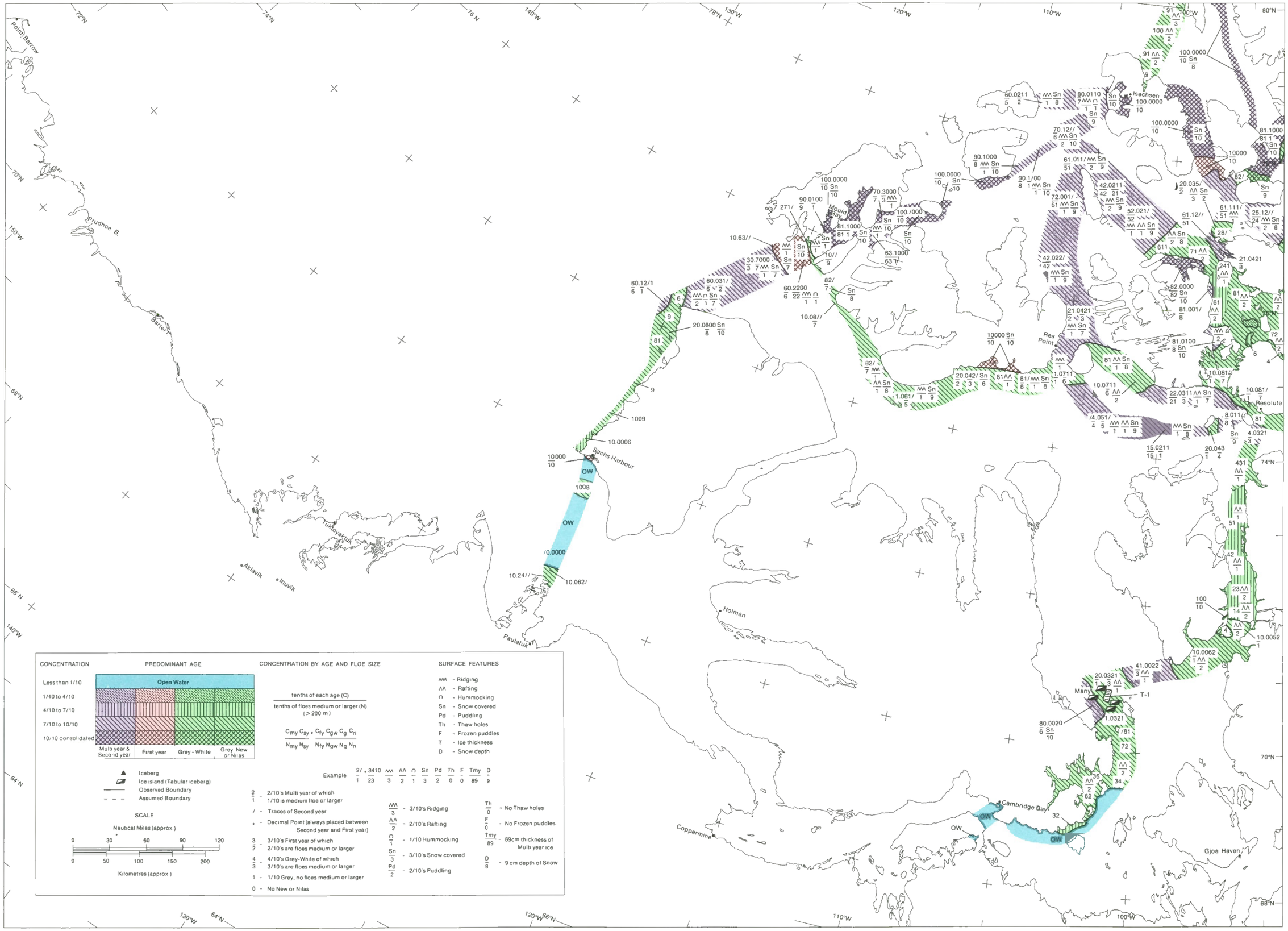
The ice conditions in the majority of the channels in the western area remained unobserved at the end of Flight 8. However, the ice conditions are fairly well known. Good satellite photographs of the area were obtained on October 8 and 9. Unfortunately, it is not possible to distinguish between open water and new ice on the E.S.S.A.-8 satellite photographs. Because of this problem, no definitive interpretation could be made and shown on Map 8-1970 West. However, on the basis of the satellite information, the current surveys, and the distributions noted in other years, it is likely that the following ice conditions would be found.

The channels separating Banks Island and Victoria Island from the mainland, from Amundsen Gulf in the west to Rasmussen Basin in the west, were mainly ice-free with some newly formed ice appearing in sheltered areas. Concentrations of multi-year ice in M'Clintock Channel ranged from seven to eight tenths in the central part while equal areas of open water and new ice extended along the east coast of Victoria Island in a band ranging up to 25 kilometres wide. The central portions of Parry Channel from Barrow Strait west to the Arctic Ocean was eight to nine tenths covered with mainly multi-year ice along with a few tenths of new ice. A band of new ice similar to the one along the south coast of Melville Island ran along the northern shores of Banks and Victoria Islands. New ice had spread across Richard Collinson Inlet and Wynniatt Bay while Hadley Bay was mainly ice-free although new ice was forming. The northern half of Prince of Wales Strait contained a few tenths of multi-year and a few tenths of new ice but the southern portion, except for some nilas, was mainly ice-free.

In the Beaufort Sea the multi-year ice had moved to within 50 kilometres of Banks Island and 75 kilometres of Tuktoyaktuk. The ice conditions shown along the west coast of Banks Island indicate the condition in the remainder of the area where the pack approached the coast. Probably this fringe area was pinched out near Herschel Island and Cape Prince Alfred where the pack ice reached the coast.

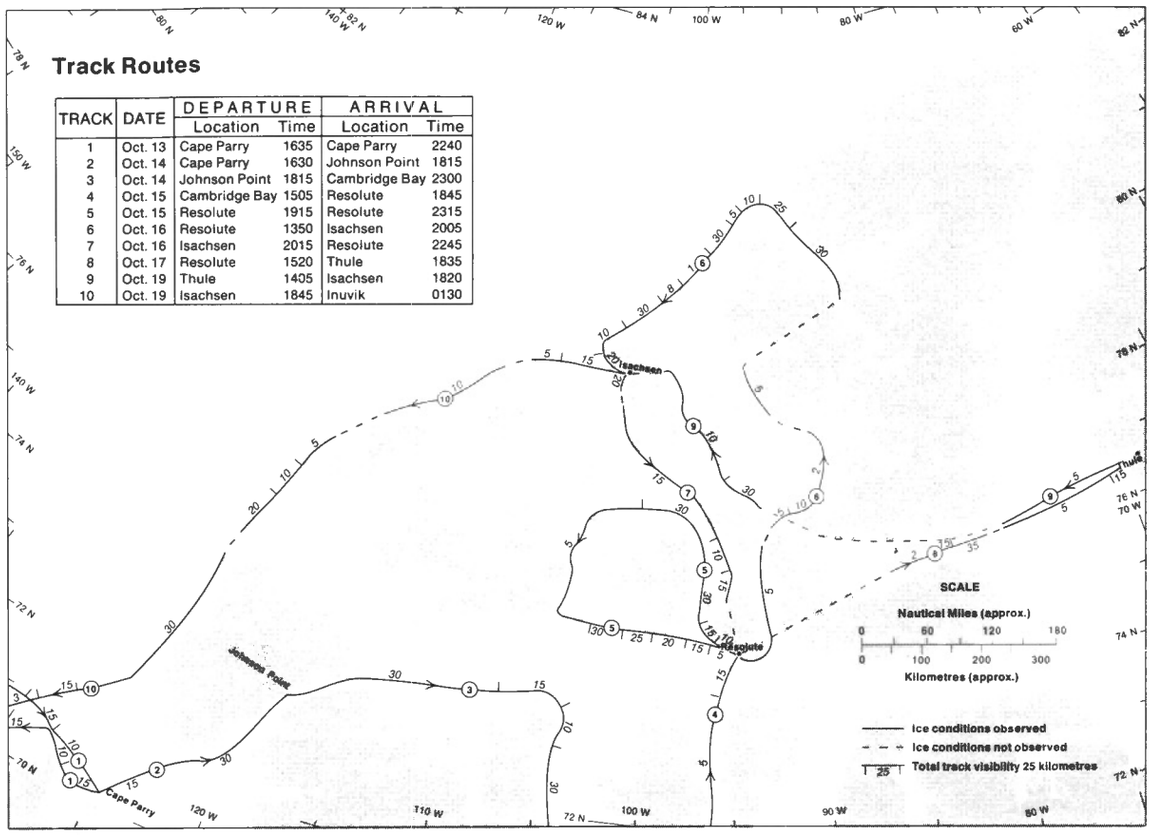
Comments

Hundreds of ice island fragments of varying sizes were seen near Gateshead Island. The main part of T-1 still remained intact. Its estimated dimensions were 25 kilometres from north to south and 15 kilometres from east to west.



MAP 8 - 1970 WEST

October 4-12, 1970



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 13	Cape Parry	1635	Cape Parry	2240
2	Oct. 14	Cape Parry	1630	Johnson Point	1815
3	Oct. 14	Johnson Point	1815	Cambridge Bay	2300
4	Oct. 15	Cambridge Bay	1505	Resolute	1845
5	Oct. 15	Resolute	1915	Resolute	2315
6	Oct. 16	Resolute	1350	Isachsen	2005
7	Oct. 16	Isachsen	2015	Resolute	2245
8	Oct. 17	Resolute	1520	Thule	1835
9	Oct. 19	Thule	1405	Isachsen	1820
10	Oct. 19	Isachsen	1845	Inuvik	0130

MAP 9-1970 East

October 13-19

Flight Effectiveness

During Flight 9 the weather was very stable resulting in ice crystals or ice prisms which considerably reduced horizontal visibility. The low sun angle added to the problems because it did not provide enough light to see the ice surface while at the same time it appeared to increase the brightness of the haze, making it even more difficult to make observations. The results of the six surveys ranged from fair through very poor to none at all. The Flight over the eastern part of the region was judged to be between 30 and 40 per cent effective.

Ice Conditions

There was very little change in the total area of ice observed during Flights 8 and 9. The main change was an increase in the thickness of the younger forms. A secondary difference was the appearance of solid ice covers in protected areas. In some areas such as northern Norwegian Bay, Eureka Sound and its adjacent fiords and McDougall Sound, the ice would remain solid until the following summer. In other channels such as Byam Martin, Byam and Austin, the solid cover would break-up and re-freeze a number of times before final consolidation would take place. Finaly freeze-up in Admiralty Inlet, Navy Board Inlet, Pond Inlet and the southern half of Nansen Sound would soon take place.

The ice cover in southern Norwegian Bay and Belcher Channel would consolidate next followed by Jones Sound and the channels surrounding Lougheed Island. Peel Sound, Wellington Channel and the channels to the north, west and east of Byam Martin Island would solidify next. The last to stop moving would be Barrow Strait. Occasionally, the ice in the eastern part of Barrow Strait, Lancaster Sound and Prince Regent Inlet remains in motion throughout the winter.

The multi-year ice which was moving south from Nares Strait into Baffin Bay during Flight 8 had continued its drift and by the end of Flight 9 had crossed the eastern entrances to Jones Sound and Lancaster Sound.

Unobserved Areas

Some areas remained unsurveyed at the end of Flight 9-1970 East and the following ice conditions probably existed in them. The northern part of Nares Strait supported a moving cover of multi-year ice. Archer Fiord was solid grey white ice. Around northern Ellesmere Island, the ice conditions were similar to those shown on Map 8-1970 East. A solid cover of multi-year ice extended through Fitzwilliam Strait and into Hazen Strait, Ballantyne Strait, Wilkins Strait and Hecla and Griper Bay. Similarly, a solid cover had developed on Danish Strait, Hendriksen Strait and the northern half of Norwegian Bay. An east-west line across the southern half of Norwegian Bay, which extended through Belcher Channel, separated the multi-year floes from the rapidly developing grey white ice. Except for a small area of young ice north of Penny Strait and Helena Island, a moving cover of multi-year ice stretched across the remainder of the area. Desbarats Strait was mainly grey white ice. The multi-year ice in the remainder of the channels surrounding Lougheed Island including Maclean Strait and Prince Gustaf Adolf Sea continued to move.

Comments

The final dates of freeze-up are not known. Probably freeze-up would progress from northern areas such as Prince Gustaf Adolf Sea toward Barrow Strait.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

D.O.T. - Department of Transport

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$\frac{C_{my}\ C_{sy} * C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$

Example: 2/1 * 3410 MM/3 AA/2 ∩/1 Sn/3 Pd/2 Th/0 F/0 Tmy/89 D/9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

MM/3 - 3/10's Ridging
AA/2 - 2/10's Rafting
∩/1 - 1/10 Hummocking
Sn/3 - 3/10's Snow covered
Pd/2 - 2/10's Puddling

SURFACE FEATURES

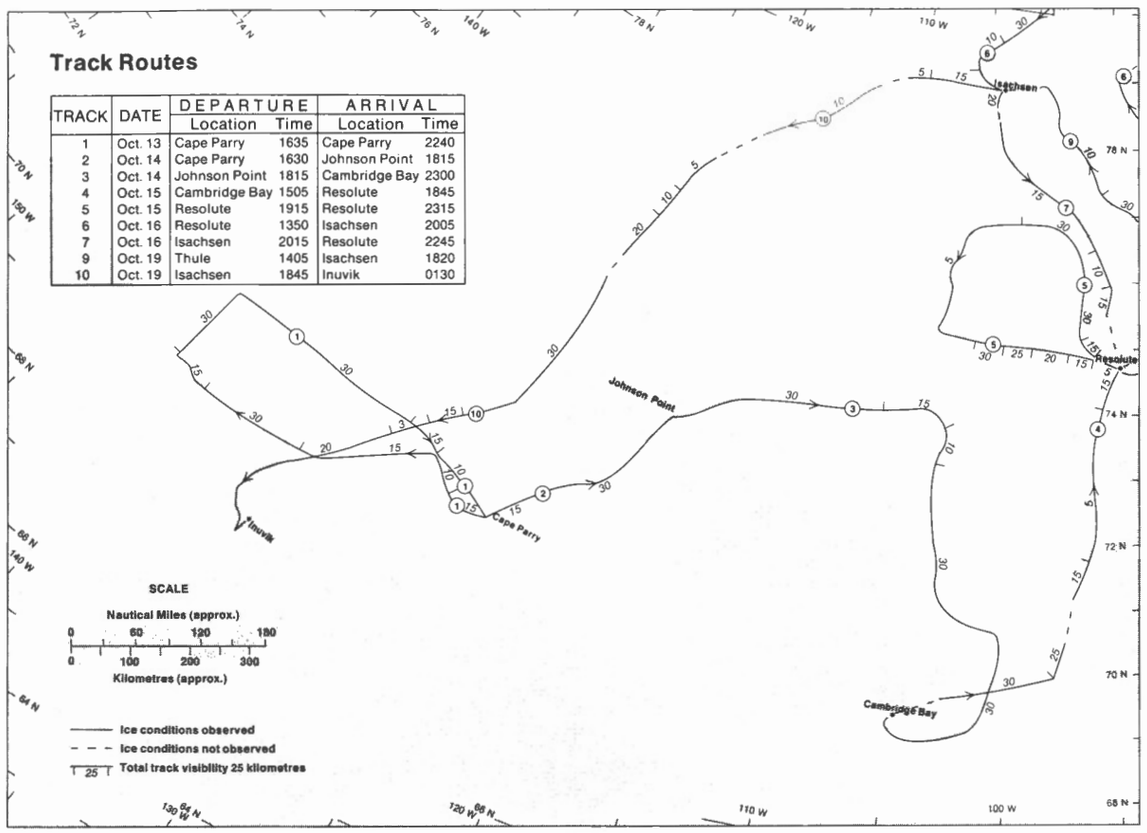
MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

Th/0 - No Thaw holes
F/0 - No Frozen puddles
Tmy/89 - 89cm thickness of Multi year ice
D/9 - 9 cm depth of Snow

Ward Hunt Ice Shelf
Alert
Eureka
Sachsen
Mould Bay
Sachs Harbour
Resolute
Arctic Bay
Qanaq
Thule
Grise Fiord
OW
D.O.T. October 13

MAP 9 - 1970 EAST

October 13-19, 1970



MAP 9-1970 West

October 13-19

Flight Effectiveness

Parts of two main areas remained unsurveyed at the end of Flight 9. Generally, the visibility during the tracks in the remaining areas was fair to good and the Flight was considered to be about 50 per cent effective.

Ice Conditions

The time interval between the start of Flight 8 and the end of Flight 9 was relatively short. No major changes took place during the period, and the advance of freeze-up seemed to be proceeding in a normal fashion and at the usual rate. New ice was forming in all areas and fresh snow covered most areas where the ice was comparatively stable.

The multi-year ice in the Beaufort Sea continued to invade the southern part of the area. This advance would be reversed at a later date because most of the area was covered with first-year ice in the spring of the following season.

Only small amounts of multi-year ice were drifting south from M'Clintock Channel through Victoria Strait and into Queen Maud Gulf.

The Mackenzie River was surveyed as far as Aklavik on October 19 during the course of track 10. With the exception of a few very small areas of open water along the length of the observed part, a solid first-year ice cover spread from shore to shore. This was blanketed by a ten tenths cover of fresh snow.

The band of new ice along the length of the east coast of Victoria Island was temporary. It would soon shift over to the west coast of Prince of Wales Island as the multi-year ice occupying the central part of M'Clintock Channel shifted back and forth.

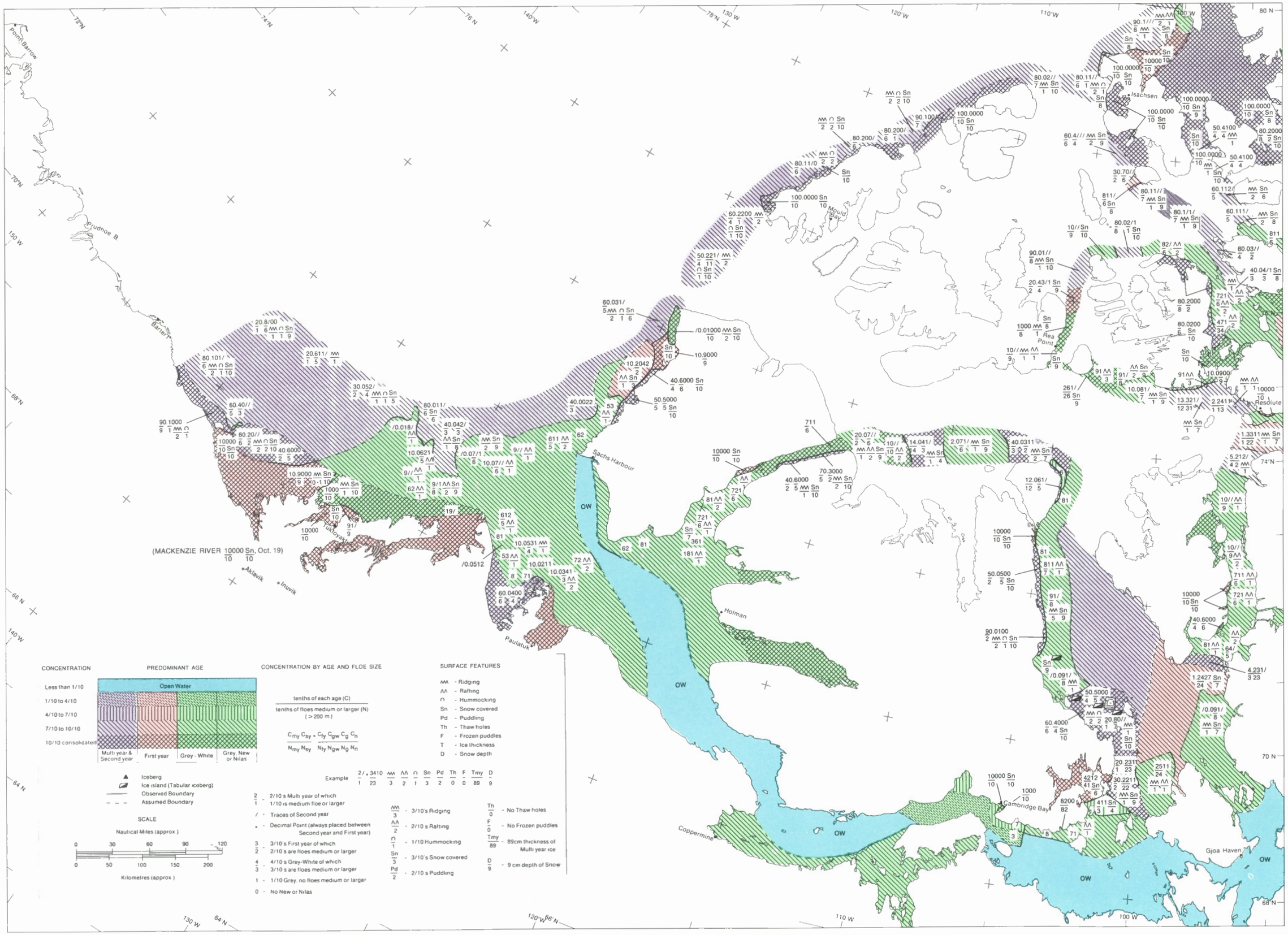
Unobserved Areas

Although open water seemed to prevail in Queen Maud Gulf and Rasmussen Basin, it is likely that nilas and new ice was rapidly forming. As in the previous areas, the ice conditions in the remaining channels between the mainland and Victoria and Banks Islands were determined on the basis of pilot reports and a satellite photograph taken on October 18.

Probably the western part of M'Clure Strait was at least six tenths covered with multi-year ice. This concentration would gradually fall to three tenths in the eastern half. Two north-south trending bands of multi-year ice stretched across the central part of Viscount Melville Sound. New ice had formed in the remaining areas. A solid ice cover had formed across the bays in the north part of Victoria Island.

Comments

Many ice island fragments were observed along the southern half of the east coast of Victoria Island. The main piece remaining of T-1 was about 13 kilometres east to west by 16 kilometres north to south. This piece was centred at 70° 40'N and 101° 05'W.



MAP 9 - 1970 WEST

October 13-19, 1970

SEASONAL SUMMARY: 1971

The ice conditions observed in all the straits and channels of the Canadian Arctic during the summer of 1971 were much better than normal in that large areas of open water developed and the ice cover in all the major channels broke up. Ablation and melting in 1971 progressed very rapidly after what seemed, in some areas, to be a rather slow start. It surpassed the 1970 season which was considered to be a good year with considerable open water. At its peak, the 1971 season almost reached the record levels of open water set later in 1973 and the all-time record of open water established in 1962.

There were a number of departures from the normal situation, most of these however reflecting the time of break-up, the amount of clearing and open water rather than a change in patterns and sequences of break-up.

Early in the year the ice in the western part of the archipelago, particularly the southern portion of the Beaufort Sea and Amundsen Gulf, seemed to be more concentrated than usual. By mid-June conditions in these areas resembled those normally expected. The progression of break-up in the channels linking Amundsen Gulf with Coronation Gulf seemed to lag behind the usual rate of advance but rapid ablation during the last weeks in July cleared all the ice from these channels by the usual time. This same rate of ablation also affected the ice in Victoria Strait and McClintock Channel. The latter area broke up at least four weeks earlier than usual and then became almost totally ice-free whereas a ninetenths cover of mainly multi-year ice usually exists in the area at the peak of the ablation season.

In the eastern part of the archipelago, the pattern of break-up appeared to be normal and there were no obvious indications of the season to follow until the first week in July. Extensive changes took place in July. The ice in the northern channels broke up at least four weeks ahead of normal. Open areas which usually do not develop until the end of the month were seen early in August and other areas which normally maintain a nine or ten tenths ice cover throughout the summer season became completely ice-free.

Despite the early break-up of the ice cover in the northern channels, only very limited amounts of ice moved into the archipelago from the Arctic Ocean and even smaller quantities managed to invade Parry Channel. This minor influx of multi-year ice was much less than expected given the ice-free conditions that developed.

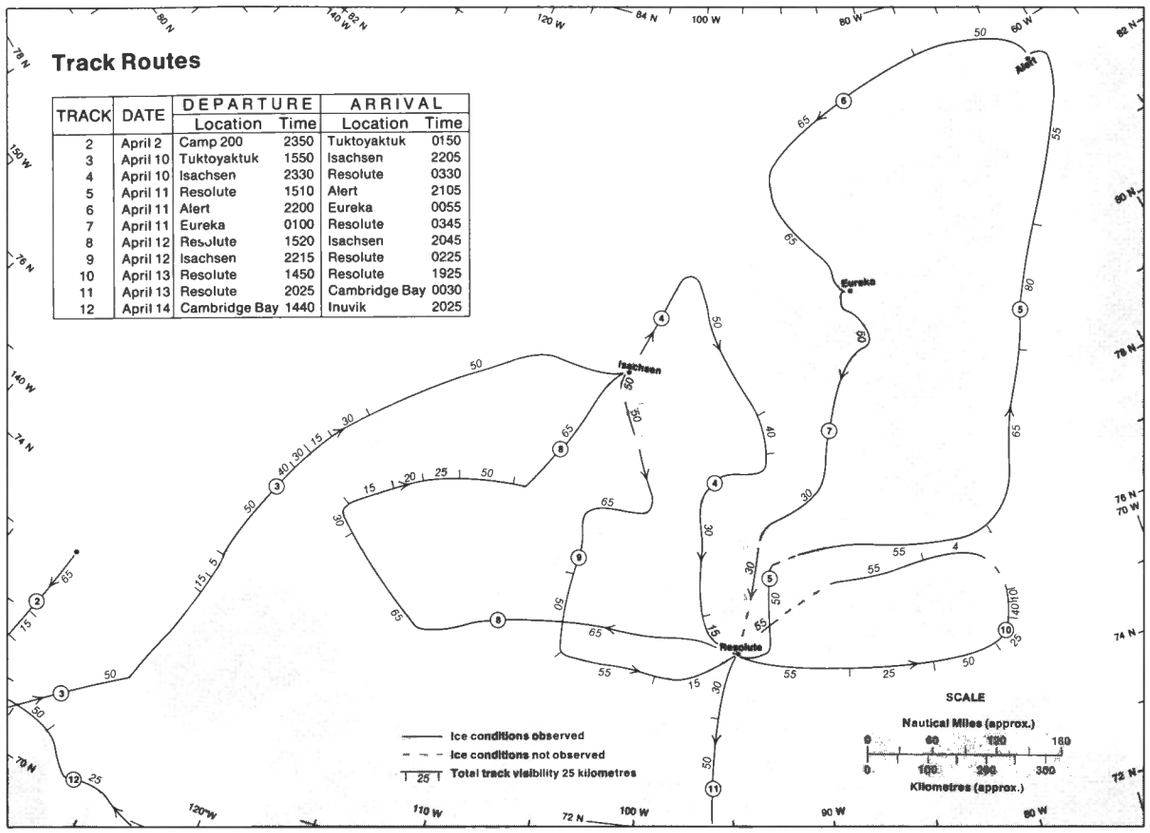
One minor departure from the usual situation was the small number of ice islands sighted along the fringe of the Arctic Ocean as well as the channels of the archipelago.

Just as break-up came much earlier than usual, the final date of freeze-up in most areas was probably a little later than normal. Unfortunately, darkness, ice prisms, ice fog and some blowing snow combined to reduce the effectiveness of the late season surveys to the point where they were only marginally effective and little freeze-up data could be collected. Although some efforts have been made to collect ice information during the clear moonlit periods in November and December, the results are not encouraging because the horizontal visibility is very limited.

The first six Flights in 1971 were made using a Beechcraft-18 aircraft. The last three Flights used a Twin Otter. The Twin Otter is easier to start in cold weather, provides greater flexibility for landing and can cope with more aircraft icing than the Beechcraft.

The final break-up of ice island T-1 which started in 1970 was completed in 1971. By the end of the season all that remained of the once huge ice island were hundreds of small pieces.

One cargo vessel, escorted by an icebreaker, made very good use of the ice-free conditions and was sighted more than 50 kilometres north of Penny Strait on September 7. It is unusual that any ship, including an icebreaker, attempts to penetrate this area.



MAP 1-1971 East April 2-14

Flight Effectiveness

Four days were required to conduct nine tracks over the eastern part of the region. Although sporadic patches of low cloud and ice fog occasionally reduced visibility, only once near the northeast tip of Devon Island did the weather in the form of ice prisms seriously impede observations. Generally, weather was at its optimum; the width of the area surveyed during each track averaged nearly 50 kilometres, and excellent coverage was obtained. The Flight was judged to be almost 90 per cent effective.

Ice Conditions

In general, ice conditions observed in the spring and shown on Map 1-1971 East reflect the patterns noted in the fall of 1970. Most of the areas previously supporting a young ice cover were now first-year ice. Some reduction in the overall concentrations of multi-year ice took place in Norwegian Bay and the southern part of Eureka Sound. Probably movements in the latter part of the 1970 season redistributed the older ice.

No major departures from normal were noted during Flight 1 although some minor variations should be commented upon. As in the previous year, a solid ice cover extended along the length of Lancaster Sound. This condition had recently developed because grey and grey-white ice was observed. This ice was bonding the older floes into a solid mass. The first strong winds would probably set the ice in motion once again.

Another variation, similar to that in Lancaster Sound, was the extent of solid ice observed along the western fringe of the archipelago from M'Clure Strait to the Lincoln Sea. Usually this ice shows more signs of movement than were observed during Flight 1. More movement than was evident can also be expected along the east coast of Devon Island where the shorefast ice does not normally extend more than a few kilometres from the coast.

The ice cover in Hell Gate and Cardigan Strait was almost total whereas it is normal to see some open water. No open water was observed in Penny Strait or near Baillie-Hamilton and Dundas Islands where it usually develops at this time of year.

Unobserved Areas

Ice conditions in unobserved areas north of Meighen Island and south of Devon Island likely reflected the situation shown for the adjacent areas. Undoubtedly the ice in the central part of Baffin Bay remained in motion, but the transition area between the younger types of ice and the first-year ice varieties remains unknown.

Hundreds of icebergs were clustered in small groups along the southeast coast of Ellesmere Island from Glacier Strait to Smith Bay. A solid ice cover prevented any movement.

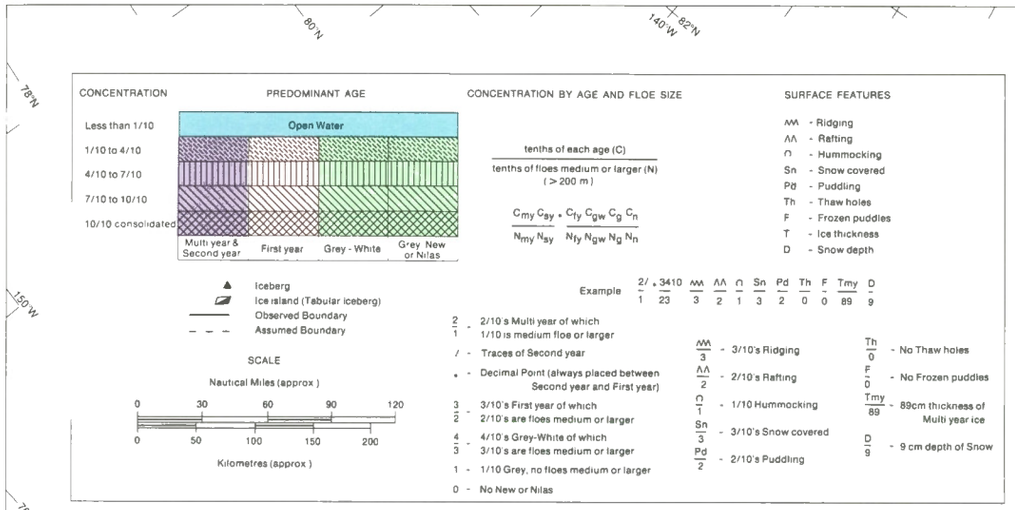
Comments

The solid ice cover in Lancaster Sound, along the northwestern fringe of the archipelago and off the east coast of Devon Island, probably reflected a week or two of relatively calm weather. When the winds increased again, the ice in these areas would break up and continue to move.

The start of Flight 1-1970 was delayed nine days due to a series of events generally related to the low temperatures, −40°C.

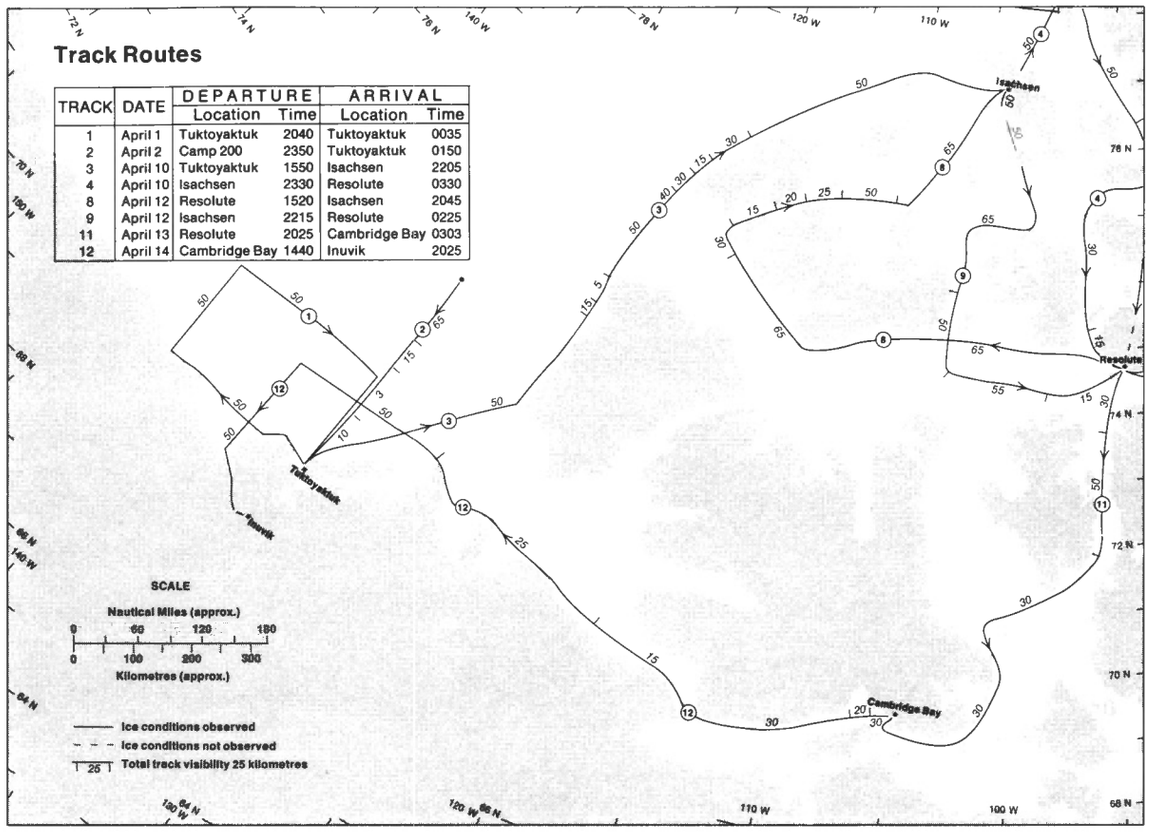
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 1 - 1971 EAST

April 2-14, 1971



MAP 1-1971 West April 1-14

Flight Effectiveness

The weather and the observing conditions during the surveys in the western part of the archipelago during Flight 1-1971 were good. Occasionally, low cloud, haze or ice fog briefly reduced the observer's visibility. Overall, the Flight was satisfactory and was judged to be 80 per cent effective.

Ice Conditions

Most of the areas supporting a young ice cover in the fall of 1970 supported a ten tenths cover of first-year ice the following spring. Other changes that occurred during the interval reflected the amount of movement which can take place in the late fall. When last observed in October, 1970 M'Clure Strait was mainly multi-year ice. A westerly drift took place sometime during the winter and the older ice moved out of the strait leaving room for the large area of first-year ice to develop. The fall observations in M'Clintock Channel indicated most of the area supported a multi-year ice cover. Prior to final freeze-up in the area, a westerly wind concentrated all the older ice along the coast of Prince of Wales Island and permitted a first-year ice cover to develop on the western half of the channel.

Large areas of first-year ice had recently formed in the southern Beaufort Sea and in the area west of Banks Island.

The lack of ridging in this area indicated that the first-year ice had formed recently to fill the open area left as the multi-year ice moved offshore.

The survey conducted on April 10 and pilot reports indicated that a solid ice cover extended across Amundsen Gulf. After four days of strong southerly winds the area was observed again on April 14. The broken area which was seen would probably re-freeze within a week and once again a solid ice cover would extend across the Gulf.

Between Kugmallit Bay and Point Separation a solid first-year ice cover was observed on the Mackenzie River. The snow cover was ten tenths.

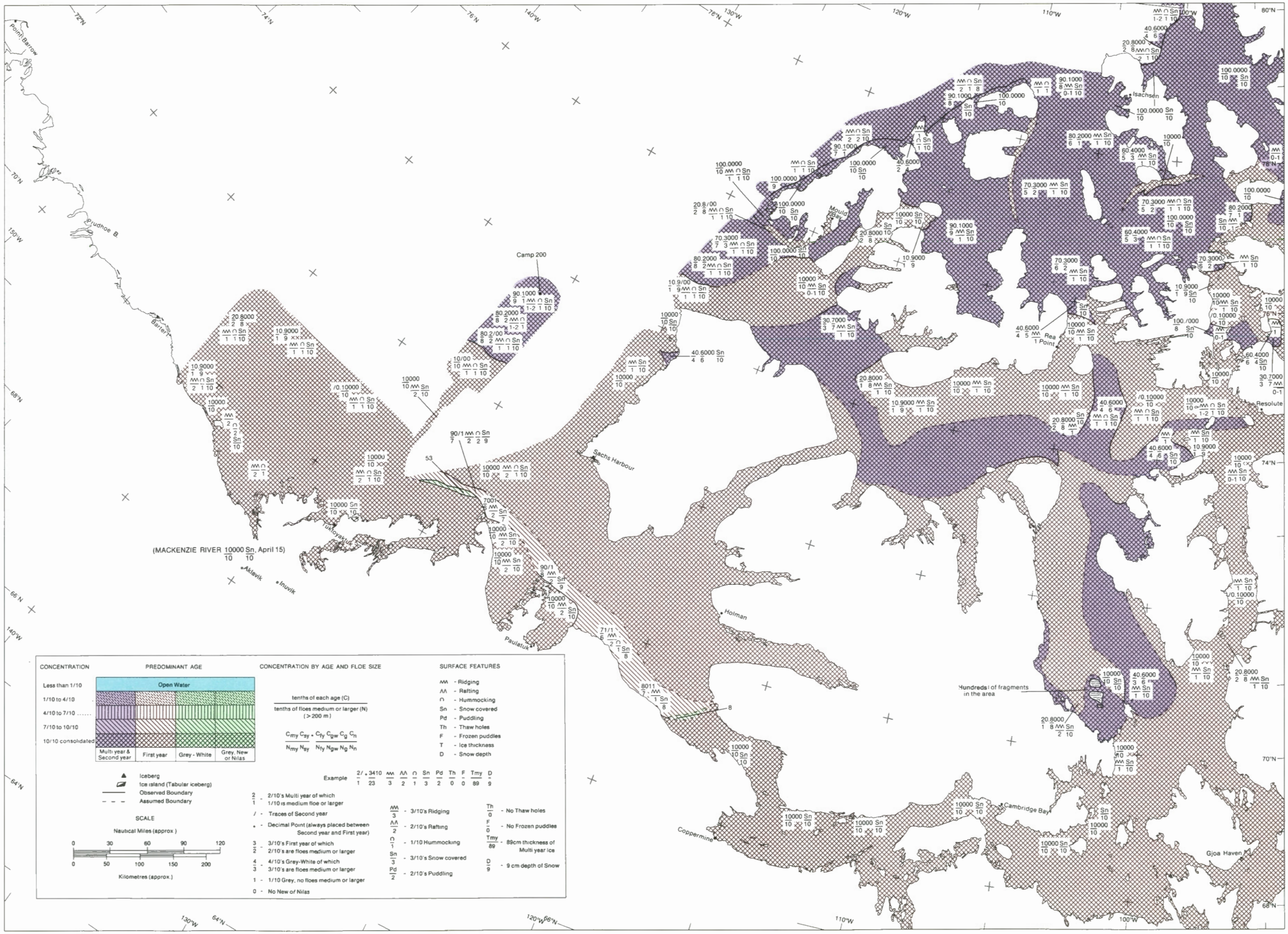
Unobserved Areas

The transition between first-year and multi-year ice in the eastern part of the Beaufort Sea probably occurred about 100 kilometres west of Banks Island. The east-west zone separating the two ice types likely tapered toward the coast and reached the mainland near Point Barrow from its observed position at 72° 30'N, 132°W. A small area of open water likely persisted in Bellot Strait.

Comments

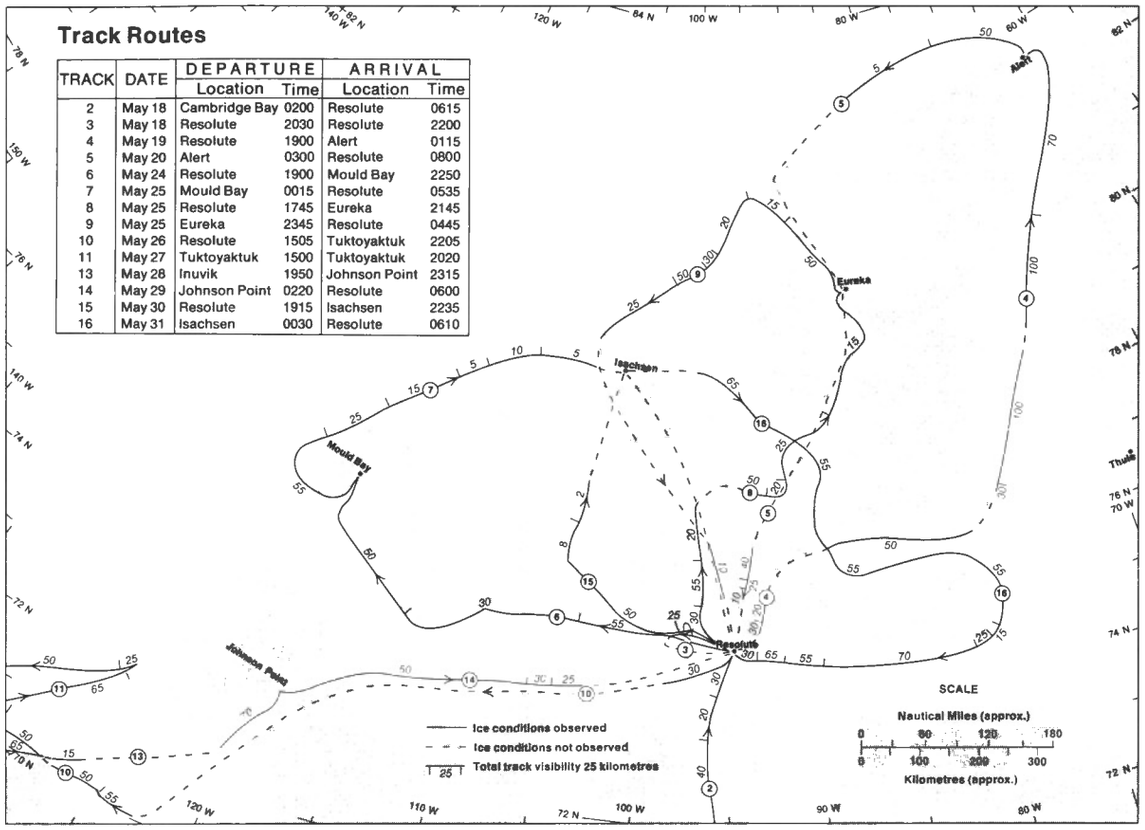
The Polar Continental Shelf Project set out a hydrographic survey camp, Camp 200, on the ice in the northern part of the Beaufort Sea at 74° 06'N, 131° 15'W on March 17. It was located at 73° 40'N, 131° 09'W on April 2. After the surveys were completed the camp was evacuated on April 15 from a position at 73° 52'N, 132° 00'W. During those four weeks the ice floe moved 120 kilometres. The net drift was about 35 kilometres to the west.

The Bathurst Polynya had not developed.



MAP 1 - 1971 WEST

April 1-14, 1971



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	May 18	Cambridge Bay	0200	Resolute	0615
3	May 18	Resolute	2030	Resolute	2200
4	May 19	Resolute	1900	Alert	0115
5	May 20	Alert	0300	Resolute	0800
6	May 24	Resolute	1900	Mould Bay	2250
7	May 25	Mould Bay	0015	Resolute	0535
8	May 25	Resolute	1745	Eureka	2145
9	May 25	Eureka	2345	Resolute	0445
10	May 26	Resolute	1505	Tuktoyaktuk	2205
11	May 27	Tuktoyaktuk	1500	Tuktoyaktuk	2020
13	May 28	Inuvik	1950	Johnson Point	2315
14	May 29	Johnson Point	0220	Resolute	0600
15	May 30	Resolute	1915	Isachsen	2235
16	May 31	Isachsen	0030	Resolute	0610

MAP 2-1971 East May 18-31

Flight Effectiveness

Weather was a constant problem during Flight 2. Low stratus cloud, fog or near whiteout conditions developed during some part of each track. Even when observations were possible, the extent was limited because in many areas the cloud ceiling restricted observations to an altitude of 500 feet or less. Of the 10 tracks carried out over the area only two, numbers 4 and 16, provided good coverage. Observing conditions for the remaining tracks ranged from fair to terrible. The flight was judged to be about 40 per cent effective.

Ice Conditions

During the month-long interval between Flights 1 and 2, a few minor but anticipated changes took place. The ice cover at the eastern and western entrances to Jones Sound had disappeared and the areas of open water were beginning to enlarge. The solid ice cover in Lancaster Sound had given way and the usual area of open water and ice edge between the solid and moving ice had developed between Devon Island and the northeast tip of Somerset Island.

Other small indications that summer was coming were noted in Penny Strait and at the northern end of Kane Basin near Cape Jackson where small areas of open water had appeared in their usual locations.

The snow cover throughout the eastern part of the archipelago was ten tenths. The ice in Norwegian Bay to the west of Graham Island seemed to have an especially thick snow cover.

The solid ice cover observed in the Arctic Ocean near the northern coasts of Axel Heiberg Island and Ellesmere Island was a temporary condition. Soon, winds and currents in the region would exert their combined influence and the brief period of consolidation would end.

Unobserved Areas

The ice conditions in many channels in the area including Prince Regent Inlet, Admiralty Inlet, Navy Board Inlet and Pond Inlet are shown on Map 2-1971 East because they are usually solid at this time of year and because they were observed to be solid during later surveys. Baffin Bay likely supported a nine tenths cover of mainly thin, first-year ice.

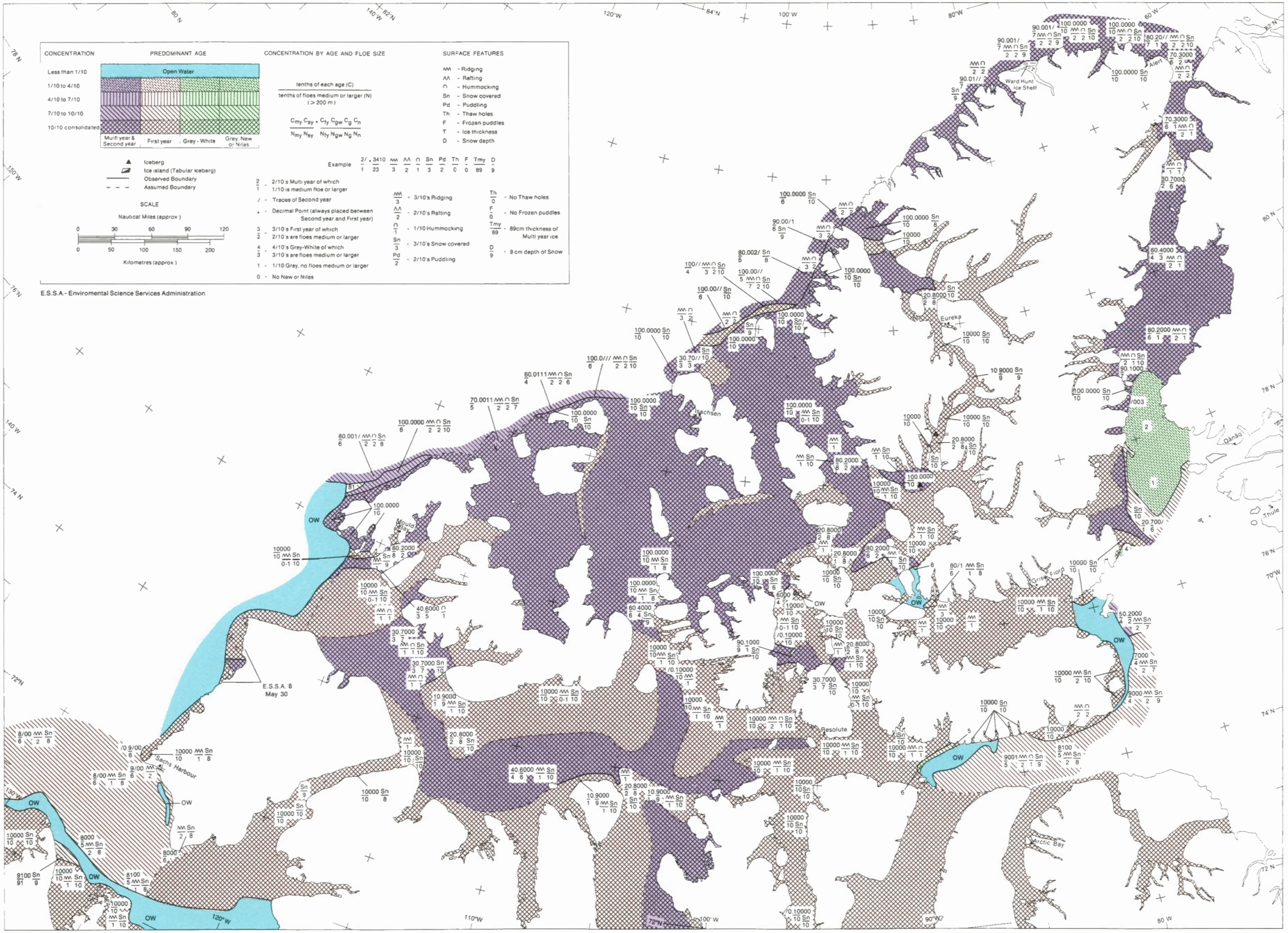
Comments

Ice conditions throughout the area appeared to be normal. The ice-free area in Penny Strait was not as large as usual and the open areas around the northern ends of Baillie-Hamilton Island and Dundas Island had not appeared.

The open area in the northern part of Kane Basin near Cape Jackson was surrounded by many icebergs, a normal situation at this time of year. During a period of ice movement the icebergs calved into the northern half of Peabody Bay, seemed to sweep to the north along the west coast of Greenland and then move south through the central part of Kane Basin.

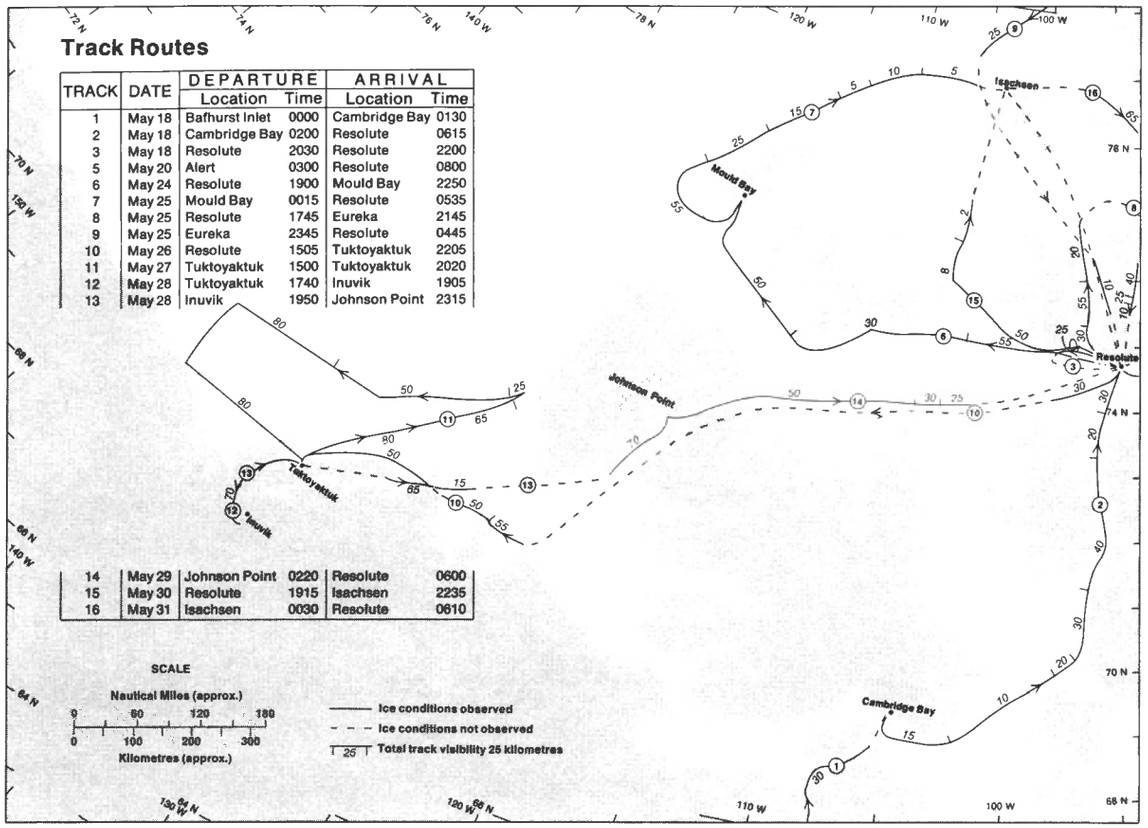
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 2 - 1971 EAST

May 18-31, 1971



MAP 2-1971 West May 18-31

Flight Effectiveness

Visibility during the eight tracks over the western part of the archipelago varied considerably as weather conditions ranged from poor to very good. Generally, observations during each track were limited to some extent by either low stratus cloud, freezing rain or fog. Overall, the Flight effectiveness was between 50 and 60 per cent.

Ice Conditions

The main changes that occurred between Flights 1 and 2 were the development of large areas of open water in Amundsen Gulf and in the vicinity of M'Clure Strait.

The changes in snow cover were not as obvious. Generally, most of the northern part maintained a ten tenths cover, while very rapid advances were occurring along the mainland coast. No puddles were seen on Kugmallit Bay on May 28 while a day later up to two tenths of the area was puddled. A similar development took place on Liverpool Bay between May 26 and May 28.

The Mackenzie River was surveyed on May 28. From Kugmallit Bay to Point Separation the concentration ranged between six and seven tenths of first-year ice. South of Point Separation the river was mainly open water although a few small floes were seen.

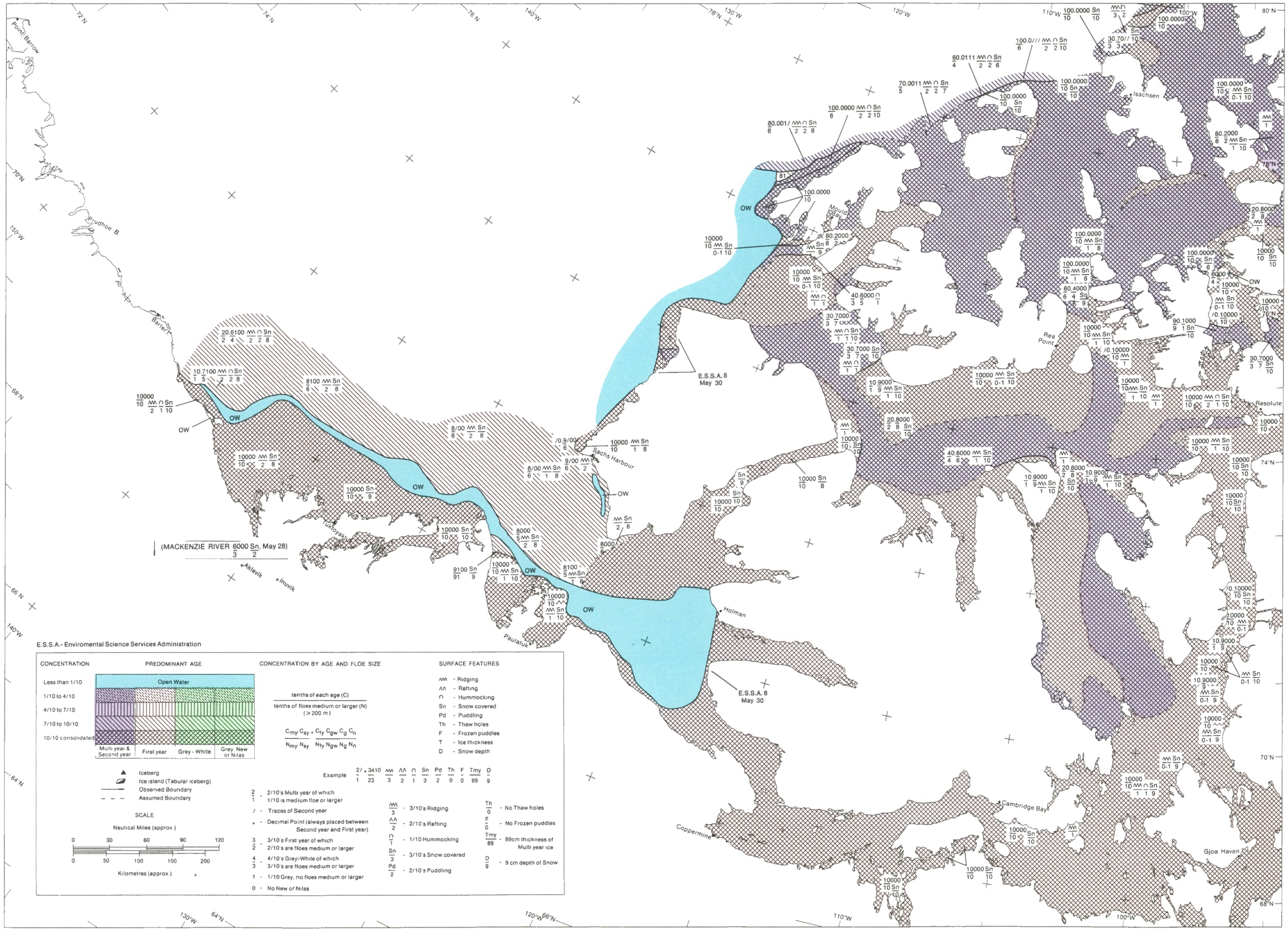
Unobserved Areas

The satellite photograph showed the extent of open water in Amundsen Gulf very clearly. Unfortunately, cloud obscured the boundary between ice and open water to the west of Banks Island. Probably the ice-free area west of the island did not extend more than 40 kilometres from the coast. The multi-year ice probably drifted about 80 kilometres west of Banks Island and 150 kilometres north of the mainland. With the exception of the open areas shown on the map or referred to above, the overall concentrations of ice in the Beaufort Sea likely ranged between nine and ten tenths.

Comments

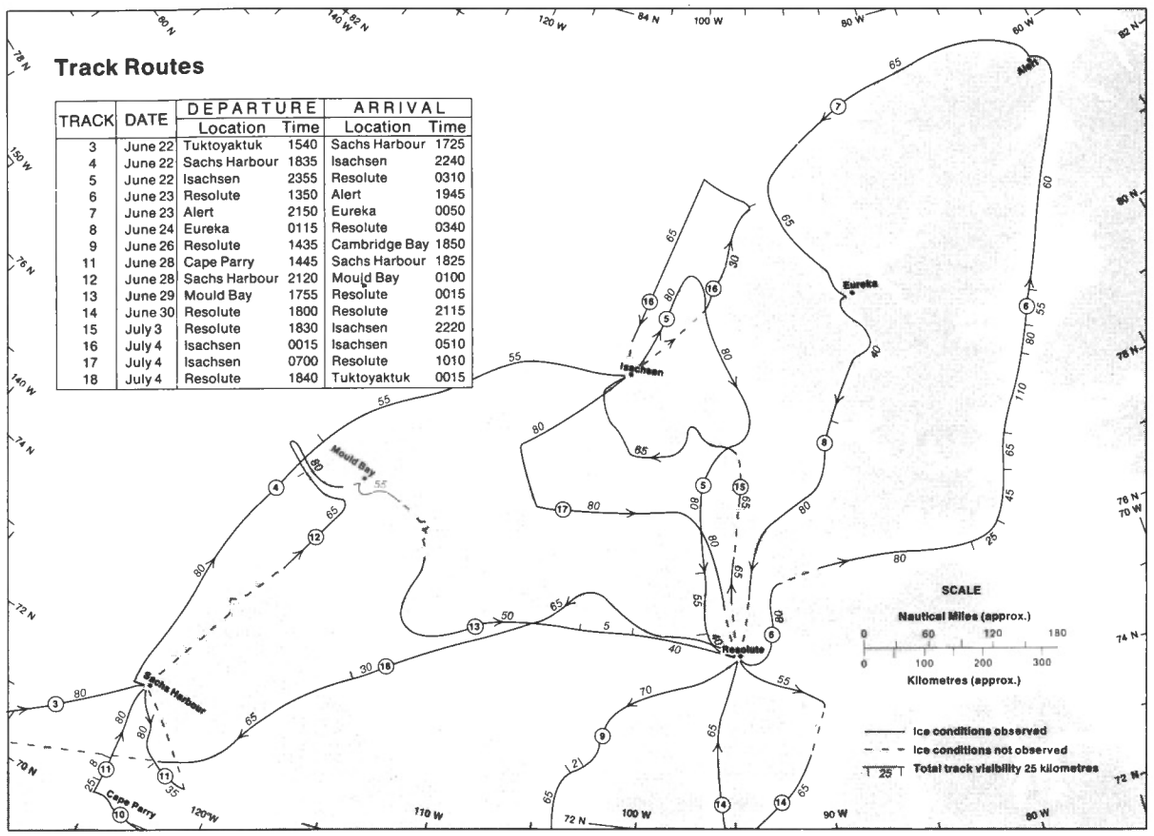
The ice conditions along the mainland coast in the southern part of the Beaufort Sea were typical and the amount of open water noted west of Banks Island and M'Clure Strait has been noted in other years. However, the large ice-free area which had developed in the eastern part of Amundsen Gulf seldom appears before the middle of July. Usually the open area gradually extends from the western part of the gulf to the east with break-up progressing in the same manner. Both of these trends were reversed in May, 1971.

For some, the early development of this large ice-free area might prompt a forecast for an ice-free season in the Beaufort area. However, ice conditions throughout the rest of the region remained solid and the only signs of the advance of the season were three very small patches of open water which developed at the narrows in the central part of Bathurst Inlet.



MAP 2 - 1971 WEST

May 18-31, 1971



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
3	June 22	Tuktoyaktuk	1540	Sachs Harbour	1725
4	June 22	Sachs Harbour	1835	Isachsen	2240
5	June 22	Isachsen	2355	Resolute	0310
6	June 23	Resolute	1350	Alert	1945
7	June 23	Alert	2150	Eureka	0050
8	June 24	Eureka	0115	Resolute	0340
9	June 26	Resolute	1435	Cambridge Bay	1850
11	June 28	Cape Parry	1445	Sachs Harbour	1825
12	June 28	Sachs Harbour	2120	Mould Bay	0100
13	June 29	Mould Bay	1755	Resolute	0015
14	June 30	Resolute	1800	Resolute	2115
15	July 3	Resolute	1830	Isachsen	2220
16	July 4	Isachsen	0015	Isachsen	0510
17	July 4	Isachsen	0700	Resolute	1010
18	July 4	Resolute	1840	Tuktoyaktuk	0015

MAP 3-1971 East
June 22-July 4

Flight Effectiveness

Eleven tracks were completed in the eastern part of the archipelago during Flight 3 and visibility ranged from very good to excellent. The route chart and the map show the results of one of the most comprehensive series of surveys ever completed in the area. The Flight was 100 per cent effective.

Ice Conditions

Some expansion of the open water areas occurred during the interval between the two flights, especially in Penny Strait. Small areas of open water came into existence in Belcher Channel, Hendriksen Strait, near Cape Cockburn and in the southern quarter of Kennedy Channel. Although open areas appeared where they were expected, they started much earlier than usual. The ice-free area south of Cape Cockburn usually develops about a month later. Similarly, the open area in Hendriksen Strait usually appears in the early part of August. In the worst of seasons it does not develop at all.

Puddling had developed very rapidly during the last part of June and was reaching its peak in many parts of the area. No concentrations of thaw holes were noted during the flight, but the puddles in some of the southern channels were very deep. If the warm weather persisted many of these areas would support thaw holes in the next two weeks.

Unobserved Areas

Satellite photography along with a few glimpses through the cloud provided the information for northern Prince Regent Inlet. It is possible that the open area extended further south into the Inlet than is shown on Map 3-1971 East.

Comments

The characteristic hook of solid ice was observed extending from the eastern part of Smith Bay and curving toward the south in Baffin Bay. This feature develops and remains in this position for various lengths of times in the early parts of most summer seasons. See Map 2-1971 East.

The boundary between solid ice and open water in Smith Sound ran straight across the Sound. Usually it arcs a little to the north into the southern part of Kane Basin. Another slight departure was noted in Kennedy Channel. In this channel although small areas of open water may develop at this time break-up does not usually result until later.

Once again the areas of open water which probably existed in the central, eastern part of Belcher Channel were not observed and, even though it does not appear on Map 3-1971 East, the small area of open water in the northern part of Kane Basin continued to expand.

Throughout the area puddling was developing at a very rapid rate. No thaw holes were observed in the eastern part of the archipelago.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx)

E.S.S.A. - Enviromental Science Services Administration

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2}{1}\ /\ \bullet\ \frac{3410}{23}$ ΛΛ 3 ΛΛ 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

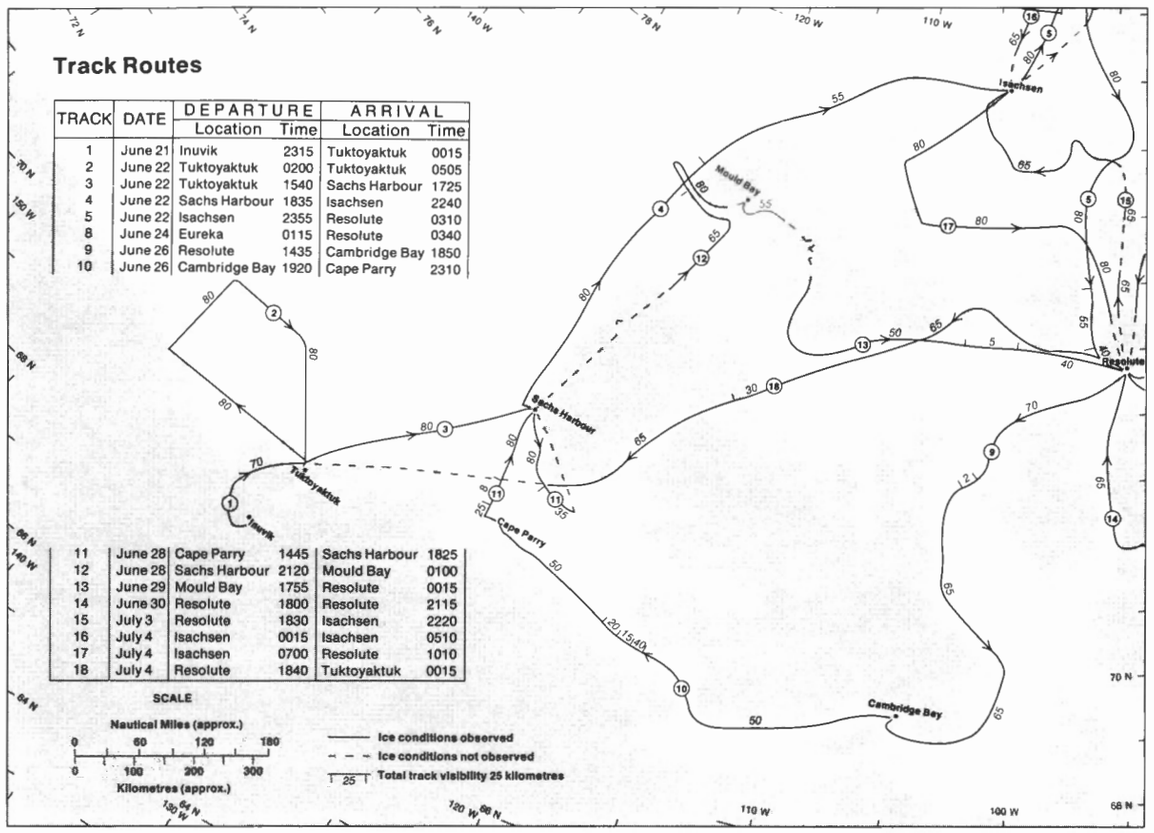
SURFACE FEATURES

ΛΛ - Ridging
ΛΛ - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

ΛΛ 3 - 3/10's Ridging
ΛΛ 2 - 2/10's Rafting
∩ 1 - 1/10 Hummocking
Sn 3 - 3/10's Snow covered
Pd 2 - 2/10's Puddling

Th 0 - No Thaw holes
F 0 - No Frozen puddles
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow

Ward Hunt Ice Shelf
Alert
Eureka
Isachsen
Mould Bay
Sachs Harbour
Resolute
Arctic Bay
Pond Inlet
Thule
Grise Fiord
E.S.S.A. 8 June 24
OW



TRACK	DATE	DEPARTURE Location	Time	ARRIVAL Location	Time
1	June 21	Inuvik	2315	Tuktoyaktuk	0015
2	June 22	Tuktoyaktuk	0200	Tuktoyaktuk	0505
3	June 22	Tuktoyaktuk	1540	Sachs Harbour	1725
4	June 22	Sachs Harbour	1835	Isachsen	2240
5	June 22	Isachsen	2355	Resolute	0310
8	June 24	Eureka	0115	Resolute	0340
9	June 26	Resolute	1435	Cambridge Bay	1850
10	June 26	Cambridge Bay	1920	Cape Parry	2310
11	June 28	Cape Parry	1445	Sachs Harbour	1825
12	June 28	Sachs Harbour	2120	Mould Bay	0100
13	June 29	Mould Bay	1755	Resolute	0015
14	June 30	Resolute	1800	Resolute	2115
15	July 3	Resolute	1830	Isachsen	2220
16	July 4	Isachsen	0015	Isachsen	0510
17	July 4	Isachsen	0700	Resolute	1010
18	July 4	Resolute	1840	Tuktoyaktuk	0015

MAP 3-1971 West
June 21-July 4

Flight Effectiveness

Visibility during the majority of the tracks over the western part of the archipelago was very good and ice conditions in most of the region were observed. The Flight was 90 per cent effective.

Ice Conditions

Vast areas of ice had disappeared from the southern part of the Beaufort Sea during the four-week interval between Flights 2 and 3. Break-up and melting had continued in Amundsen Gulf and in the western part of M'Clure Strait. Although normal break-up was taking place in the eastern part of Dolphin and Union Strait the remaining channels maintained a solid ice cover.

In the channels south of Victoria Island there were no signs of thaw holes, but the advance of the melting season was indicated by numerous cracks running north and south. Puddling was advancing very rapidly throughout the region, but thaw holes were restricted to Amundsen Gulf and that part of the Beaufort Sea south of the latitude through Sachs Harbour. The large area of new ice observed west of Banks Island was a temporary reversal of the advance of the season. Soon this ice would disappear.

The sequence of events that took place in M'Clure Strait between the end of May and the end of June are not known for certain. It is probable that break-up occurred first, followed by a partial clearing as the first-year ice drifted south and west and then the multi-year ice from the Arctic Ocean drifted into the strait.

The Mackenzie River was surveyed from Point Separation to Kugmallit Bay on June 21 during tracks one. The river was ice-free.

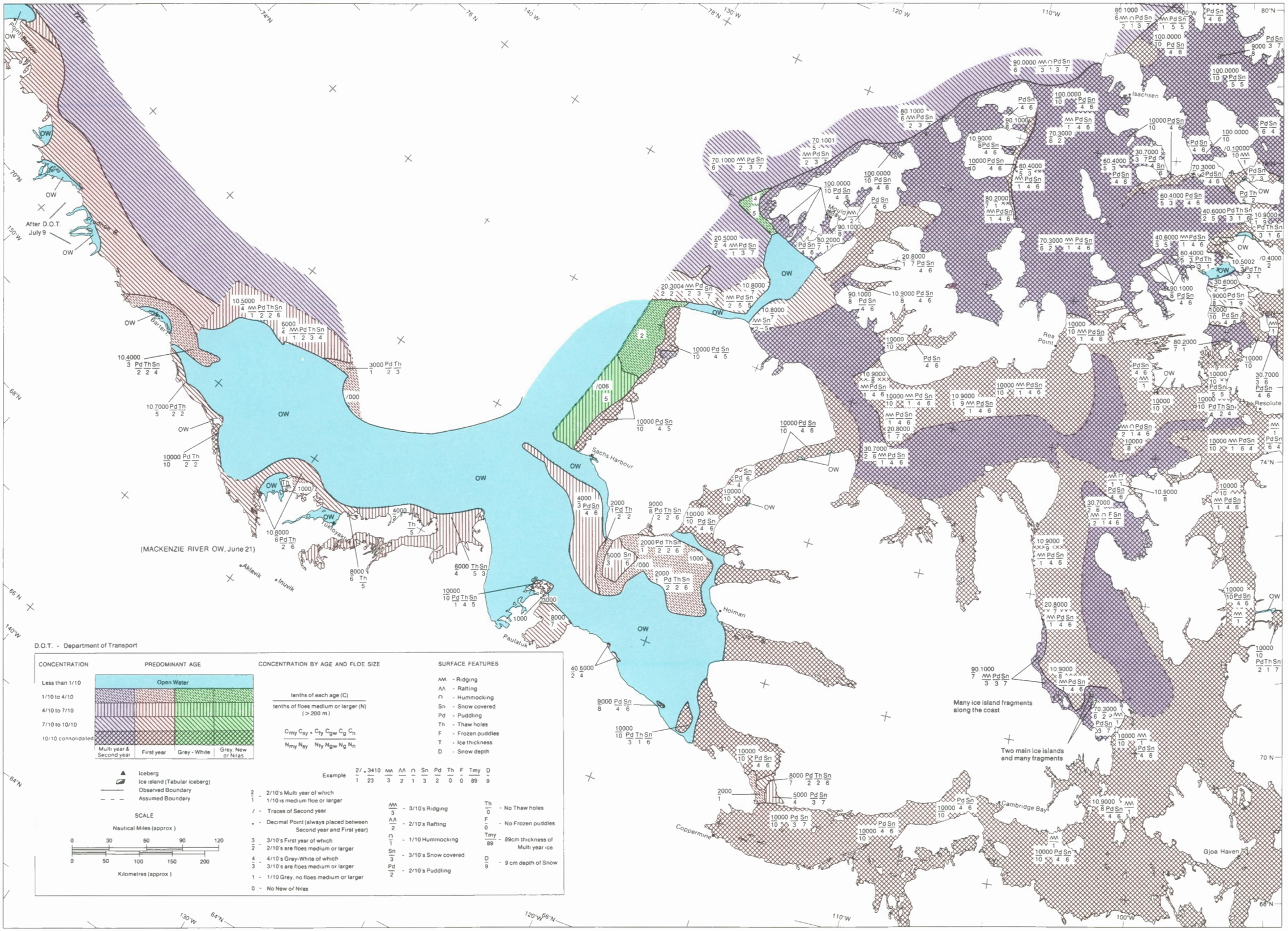
Unobserved Areas

Observations made over the south-eastern part of the Beaufort Sea indicated that the ice edge had drifted about 125 kilometres north of the mainland. Probably a similar gap separated the ice from the coast of Banks Island. Although the trend of the boundary separating open water from ice was noted, the types and concentrations of ice remained unobserved. Probably concentrations increased to nine tenths or more and ice types changed from first-year to multi-year within a zone extending about 50 kilometres from the edge of the ice.

Comments

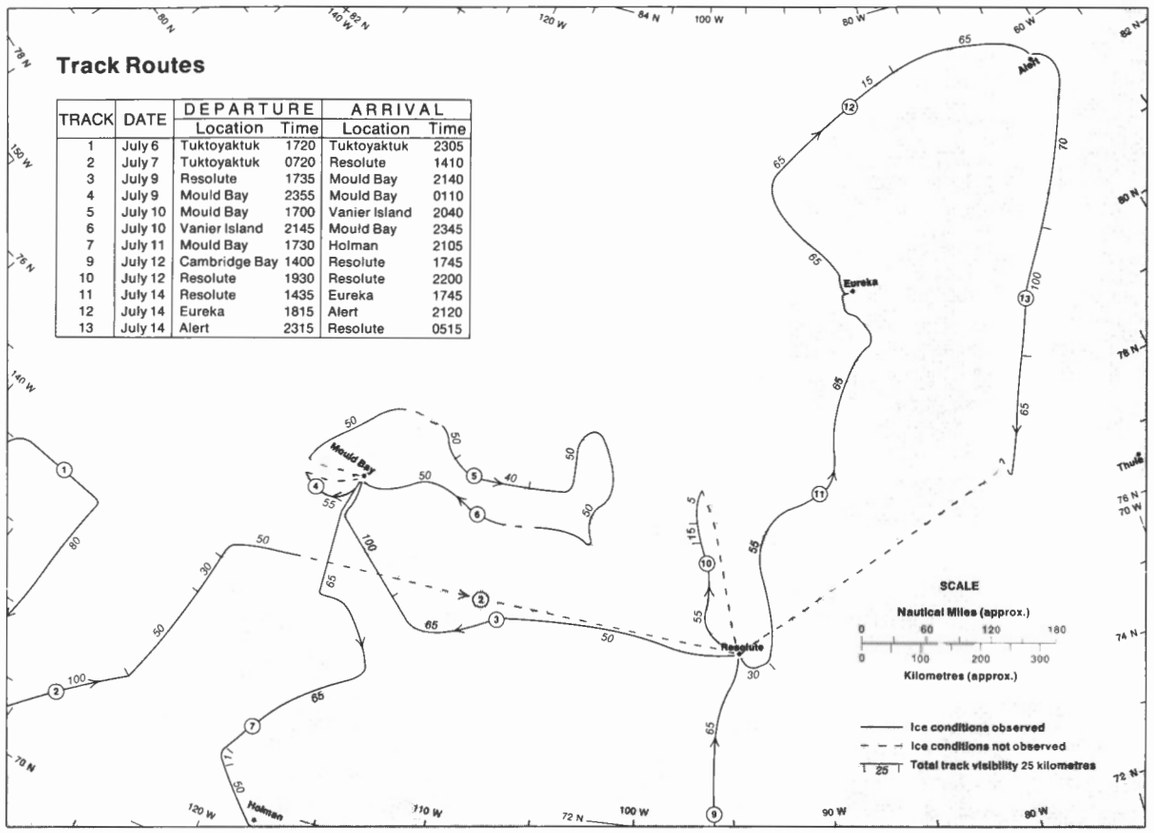
Although track 12 was primarily concerned with aerial photography over western Banks Island, some ice observations were made which indicated a rapid clearing. On June 22 a compact fringe of first-year ice about 15 kilometres wide extended along the southwest coast of Banks Island between Sachs Harbour and Cape Lambton. On June 29 the area was ice-free and concentrations in the adjacent areas had dropped to four tenths and less. A similar indication of the rate at which the season was advancing was noted during a mission to take aerial photographs of the ice caps on the western part of Melville Island. This anomaly was a small patch of open water near the southwest tip of Bathurst Island. Usually this feature does not appear until the first or second week in August.

The fringe of multi-year ice along the east coast of Victoria Island was very heavily pressure-ridged. Numerous ice island fragments were also scattered along the length of the multi-year fringe. The large part of T-1 was located at 70° 38'N, 101° 40'W.



MAP 3 - 1971 WEST

June 21 - July 4, 1971



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	July 6	Tuktoyaktuk	1720	Tuktoyaktuk	2305
2	July 7	Tuktoyaktuk	0720	Resolute	1410
3	July 9	Resolute	1735	Mould Bay	2140
4	July 9	Mould Bay	2355	Mould Bay	0110
5	July 10	Mould Bay	1700	Vanier Island	2040
6	July 10	Vanier Island	2145	Mould Bay	2345
7	July 11	Mould Bay	1730	Holman	2105
9	July 12	Cambridge Bay	1400	Resolute	1745
10	July 12	Resolute	1930	Resolute	2200
11	July 14	Resolute	1435	Eureka	1745
12	July 14	Eureka	1815	Alert	2120
13	July 14	Alert	2315	Resolute	0515

MAP 4-1971 East July 6-14

Flight Effectiveness

Observing conditions during the six tracks over the eastern part of the archipelago spanned the complete range from poor through fair, good, very good, and excellent. Generally, visibility was restricted by low cloud and fog, although during track 13 heavy rain interrupted observations. These conditions along with the failure to complete a number of planned tracks reduced the overall effectiveness of the Flight to about 60 per cent.

Ice Conditions

The open water areas in Penny Strait and the Hell Gate area expanded considerably and break-up took place in the western part of Barrow Strait, Queens Channel, southern Norwegian Bay, Eureka Sound and Nares Strait. The most impressive change took place in Baffin Bay where large scale clearing occurred between June 24 and July 18. The fracturing of the ice cover in Nares Strait was completed between June 23 and July 14.

The break-up in Nares Strait and the clearing in Baffin Bay and Lancaster Sound suggested that the season was advancing faster than usual. Developments in other areas indicated that the season was about one month ahead of normal. For example, the ice in the western part of Barrow Strait does not usually break up until mid-August. The ice cover in the southern part of Norwegian Bay usually follows a similar timetable.

While all this rapid ablation and break-up was taking place, in some areas the appearance of frozen puddles and the lack of thaw holes suggested that in other areas ablation was not as rapid.

Shore leads had developed along all coasts and open areas were appearing at the mouths of the main rivers. In most areas cracks had appeared but the greatest number per unit area appeared in the southern part of Eureka Sound.

The conditions in Wellington Channel reflected the rather confused pattern of ablation that had developed up to mid-July. Thaw holes covered six tenths of the northern part of this channel while the southern portion was two tenths frozen puddles. Numerous similar dichotomies were also noted.

Unobserved Areas

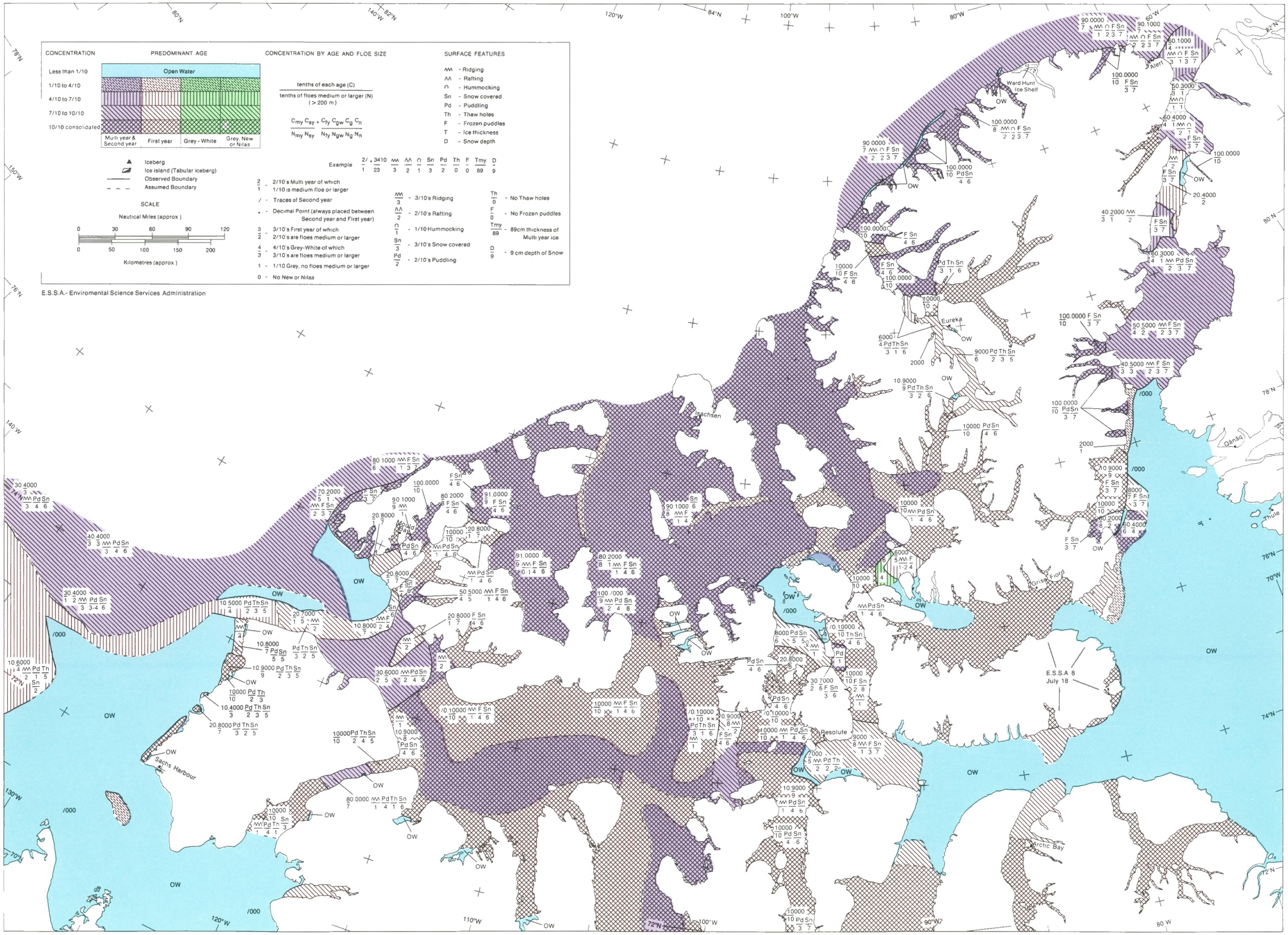
The ice conditions in the northern channels and along the fringe of the Arctic Ocean between Prince Patrick Island and Ellesmere Island were probably very similar to those shown on Map 3-1971 East. Although they were not observed, the open areas in the central eastern part of Belcher Channel and in the central part of Hendriksen Strait had continued to develop and would soon cover most of these channels. The southern part of Prince Regent Inlet and the northern part of the Gulf of Boothia may have supported a solid ice cover or very close pack ice.

Comments

Throughout the region ablation was advancing much faster than usual and it seemed likely that break-up would take place at least one month earlier than usual.

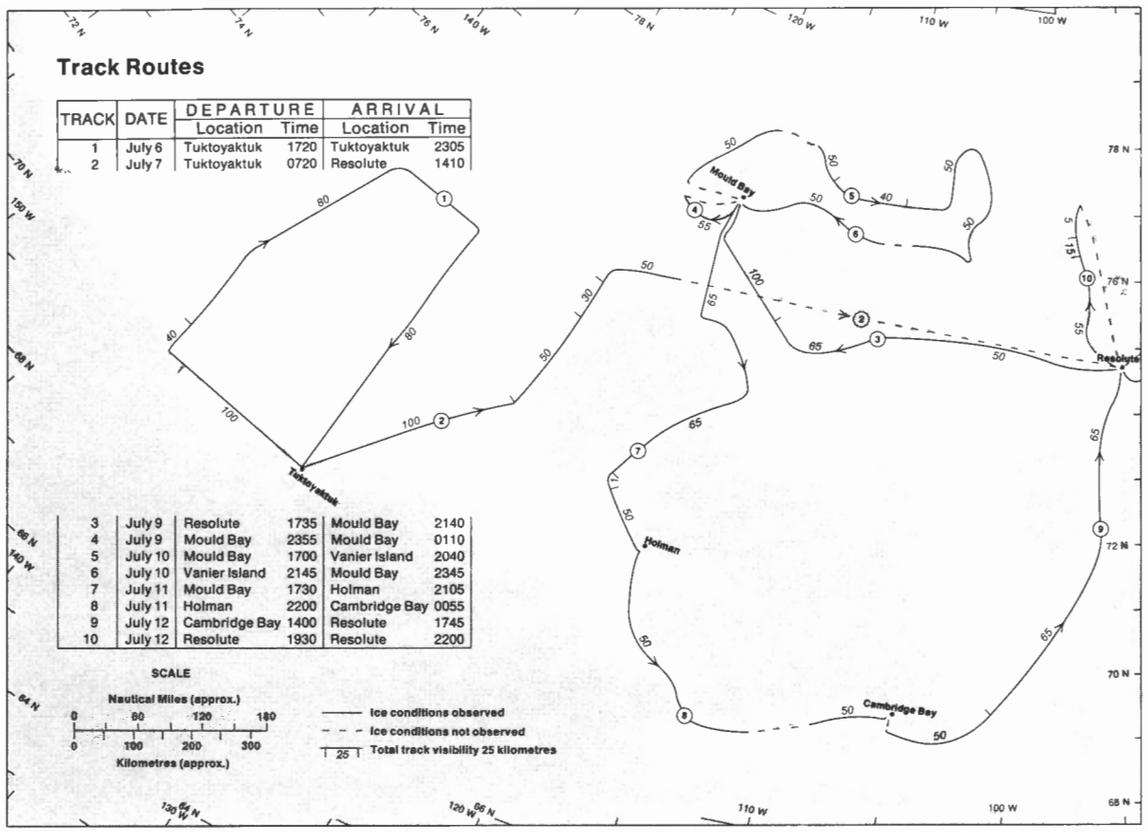
While this flight was being carried out the author was completing a program from the ice surface in Byam Martin Channel and in Desbarats Strait. By the 10th of July the puddles and drainage on the old channels' multi-year ice in the latter area had developed a depth ranging between 70 and 110 cm. Puddles in the first-year ice in Byam Martin Channel seldom exceeded a depth of 30 cm. The multi-year ice thicknesses in Desbarats Strait ranged from six or more metres through a hummock to about three metres on a level area. Thicknesses over 250 centimetres were rare in the central part of Byam Martin Channel.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 4 - 1971 EAST

July 6-14, 1971



MAP 4-1971 West July 6-12

Flight Effectiveness

Observing conditions during three of the seven tracks for this Flight of the western part of the archipelago were fair to poor. Visibility ranged from very good to excellent for the remainder. Observations were completed for most of the channels in the region and the Flight was considered to be at least 90 per cent effective.

Ice Conditions

Two weeks separated observations in the southern part of the Beaufort Sea. During that interval the ice along the Canadian mainland coast and in Amundsen Gulf had disappeared. Other changes occurred in central Prince of Wales Strait, Dolphin and Union Strait, Bathurst Inlet, and Victoria Strait; the ice cover in each of these channels had broken up.

Thaw holes throughout the southwestern quarter of the region indicated the advance of the season. The concentrations of these indicators of ablation ranged as high as six tenths of the ice cover which is a clear sign of imminent break-up.

Many cracks crossed the solid ice cover in Prince of Wales Strait, Coronation Gulf, and Dease Strait. Shore leads had also developed along the shores of these channels and throughout the rest of the area. Viscount Melville Sound had numerous cracks running across it.

In most areas break-up was advancing in a normal fashion but slightly ahead of its usual rate. The break-up in Victoria Strait took place earlier than had been previously noted. The frozen puddles noted in Viscount Melville Sound were temporary features.

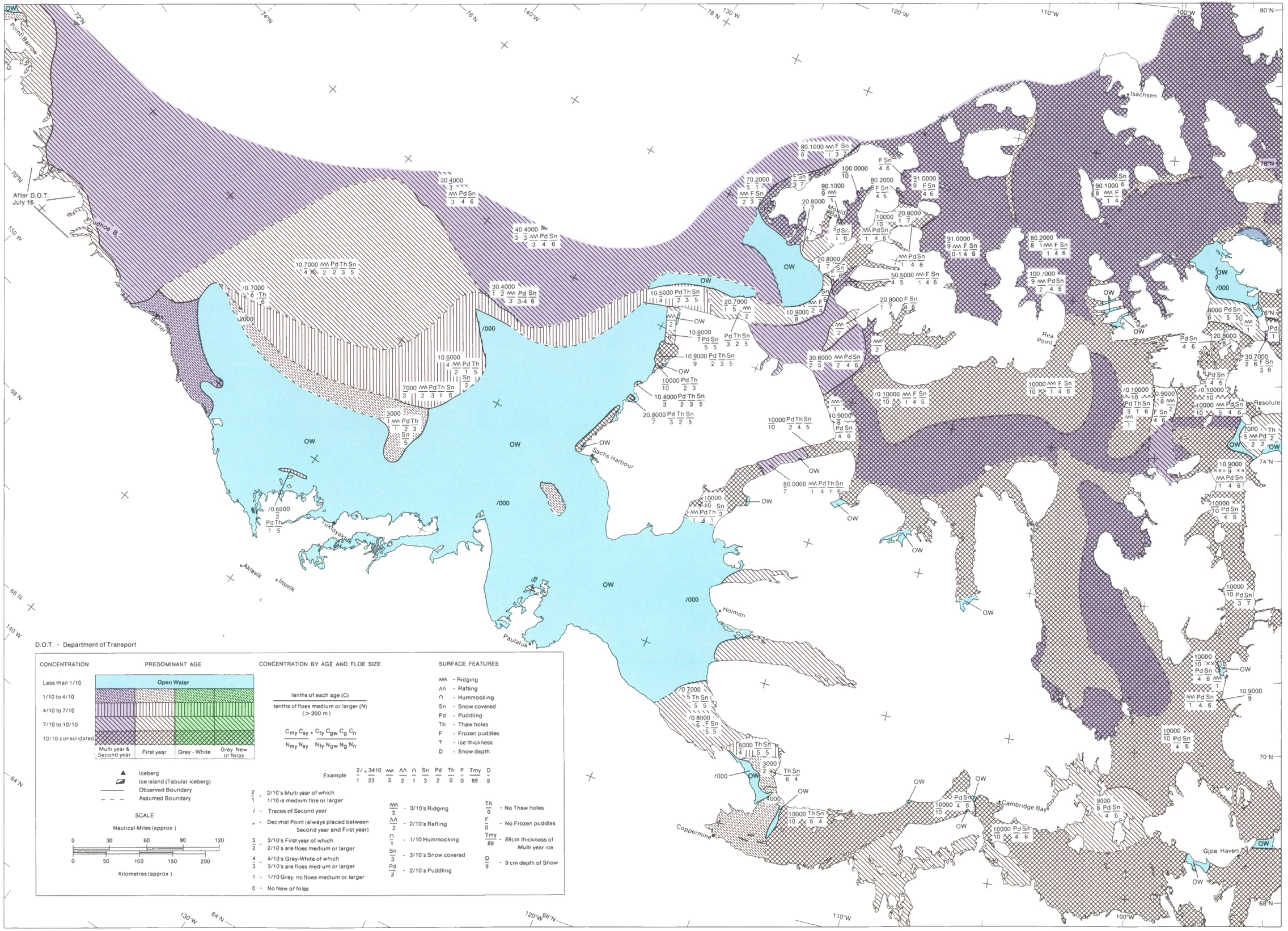
Unobserved Areas

Satellite photographs indicated that small areas of open water had developed in the narrow channels at both ends of Rasmussen Basin and in the three bays along the north coast of Victoria Island.

Comments

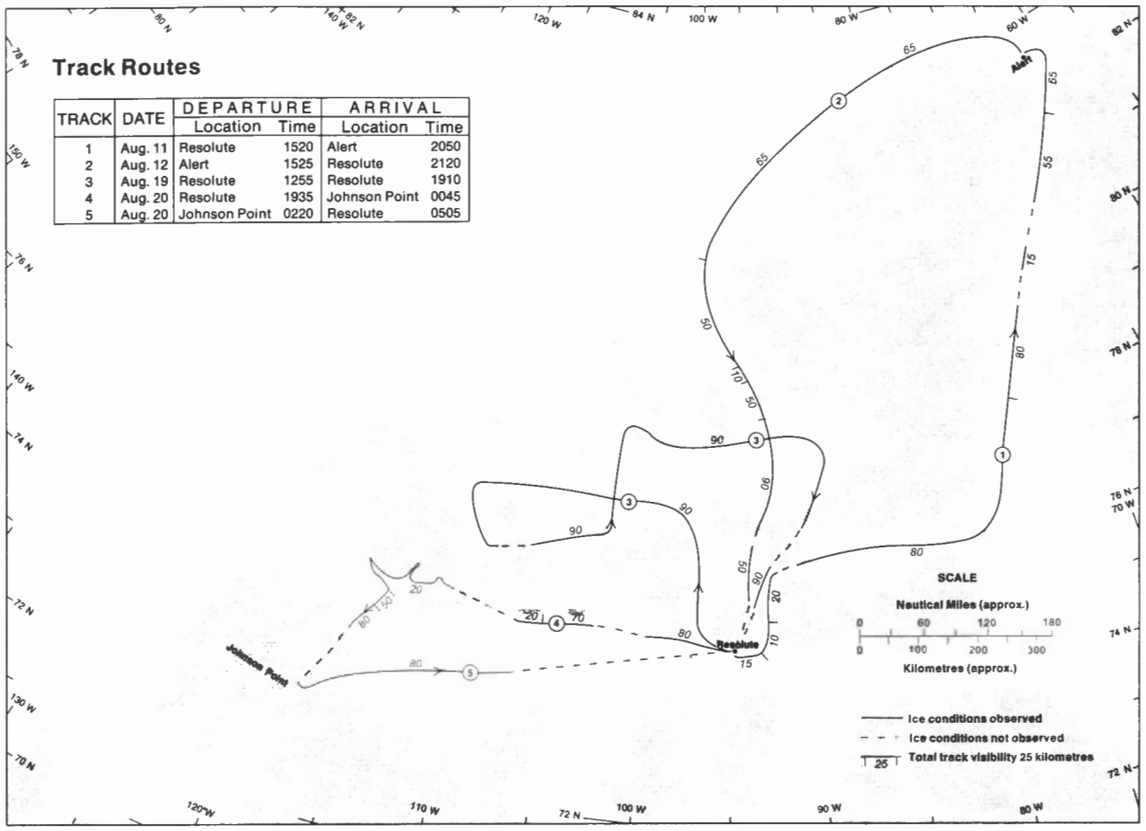
A massive shift of first-year ice took place in the Beaufort Sea between June 22 and July 6. Apparently first-year ice from the north, Amundsen Gulf and along the mainland coast, was concentrated and moved into the northwestern part of the Beaufort Sea. Although it appears that large areas of ice disappeared during the interval, the total area was almost the same because the existing ice had been compacted.

Normally the track over the Beaufort Sea does not go as far north as track one on July 6. This survey combined ice reconnaissance with a request to try to locate the remains of Camp 200 which was evacuated from an ice floe at 73° 52'N, 132° 00'W on April 15, 1971. The search radiated from a point at 74° 10'N, 132°W but the camp was not located. On July 6, 1971 the probable remains were located at 74° 25'N, 136°W or nearly 120 kilometres west of the central part of the search area.



MAP 4 - 1971 WEST

July 6-12, 1971



MAP 5-1971 East
August 11-20

Flight Effectiveness

The weather during the three tracks over the eastern part of the region was very good and fine coverage was obtained. Although an engine failure during track two grounded the aircraft for a few days another aircraft was available for use but poor weather persisted for six days between tracks 2 and 3. The Flight was about 50 per cent effective.

Ice Conditions

Almost four weeks separated the last surveys of Flight 4 from the first surveys of Flight 5. Vast changes had taken place. Areas such as Jones Sound, Eureka Sound, Admiralty Inlet, the inlets around Bylot Island, Norwegian Bay and the fringe along the southeast part of Ellesmere Island that were previously solid were now almost totally ice-free. Break-up had progressed through the remaining areas until Nansen Sound and Sverdrup Channel were the only areas that still maintained a solid ice cover. In other areas the concentration of ice was substantially reduced.

The ice conditions which had developed by mid-August, 1971 provided much more open water than the two previous seasons, but not quite as extensive as in 1962 when the greatest amount of open water yet recorded developed.

The actual progression of break-up in the various channels was not observed. However, the patterns, ice types and concentrations shown on Map 5-1971 East indicate that it did advance in a normal fashion.

New ice was forming in the open areas north of Ellesmere Island and all puddles observed during the three tracks were frozen over.

Unobserved Areas

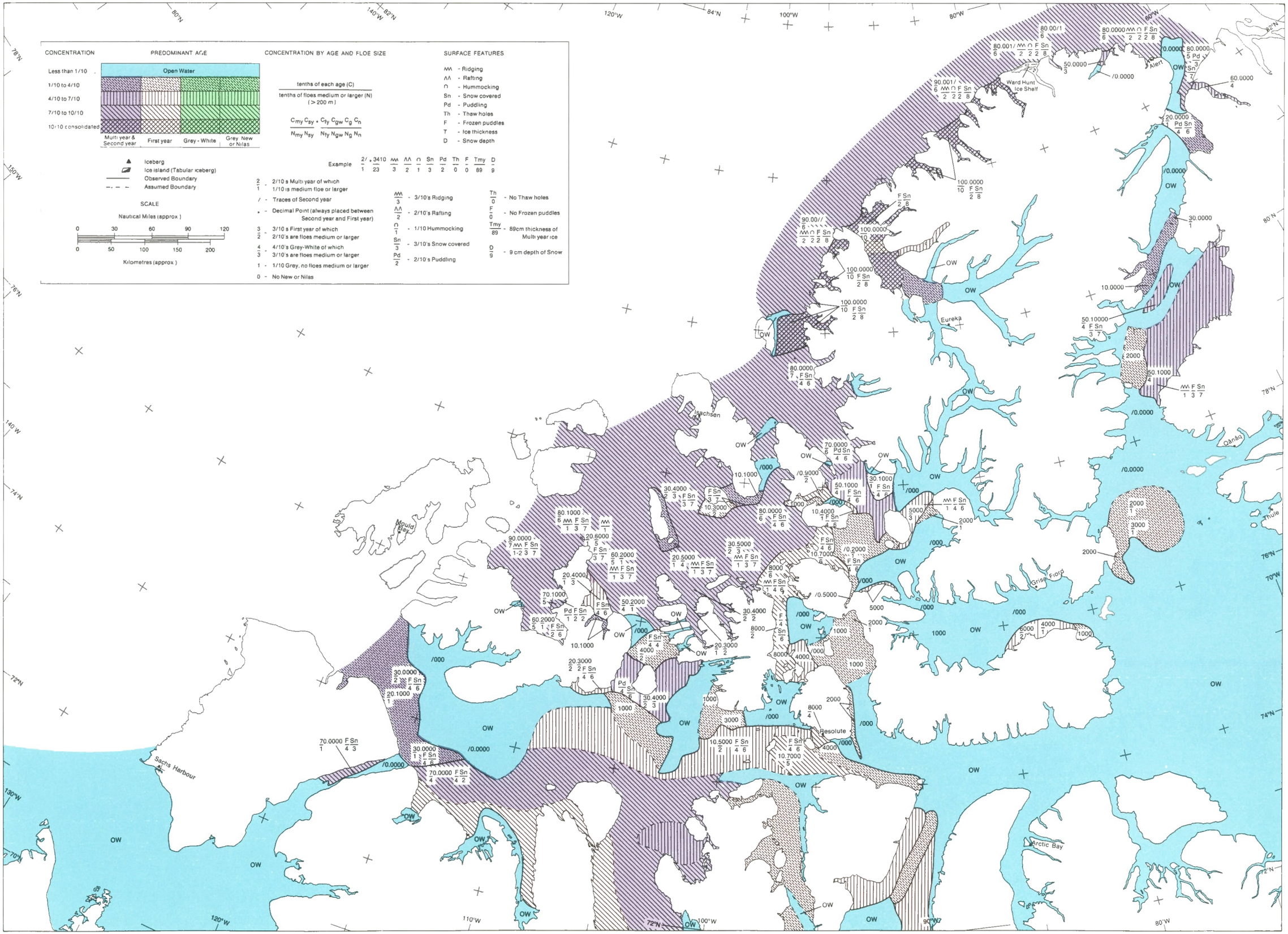
The ice conditions in Baffin Bay, Lancaster Sound, Prince Regent Inlet and the inlets on northern Baffin Island were determined from satellite photos. The conditions in Prince Gustaf Adolf Sea and Peary Channel were deduced from observations made over Sverdrup Channel and Massey Sound. The ice cover in the channels to the east and south of Meighen Island breaks up after the other areas. Since the ice in Massey Sound was in motion it follows that the ice in Peary Channel and Prince Gustaf Adolf Sea had broken slightly earlier. A similar deduction can be made to describe the ice conditions in Crozier Strait, Kellett Strait, Fitzwilliam Strait, Ballantyne Strait and Wilkins Strait. Generally, the ice cover in all these areas breaks up before the ice in Hecla and Griper Bay begins to move. Since observations indicated a broken ice cover in the latter area, it follows that the other areas, although unobserved, were broken. Probably the ice conditions in these areas resembled those shown on Map 6-1971 East.

The multi-year ice in the Arctic Ocean likely extended along the western fringe of the archipelago in the same concentrations that were observed between Meighen Island and Alert.

Comments

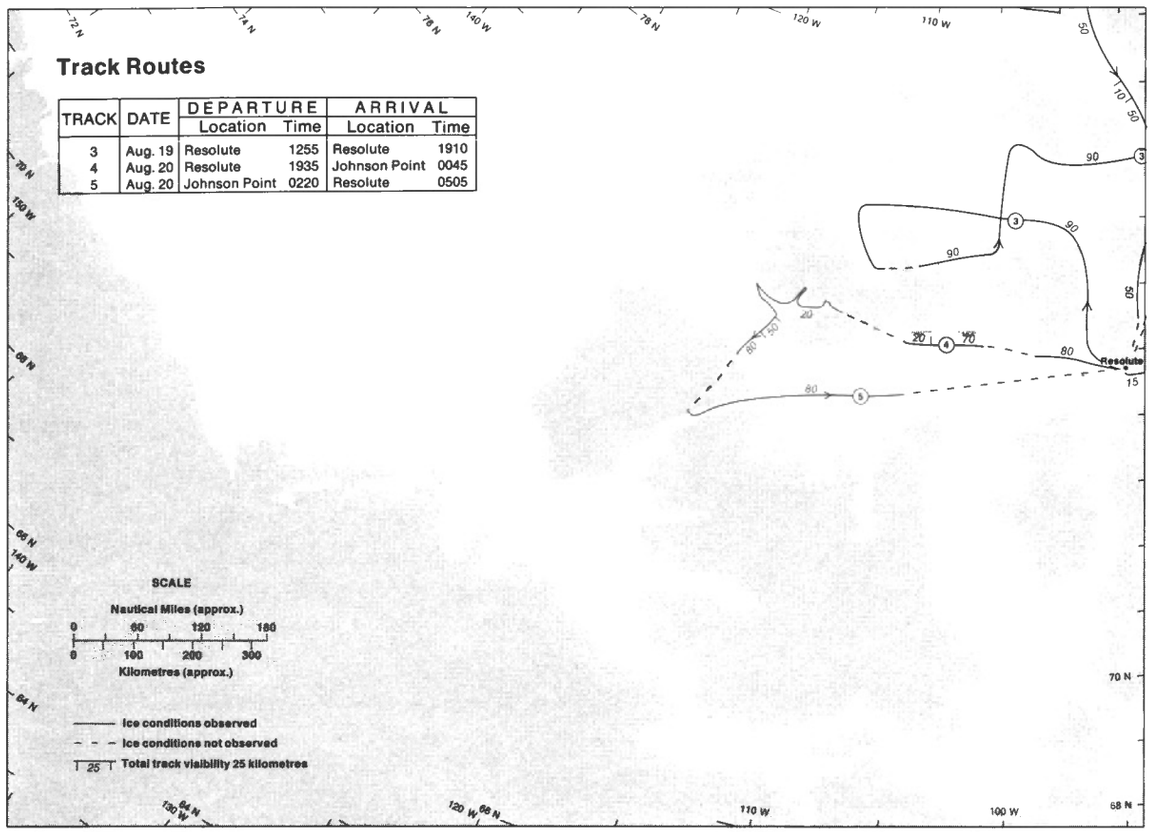
The amount of break-up, ablation and open water observed in the eastern part of the region during Flight 5-1971 was much greater than normal for this time of year. Although the season had advanced very rapidly, the signs of freeze-up were starting to appear a little earlier in that new ice was noted north of Ellesmere Island, a recent heavy snowfall covered the mountains in the southwestern part of Axel Heiberg Island, and all the puddles throughout the region were frozen.

Large numbers of icebergs were strung out along the southeast coast of Ellesmere Island from Glacier Strait to Smith Bay.



MAP 5 - 1971 EAST

August 11-20, 1971



MAP 5-1971 West
August 11-20

Flight Effectiveness

Two tracks were completed in the western part of the region during Flight 5. The overall results from these tracks were fair but, since no other tracks were completed in the area, the Flight effectiveness was very low. Fortunately, while the observer and his aircraft were grounded at Resolute by a combination of bad weather and aircraft maintenance, other Polar Continental Shelf Project aircraft were flying in the southern part of the region and the usual pilot reports added considerable information for M'Clintock Channel and the straits between Banks and Victoria Islands and the mainland. By combining these pilot reports with the results of tracks 4 and 5 the Flight effectiveness was raised to almost 60 per cent.

Ice Conditions

Ice-free conditions are normally expected in Prince of Wales Strait, Amundsen Gulf and east to Cambridge Bay by August 20. Probably these areas were almost ice-free by July 20. The greatest changes had taken place in M'Clintock Channel where break-up was about one month ahead of usual. In some seasons the ice remains solid throughout this area and into Victoria Strait. Generally the clearing in Coronation Gulf and Rasmussen Basin was two weeks early while conditions in Peel Sound had developed about three weeks ahead of time.

The normal sequence of break-up, ablation and clearing was taking place in the southern areas. In Viscount Melville Sound the progression varied. Usually a large area of open water develops in the eastern part of the sound before the central and western parts become ice-free.

A considerable decline in the total area of first-year ice had taken place between Flights 4 and 5. The decrease in the area of multi-year ice was notable but not as extensive as the ablation of first-year ice.

Unobserved Areas

The ice conditions south of Victoria and Banks Islands and in the southern portions of M'Clintock Channel and Peel Sound have been derived from pilot reports. Satellite photographs were used to determine the conditions in Rasmussen Basin and Coronation Gulf.

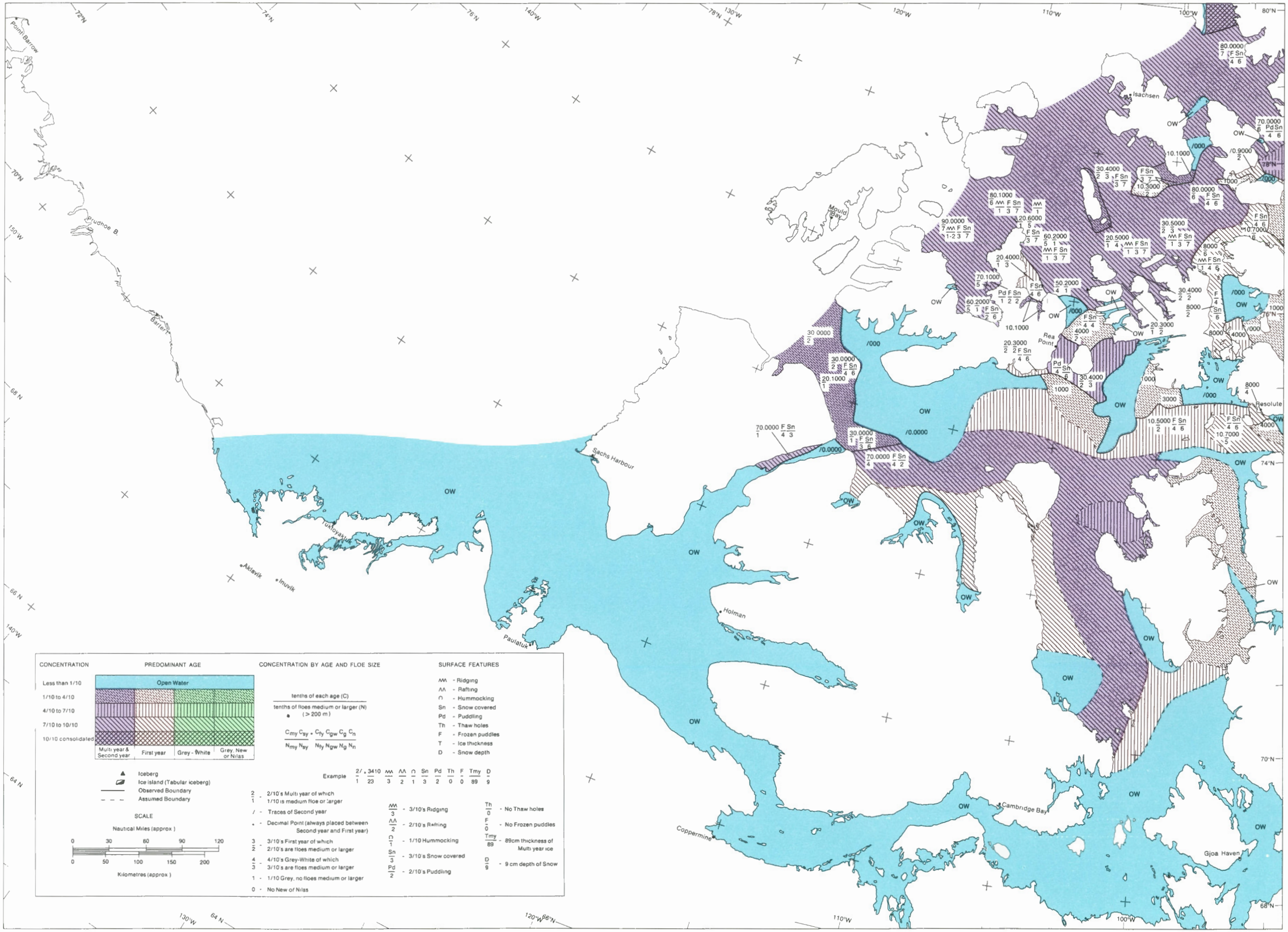
Probably multi-year ice, in concentrations ranging from three tenths in the eastern part to seven tenths in the west, spread across M'Clure Strait.

There are no reliable clues to use for extrapolating the probable position of the boundary between multi-year ice and open water in the Beaufort Sea. Cloud-covered satellite photographs taken on August 18 and 19 intimate that the boundary was similar to that shown on Map 4-1971 West.

Comments

The low concentrations in M'Clure Strait indicated that large quantities of multi-year ice had not entered the area. The loss concentrations in Peel Sound meant that the area would soon be ice-free.

Parts of the large ice island, T-1, were observed in M'Clintock Channel to the west of Gateshead Island.



CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water			
Multi year & Second year	First year	Grey - White	Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$

$\frac{C_{my}\ C_{sy} * C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy} \quad N_{fy}\ N_{gw}\ N_g\ N_n}$

Example $\frac{2/}{1} * \frac{3410}{23}$ $\frac{MM}{3}$ $\frac{AA}{2}$ $\frac{\cap}{1}$ $\frac{Sn}{3}$ $\frac{Pd}{2}$ $\frac{Th}{0}$ $\frac{F}{0}$ $\frac{Tmy}{89}$ $\frac{D}{9}$

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{MM}{3}$ - 3/10's Ridging
$\frac{AA}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

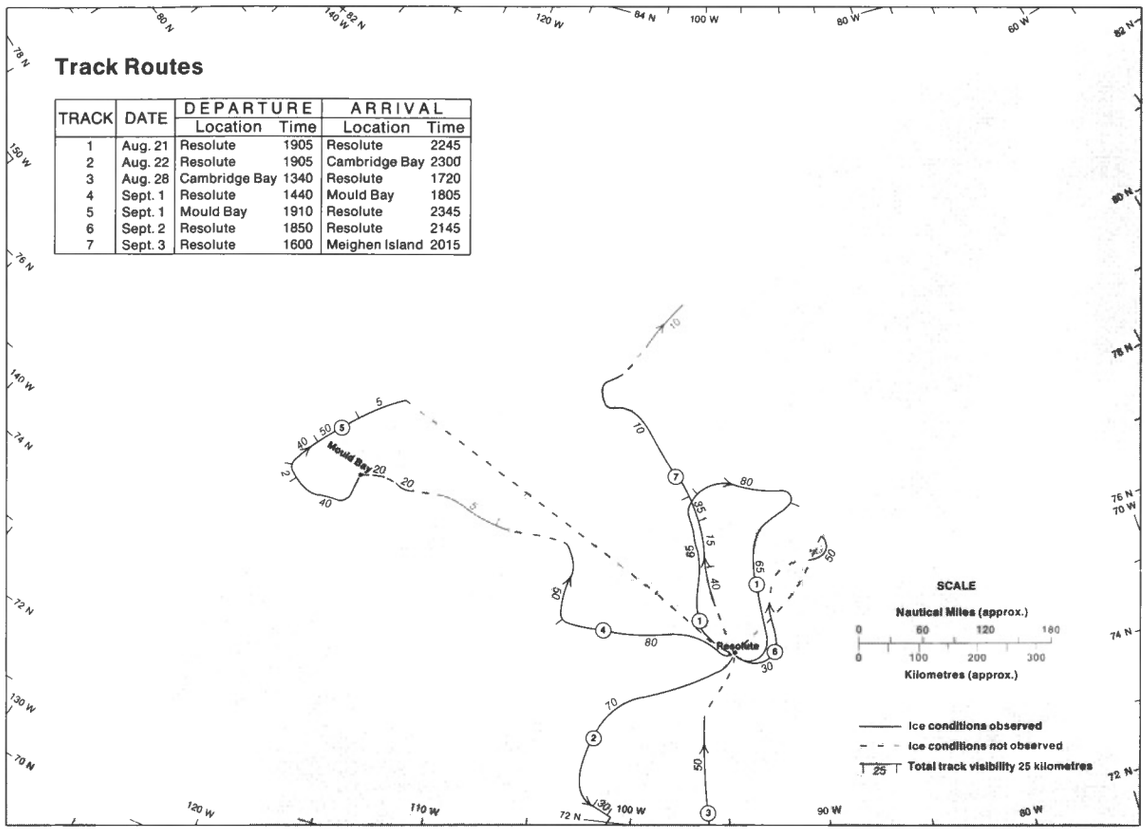
SURFACE FEATURES

MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

MAP 5 - 1971 WEST

August 11-20, 1971



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 21	Resolute	1905	Resolute	2245
2	Aug. 22	Resolute	1905	Cambridge Bay	2300
3	Aug. 28	Cambridge Bay	1340	Resolute	1720
4	Sept. 1	Resolute	1440	Mould Bay	1805
5	Sept. 1	Mould Bay	1910	Resolute	2345
6	Sept. 2	Resolute	1850	Resolute	2145
7	Sept. 3	Resolute	1600	Meighen Island	2015

MAP 6-1971 East
August 21-September 3

Flight Effectiveness

The visibility and the results from the first two tracks of Flight 6 were very good. The remaining four tracks were conducted in weather conditions which fluctuated between poor and very poor. Generally low stratus cloud restricted the observer's ceiling to 200 feet. Aircraft icing added to the existing problems. The Flight was nearly 20 per cent effective.

Ice Conditions

Only a brief interval separated Flights 5 and 6. However, clearing had continued and concentrations in Nares Strait, Prince Regent Inlet, Queens Channel, and Wellington Channel were reduced.

North of Parry Channel new ice was beginning to appear and the puddles remained frozen. In the central part of the region frozen puddles had been observed since the beginning of July.

Generally the patterns and concentrations were similar to those expected in good seasons and the open water areas had developed in their typical positions.

Unobserved Areas

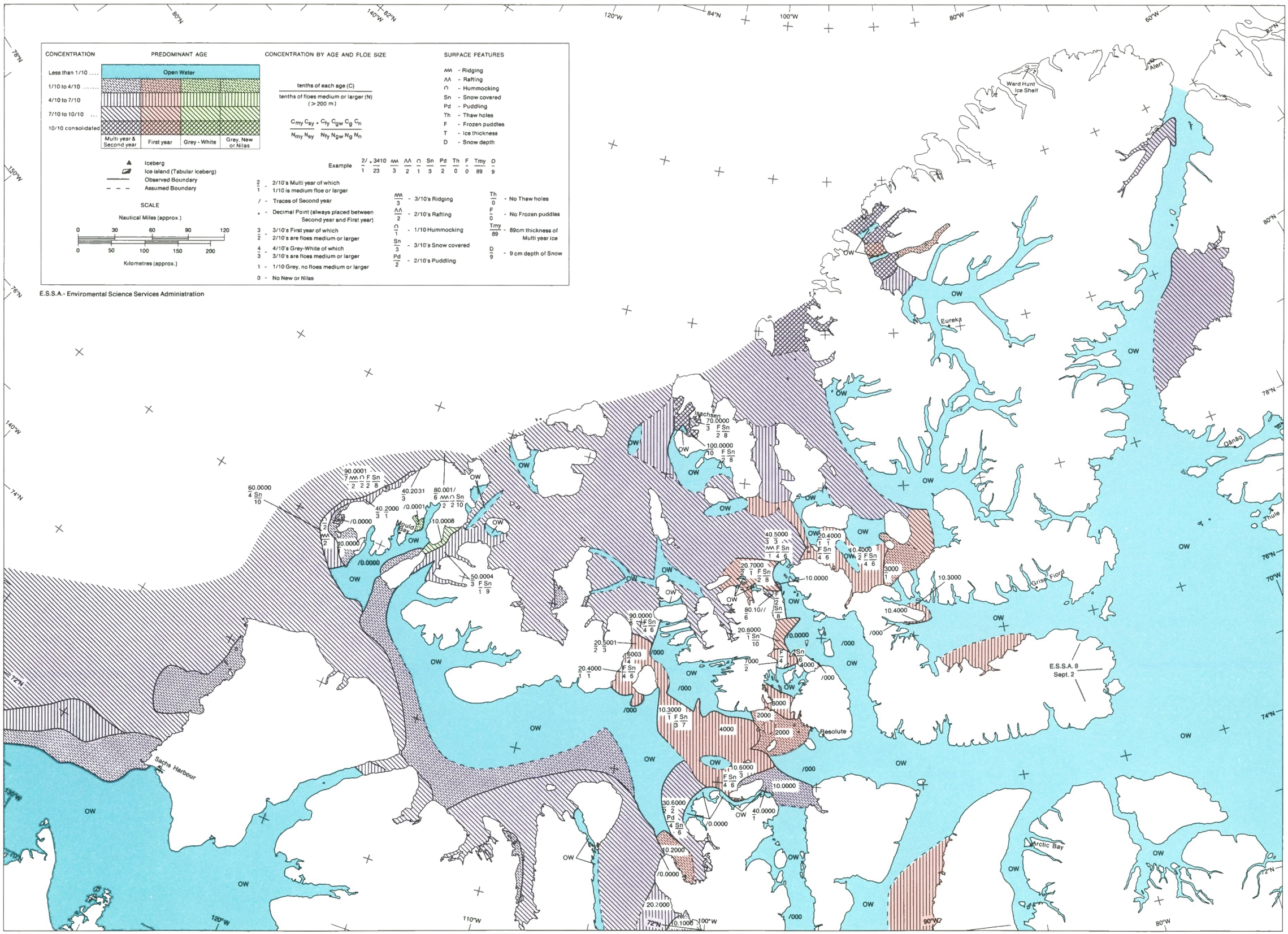
Many areas remained unobserved at the end of Flight 6. Fortunately the next flight started immediately and these observations provided some of the clues required to develop the accompanying map.

Along the coast of the western fringe of the archipelago the multi-year ice likely blended right in with the nine tenths cover on the channels to the south. Contrary to expectations the ice cover in Sverdrup Channel and Nansen Sound remained solid.

Comments

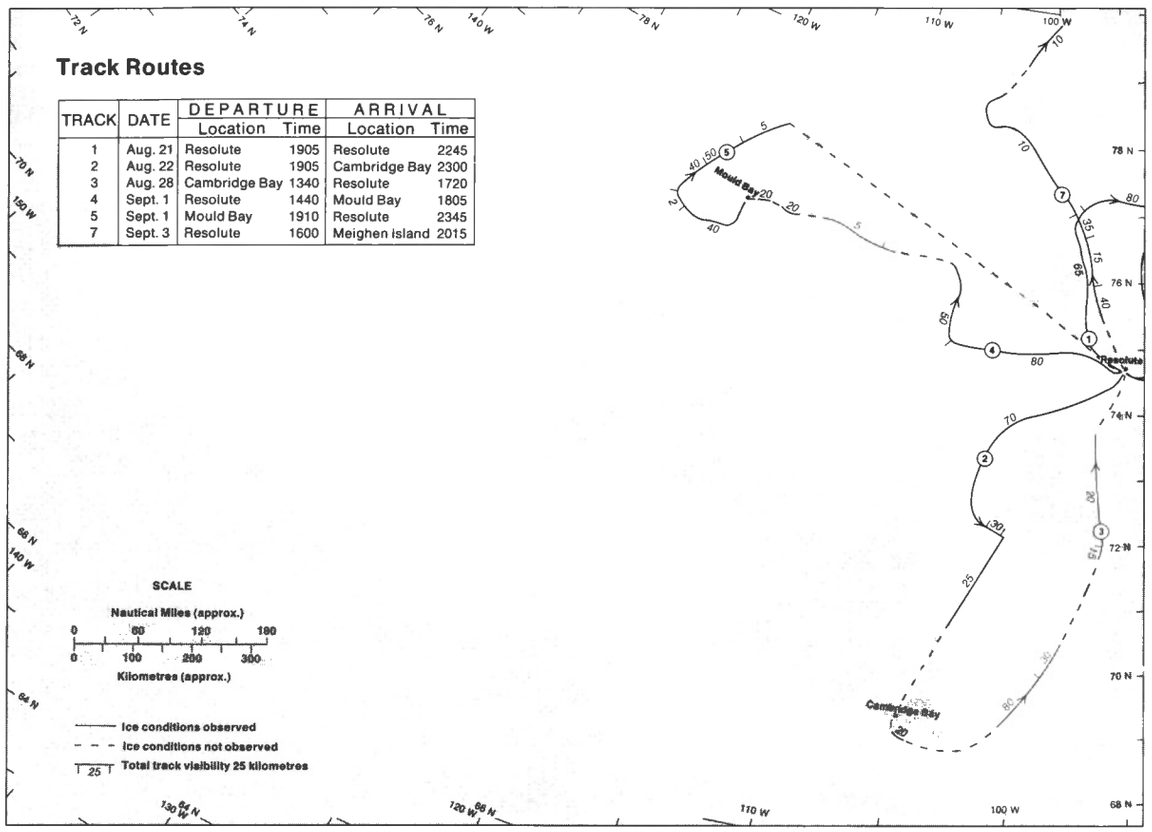
By the end of August nearly all the first-year ice, see Map 1-1971 East, had ablated and the concentrations of multi-year ice and probably the thickness had been reduced. It appeared that the northerly and westerly winds were helping the multi-year ice to move into the northern parts of the archipelago. As yet no significant quantities of multi-year ice had drifted south into Parry Channel through Byam Martin Channel or the channels connected with Penny Strait. This lack of movement was unusual considering normal trends and the fact that the ice in the northern channels had broken and was moving shortly after the beginning of August. When break-up does occur in these northern areas it usually starts at the beginning of August. In 1971 there was one month for the ice to drift further south but none did. However, the patterns of open water in the lee of the islands indicated that northerly winds were becoming more prevalent and a full-scale southerly drift would soon commence.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 6 - 1971 EAST

August 21-Sept. 3, 1971



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 21	Resolute	1905	Resolute	2245
2	Aug. 22	Resolute	1905	Cambridge Bay	2300
3	Aug. 28	Cambridge Bay	1340	Resolute	1720
4	Sept. 1	Resolute	1440	Mould Bay	1805
5	Sept. 1	Mould Bay	1910	Resolute	2345
7	Sept. 3	Resolute	1600	Meighen Island	2015

MAP 6-1971 West
August 21-September 3

Flight Effectiveness

Only three tracks were carried out in this part of the region during Flight 6. The weather was fair but the total area surveyed was limited. Flight effectiveness was between 15 and 20 per cent. Fortunately, the extent of open water in most areas was already known and could be shown based on subsequent confirmation. Also, M.O.T. surveys over the Beaufort Sea provided excellent and timely information and it is incorporated on this map.

Ice Conditions

During the brief interval separating Flight 6 from Flight 5, the ice in Peel Sound had completely melted and disappeared. The overall concentrations of ice in M'Clintock Channel declined and considerable areas of ice disappeared from the northeastern half of Viscount Melville Sound. Concentrations in M'Clure Strait were starting to increase as northwesterly winds moved multi-year ice from the Arctic Ocean into the western part of the Strait.

These winds were also responsible for moving the ice across Parry Channel and concentrating it along the north coast of Banks and Victoria Islands.

Almost all of the first-year ice previously noted in this area had been ablated and replaced by open water and the small remaining areas of ice in M'Clintock Channel and central Parry Sound would soon disappear.

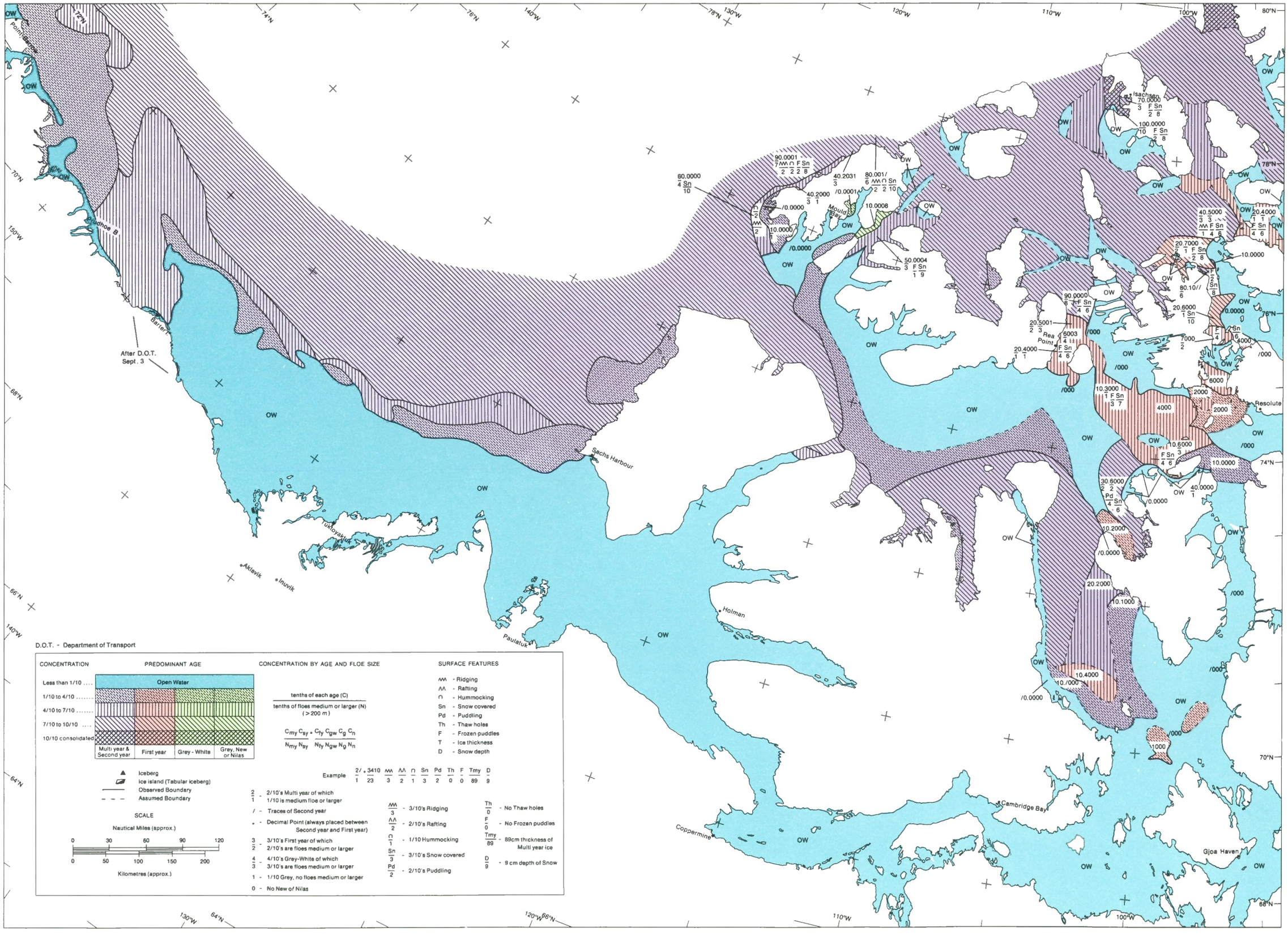
Considerable changes had taken place in the Beaufort Sea. Here persistent northwesterly winds had moved the arctic pack ice toward the mainland coast and against the west coast of Banks Island. If the winds continued from the same quadrant with a similar force, the multi-year ice would continue to invade the ice-free area and would eventually be driven against the mainland coast. As can be seen from Map 7-1971 the winds did not continue.

Unobserved Areas

When all the channels between the central part of Amundsen Gulf through Dease Strait to Queen Maud Gulf and Rasmussen Basin become ice-free they will remain so until new ice begins to form in October. These areas were ice-free by August 20 and remained so when they were observed in the first week of October. Without doubt these channels had become ice-free by the end of August, thus coinciding with the peak of the ablation season in these channels.

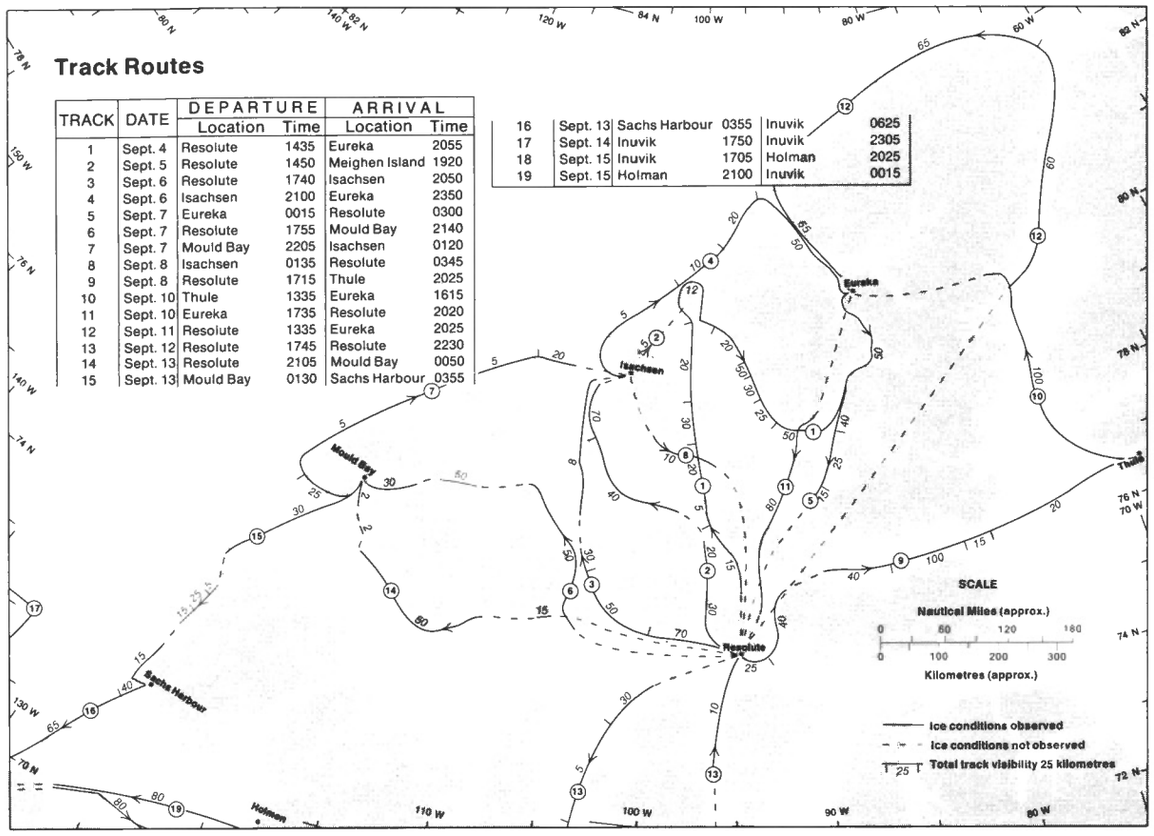
Comments

The weather during the first tracks of this flight was excellent and was forecast to continue for the few days necessary to complete the coverage of the western region. A series of events starting with a stone cutting an aircraft tire when landing at Cambridge Bay on August 22 forced the cancellation of further tracks in this region. The next two days were lost waiting for a replacement tire; two more days were lost due to bad weather and an additional two days were required to search for a missing aircraft. By this time poor weather was forecast for the western area and the aircraft returned to make surveys in the eastern part of the archipelago.



MAP 6 - 1971 WEST

August 21-Sept. 3, 1971



TRACK	DATE	DEPARTURE Location	DEPARTURE Time	ARRIVAL Location	ARRIVAL Time
1	Sept. 4	Resolute	1435	Eureka	2055
2	Sept. 5	Resolute	1450	Meighen Island	1920
3	Sept. 6	Resolute	1740	Isachsen	2050
4	Sept. 6	Isachsen	2100	Eureka	2350
5	Sept. 7	Eureka	0015	Resolute	0300
6	Sept. 7	Resolute	1755	Mould Bay	2140
7	Sept. 7	Mould Bay	2205	Isachsen	0120
8	Sept. 8	Isachsen	0135	Resolute	0345
9	Sept. 8	Resolute	1715	Thule	2025
10	Sept. 10	Thule	1335	Eureka	1615
11	Sept. 10	Eureka	1735	Resolute	2020
12	Sept. 11	Resolute	1335	Eureka	2025
13	Sept. 12	Resolute	1745	Resolute	2230
14	Sept. 13	Resolute	2105	Mould Bay	0050
15	Sept. 13	Mould Bay	0130	Sachs Harbour	0355
16	Sept. 13	Sachs Harbour	0355	Inuvik	0625
17	Sept. 14	Inuvik	1750	Inuvik	2305
18	Sept. 15	Inuvik	1705	Holman	2025
19	Sept. 15	Holman	2100	Inuvik	0015

MAP 7-1971 East
September 4-15

Flight Effectiveness

Generally poor weather persisted throughout Flight 7. Fortunately, the cloud ceilings near the various airstrips remained above regulation limits and surveys were completed over almost every part of the region. More than the usual number of tracks were completed, but this barely compensated for the reduced visibility caused by low cloud ceilings and areas of fog. Overall, the Flight was between 80 and 90 per cent effective which is much better than expected at this time of the year.

Ice Conditions

The changes in ice conditions which took place between the two flights were varied. New ice had started to appear in the open areas in the central and northern areas. At the same time the concentrations of first-year ice were declining until, at the end of Flight 7, the colour designating quantities of this type was not seen on the map.

Frozen puddles continued to exist and all the new forms of ice and rafting had started to appear. Snow was not melting and most areas were at least seven tenths covered. Of course concentrations were higher in the northern channels.

The development of open water in Norwegian Bay was impressive. Such an ice-free expanse had not appeared since 1962. The rapid rate of advance in 1971 and 1962 is demonstrated by the fact that at this time in normal seasons the area supports a seven tenths mixture of first-year and multi-year ice.

The solid plug of ice which prevented ice from moving into the archipelago through Sverdrup Channel remained intact while the ice in Nansen Sound had broken and drifted southward.

Between flights the concentrations of ice in Nares Strait increased from practically zero to between seven and nine tenths. Some of this ice was multi-year which moved south from the Arctic Ocean, but for the most part the increase in ice cover was caused by the development of new ice types.

A similar southerly drift of multi-year ice had recently started to move from Byam Martin Channel into Byam Channel.

Unobserved Areas

The conditions shown for Lancaster Sound and adjacent channels as well as Baffin Bay were deduced. Once these areas become ice-free they will remain this way until ice moves in or new ice forms. It was too early in the season for new ice to start to form in these areas and surveys over the potential points of entry indicated that no ice had entered them.

Comments

Many of the tracks during Flight 7 were concentrated on Meighen Island as sea-ice reconnaissance surveys were combined with the removal of personnel and equipment from the island. The ice conditions observed in the central parts of the archipelago were very favourable for shipping. Some ships were in a position to take advantage of this unique development and an icebreaker and a cargo vessel were sighted at 77° 24′N, 97°W on September 7th. Usually this area is not accessible by typical arctic cargo vessels with or without icebreaker assistance.

Many hundreds of icebergs were noted in the eastern half of Baffin Bay between Thule and Smith Sound during track 10.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$$\frac{C_{my}\ C_{sy} * C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2/*3410}{1\ 23}$ MM 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F - T Tmy 89 D 9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
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4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

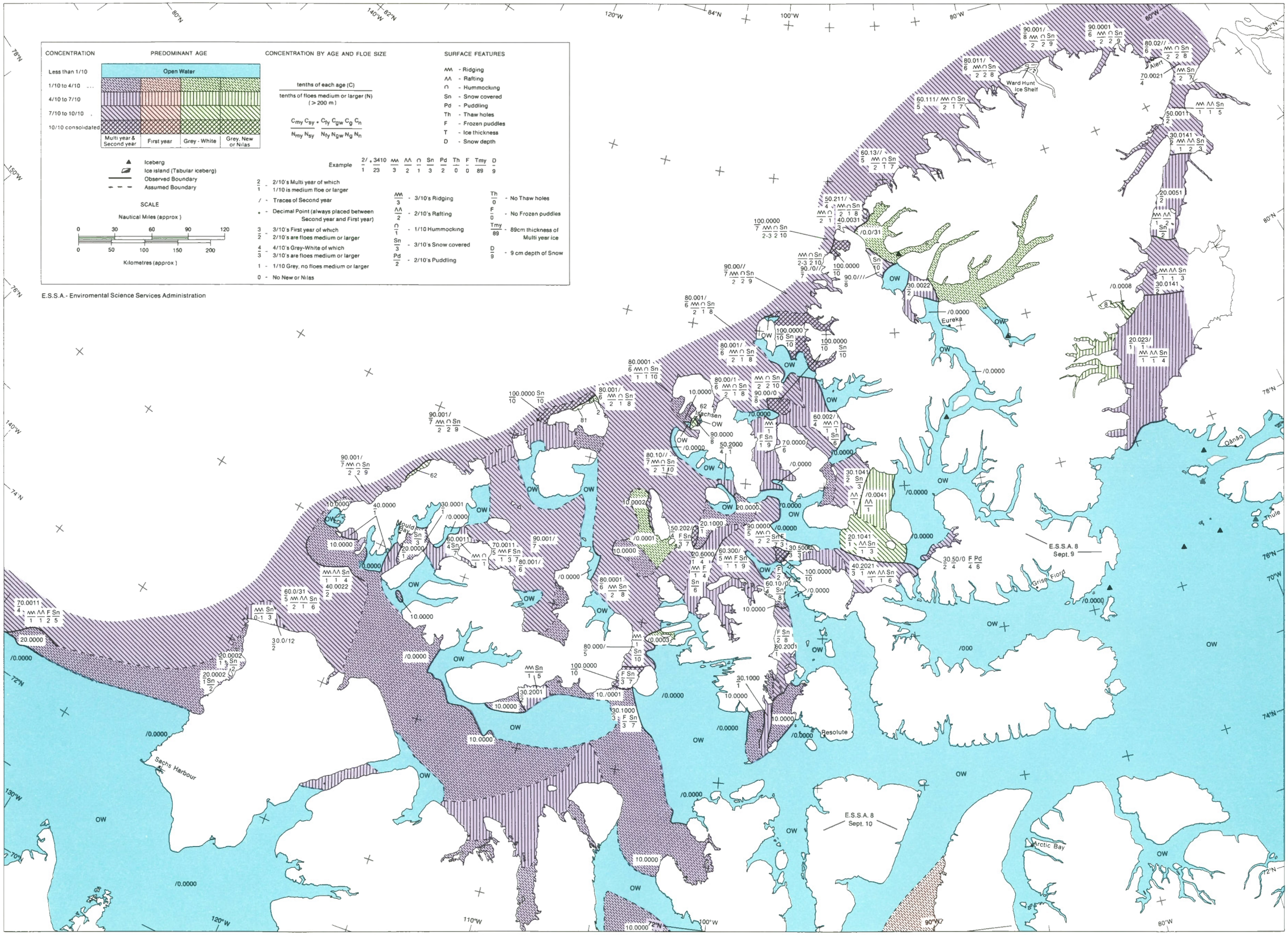
MM 3 - 3/10's Ridging
AA 2 - 2/10's Rafting
∩ 1 - 1/10 Hummocking
Sn 3 - 3/10's Snow covered
Pd 2 - 2/10's Puddling

Th 0 - No Thaw holes
F 0 - No Frozen puddles
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow

SURFACE FEATURES

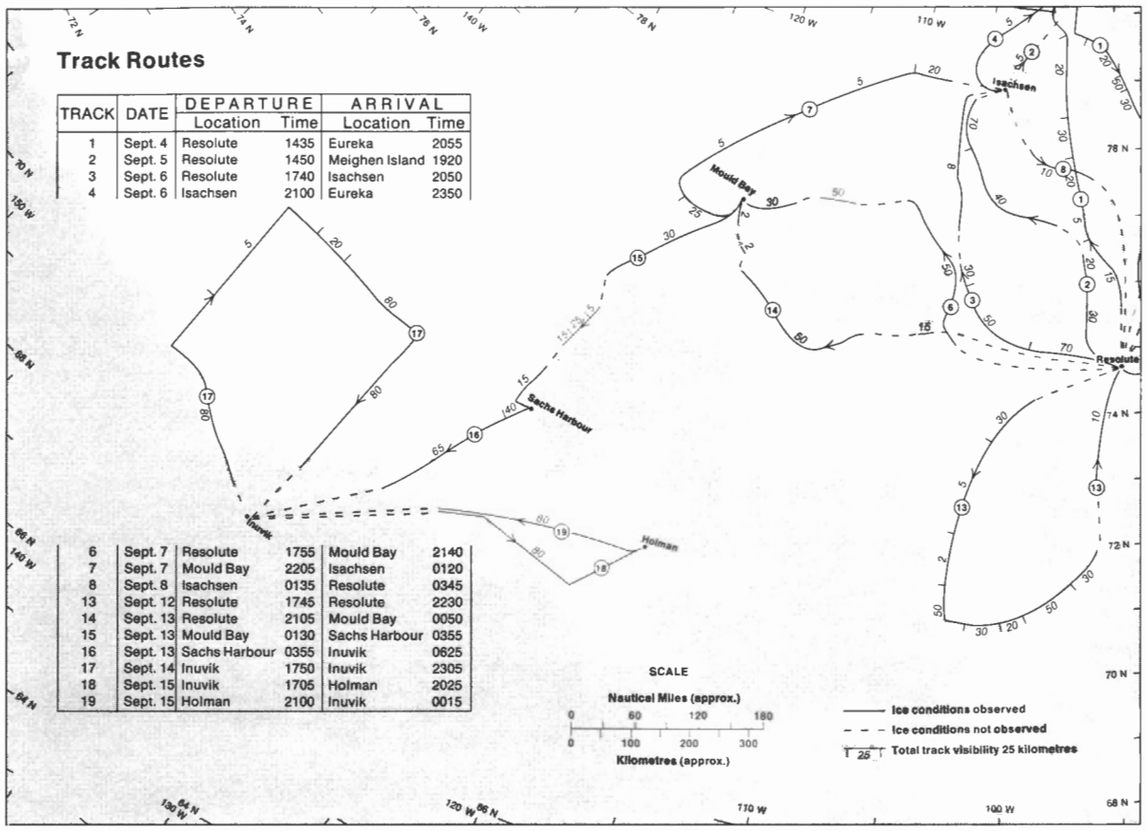
MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

E.S.S.A.- Enviromental Science Services Administration



MAP 7 - 1971 EAST

September 4-15, 1971



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2	Sept. 5	Resolute	1450	Meighen Island	1920
3	Sept. 6	Resolute	1740	Isachsen	2050
4	Sept. 6	Isachsen	2100	Eureka	2350
6	Sept. 7	Resolute	1755	Mould Bay	2140
7	Sept. 7	Mould Bay	2205	Isachsen	0120
8	Sept. 8	Isachsen	0135	Resolute	0345
13	Sept. 12	Resolute	1745	Resolute	2230
14	Sept. 13	Resolute	2105	Mould Bay	0050
15	Sept. 13	Mould Bay	0130	Sachs Harbour	0355
16	Sept. 13	Sachs Harbour	0355	Inuvik	0625
17	Sept. 14	Inuvik	1750	Inuvik	2305
18	Sept. 15	Inuvik	1705	Holman	2025
19	Sept. 15	Holman	2100	Inuvik	0015

MAP 7-1971 West
September 4-15

Flight Effectiveness

Ice conditions in the critical areas were surveyed during the tracks carried out over the western part of the archipelago for Flight 7. The weather permitted a greater number of tracks due to much better visibility than is usually expected at this time. Flight 7 was at least 80 per cent effective.

Ice Conditions

All areas of first-year ice had melted and disappeared during the interval between the completion of Flights 6 and 7. The total area of multi-year ice was nearly the same at the end of each flight, but it had spread over more of Viscount Melville Sound. In the Beaufort Sea the ice-free area was larger, but whether this was caused by melting or a reduction in the strength of the winds which had previously driven the ice toward the south is not known.

The amount of clearing in western Barrow Strait and Viscount Melville Sound was much greater than usual. Typically these areas support concentrations of ice which range from five to seven tenths or more at this time of year. Impressive as this clearing was, the amount of open water that developed in M'Clintock Channel was beyond all expectations. A nine tenths or a solid ice cover usually spreads across three quarters of this channel in the first part of September.

The eastward drift of ice from the Arctic Ocean into M'Clure Strait was almost negligible. Some small amounts of multi-year ice did manage to drift through Byam Channel and invade the area south of Byam Martin Island.

Unobserved Areas

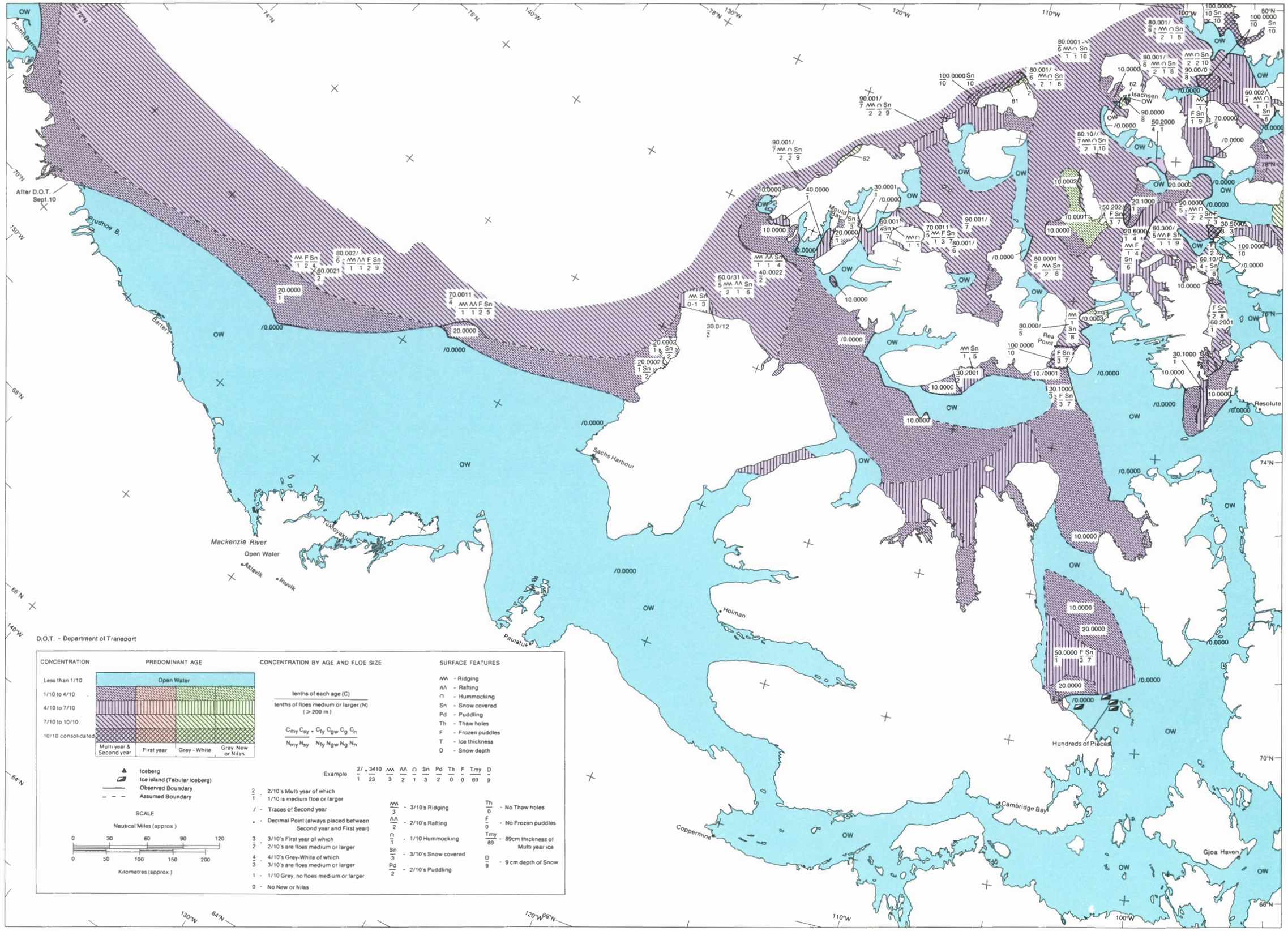
The ice conditions shown for the southern part of Viscount Melville Sound and the eastern half of M'Clure Strait are based on a number of sources of varying reliability, ranging from direct observation, through satellite photography, to subsequent surveys and what the conditions are usually like in these areas, given the observed situation in the adjacent areas.

The southern channels were ice-free because once they become ice-free, see Maps 5 and 6-1971 West, they remain so until new ice forms or other ice drifts in. No new ice had formed in any other adjacent area and observations confirmed that no ice had drifted in. Consequently, all the southern channels linking the Beaufort Sea with Victoria Strait and Rasmussen Basin remained ice-free.

Comments

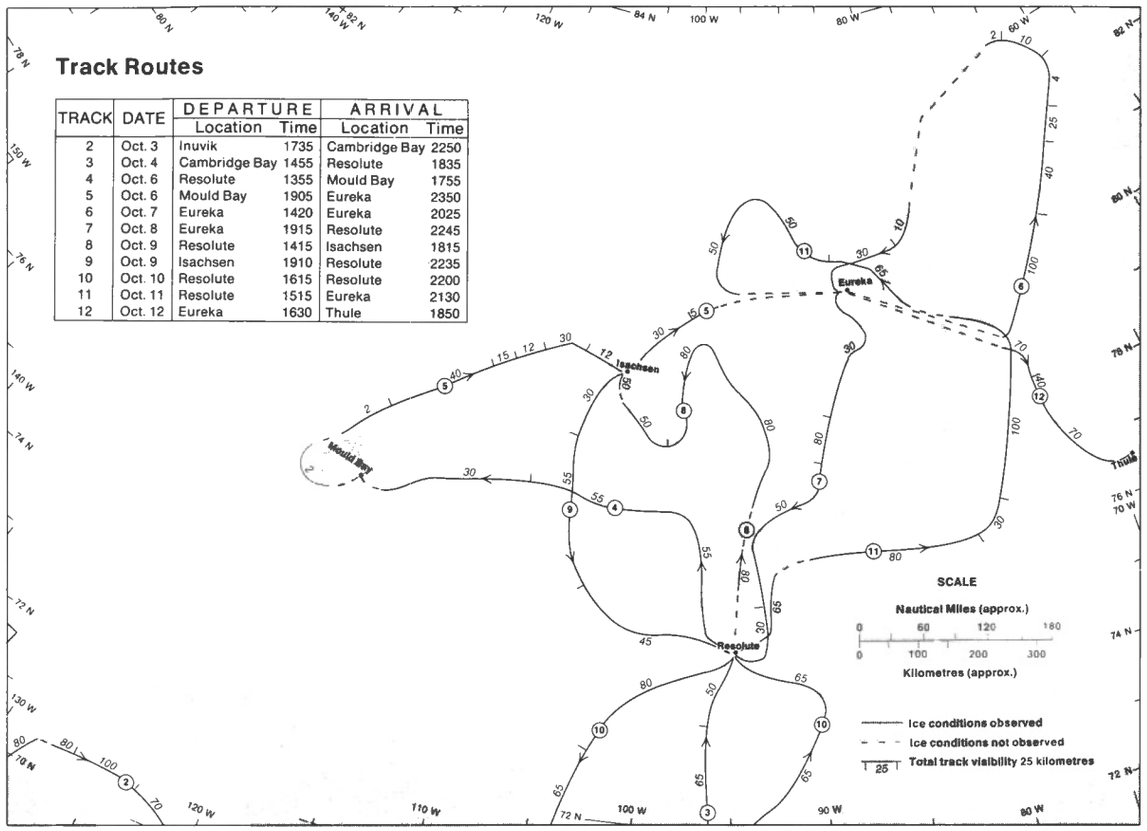
On September 12, hundreds of small fragments and two large pieces of ice island were seen in the southern part of M'Clintock Channel near Gateshead Island. The largest piece, considered to represent the last remains of T-1, was centred at 70° 45'N, 101° 05'W and measured about 11 x 13 kilometres. When this island first entered the archipelago in the late 50's the lengths of its triangular sides averaged about 27 kilometres. The ice island had stayed intact throughout its drift through the area until 1970 when it started to disintegrate in the graveyard of the arctic.

Sir John Franklin and his crew perished in the same area after waiting for three seasons for the ice to break up. Probably these men dreamed of the ice-free conditions shown on Map 7, but it is not likely that similar situations have developed more than a few times since the 1850's.



MAP 7 - 1971 WEST

September 4-15, 1971



TRACK	DATE	DEPARTURE Location	Time	ARRIVAL Location	Time
2	Oct. 3	Inuvik	1735	Cambridge Bay	2250
3	Oct. 4	Cambridge Bay	1455	Resolute	1835
4	Oct. 6	Resolute	1355	Mould Bay	1755
5	Oct. 6	Mould Bay	1905	Eureka	2350
6	Oct. 7	Eureka	1420	Eureka	2025
7	Oct. 8	Eureka	1915	Resolute	2245
8	Oct. 9	Resolute	1415	Isachsen	1815
9	Oct. 9	Isachsen	1910	Resolute	2235
10	Oct. 10	Resolute	1615	Resolute	2200
11	Oct. 11	Resolute	1515	Eureka	2130
12	Oct. 12	Eureka	1630	Thule	1850

MAP 8-1971 East
October 3-12

Flight Effectiveness

Nine surveys were completed over the eastern part of the archipelago during Flight 8. The weather was much better than usual for this time of year and the visibility during seven tracks ranged from good to excellent. Fog restricted observations during track six and the shorter periods of daylight began to reduce the length of each survey. The Flight was judged to be between 80 and 90 per cent effective.

Ice Conditions

Three weeks had elapsed between surveys over the eastern area. During this interval large areas of the various types of young ice had developed in the areas that were previously ice-free, but there were no changes that deviated to any large extent from the usual pattern.

The thickness of the young ice types had grown to 30 centimetres or more in a number of areas. Once this thickness is reached the ice is referred to as first-year ice.

The multi-year ice in the southern part of Norwegian Bay was less concentrated, but this condition was probably a temporary one. Similarly, the solid cover in Byam Channel would soon break up. The formation of such large areas of young ice, the development of first-year ice in some areas and the extent of solid ice cover indicated that the calm, cold weather encountered during Flight 8 must have existed for a few days prior to the Flight.

The multi-year ice in the northern part of Nares Strait had drifted south and some of it moved through Smith Sound into the northern part of Baffin Bay. An influx of multi-year ice from the Lincoln Sea to replace the ice lost from northern Nares Strait would soon take place.

Unobserved Areas

The conditions along the north coast of Ellesmere Island and to the north of Ellef Ringnes Island were likely very similar to those shown on Map 7-1971 except that solid ice covers would be forming on all the bays.

Probably new ice was developing in the southern part of Admiralty Inlet and in the channels surrounding Bylot Island.

Comments

Very limited amounts of multi-year ice had moved south into the archipelago considering the length of time the ice cover on the northern channels had been broken.

SEA-ICE ATLAS OF ARCTIC CANADA

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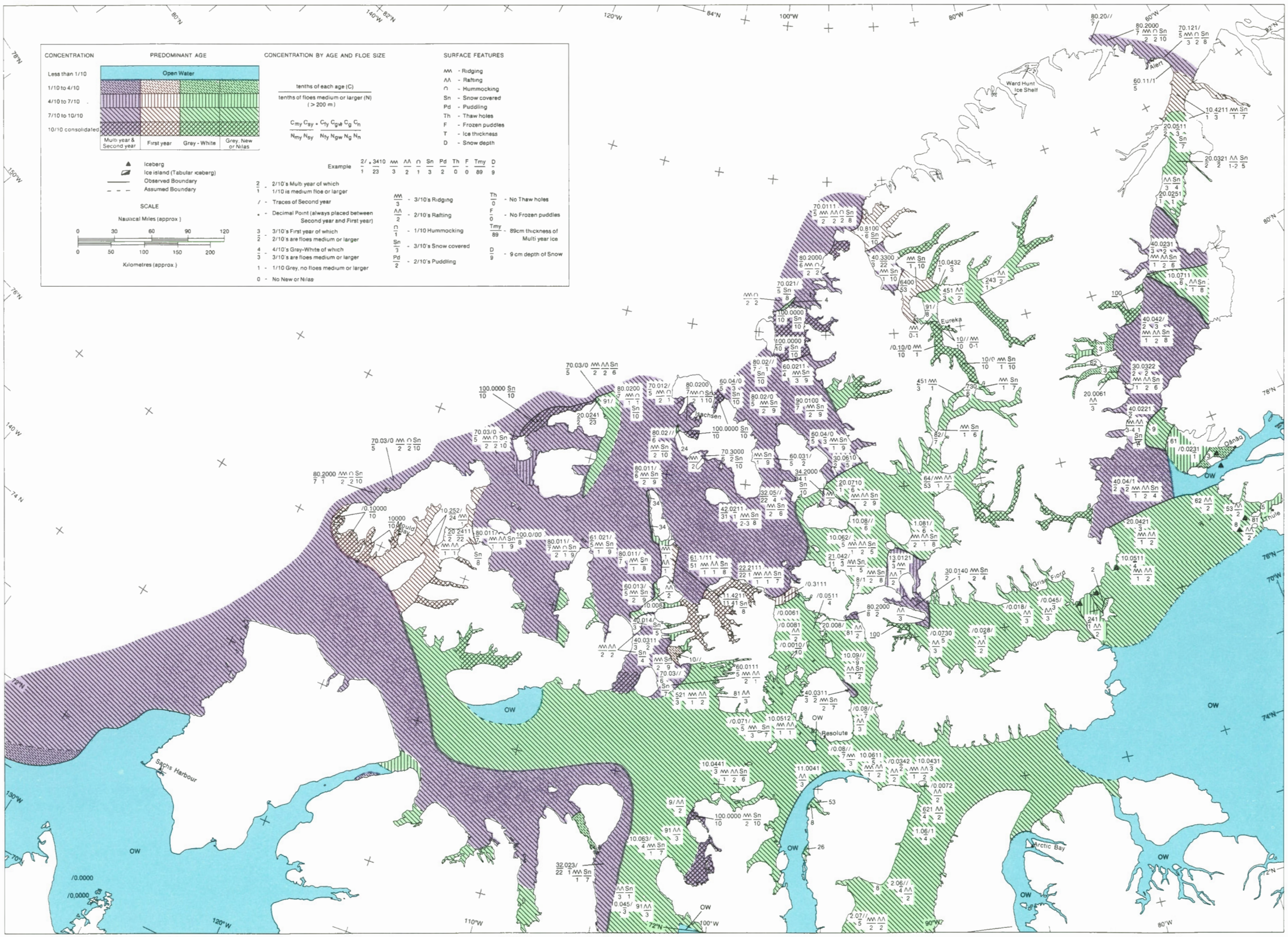
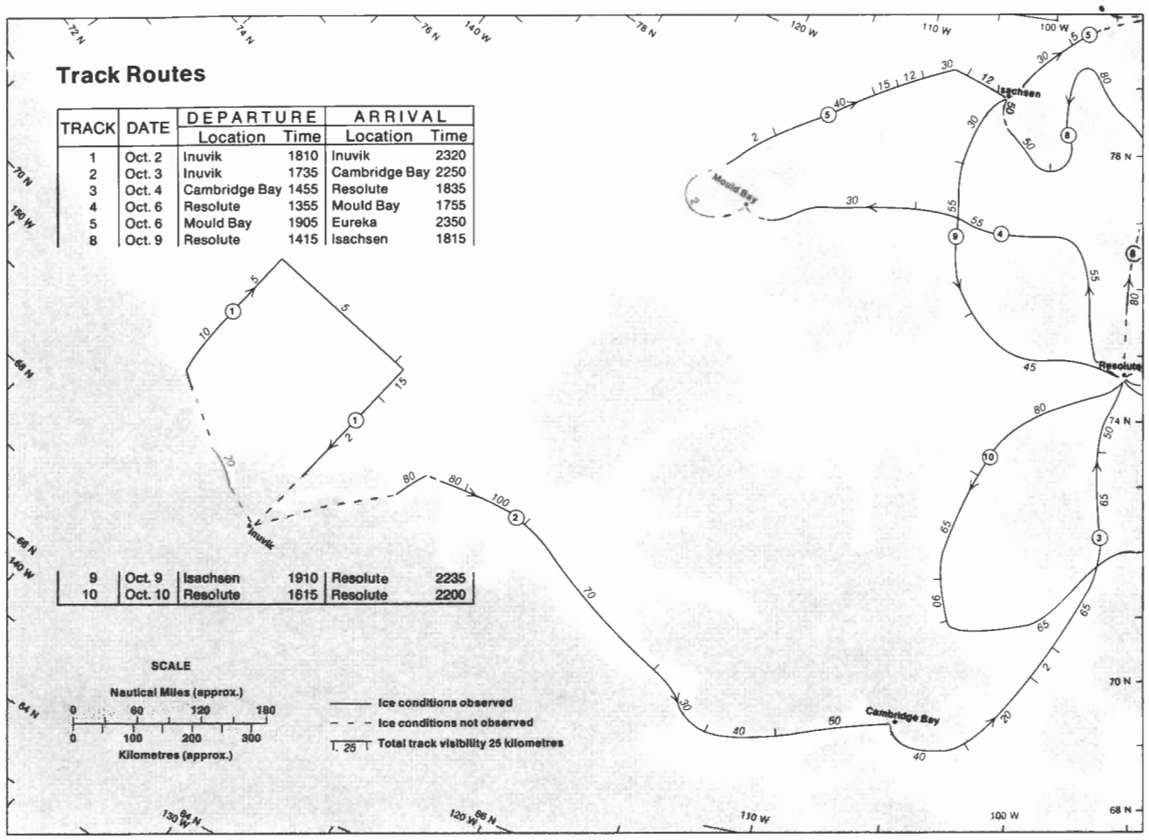


MAP 8 - 1971 EAST

October 3-12, 1971



MAP 8-1971 West
October 2-10

Flight Effectiveness

The weather and visibility during the first track over the Beaufort Sea were very poor. Fortunately very good to excellent weather for the remaining tracks in the western part of the region permitted large areas to be surveyed. Overall, the Flight was considered to be about 80 per cent effective.

Ice Conditions

Although a number of changes had taken place during the time between the ends of Flights 7 and 8 no unexpected conditions developed. A southerly drift of the multi-year ice had taken place in the Beaufort Sea, Viscount Melville Sound and M'Clintock Channel. In the former area the ice moved about 150 kilometres closer to the mainland coast. A similar drift took place in M'Clintock Channel as the ice moved south into Victoria Strait. The movement in Viscount Melville Sound served to concentrate the multi-year ice along the north coast of Victoria Island. If any ice was able to enter the archipelago through M'Clure Strait, the amount was very small. Similarly, it appeared that only limited quantities of multi-year ice had moved into Parry Channel through Byam Channel and Austin Channel.

The expansion of the young ice in the areas previously ice-free was a major change. However, large ice-free areas still persisted.

Unobserved Areas

Ice conditions shown for Viscount Melville Sound, M'Clure Strait and the northeastern part of the Beaufort Sea were determined from data collected during previous and subsequent surveys over these areas.

The Mackenzie River was ice-free.

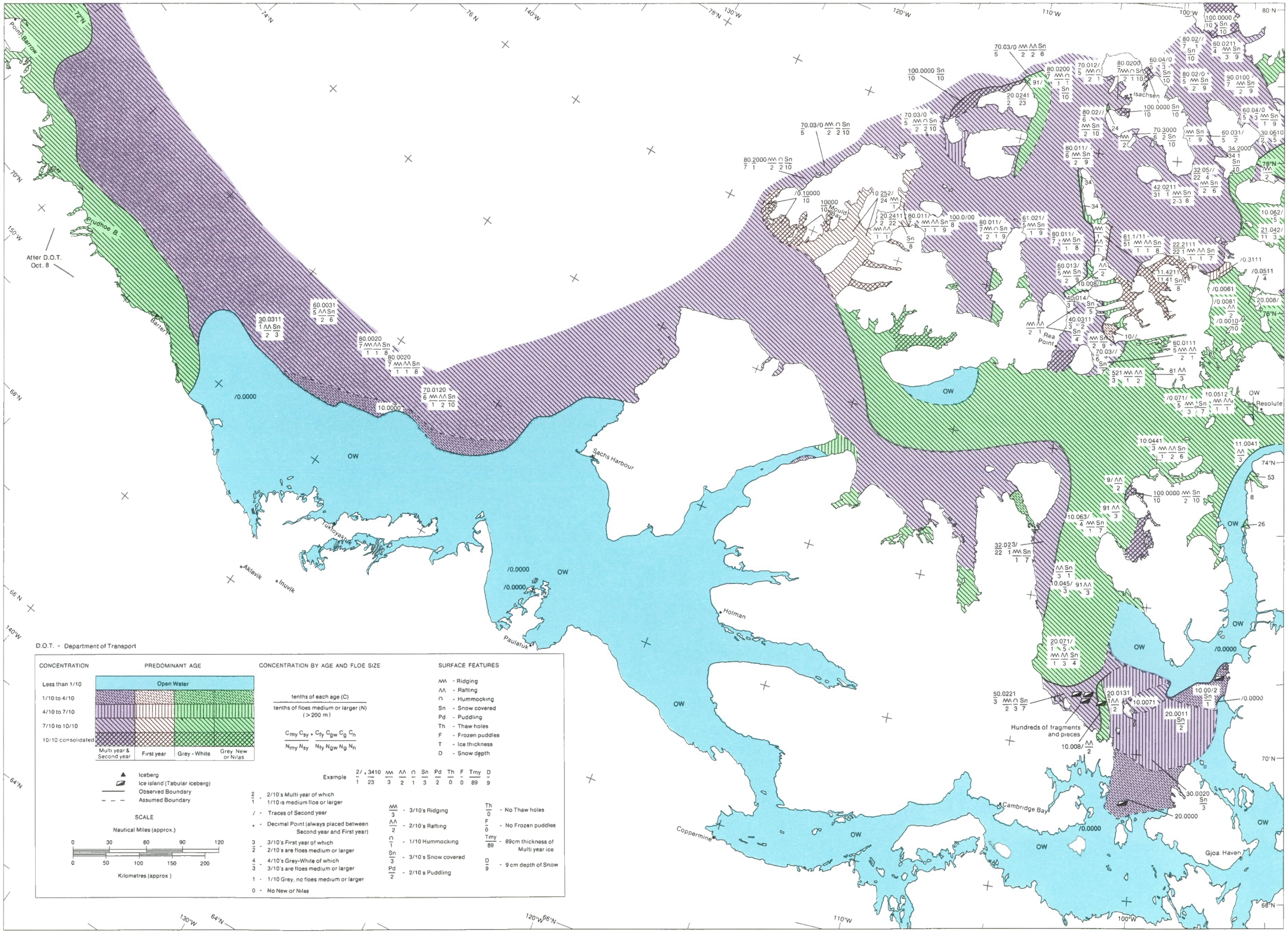
Comments

Many large ice island fragments had drifted south along with the multi-year ice in M'Clintock Channel to the vicinity of the Royal Geographical Society Islands. No large pieces of ice island were observed where T-1 was last seen, but there were hundreds of fragments and pieces. It appeared that T-1 nad completely broken up.

Considering the extent of break-up in the northern areas, the amount of open water in the southern regions, and the northerly winds which seemed to prevail during Flights 7 and 8, it is surprising that large quantities of multi-year ice did not move south through Byam and Austin Channel into Parry Channel.

The maximum amount of open water in the western part of the archipelago likely appeared in the latter part of September. Although the total ice-free area in the Beaufort Sea and southern channels was typical, the amount of open water in Viscount Melville Sound and M'Clintock Channel was extremely large. Similar conditions had not developed since 1962.

The weather was much better than usually expected and, although the cloud ceilings remained at their typically low level, the horizontal visibilities were very good.



CONCENTRATION

- Less than 1/10
- 1/10 to 4/10
- 4/10 to 7/10
- 7/10 to 10/10
- 10/10 consolidated

PREDOMINANT AGE

Open Water

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example: 2/ • 3410 MM 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9

- 2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
- / - Traces of Second year
- • - Decimal Point (always placed between Second year and First year)
- 3/2 - 3/10's First year of which 2/10's are floes medium or larger
- 4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
- 1 - 1/10 Grey, no floes medium or larger
- 0 - No New or Nilas

- MM/3 - 3/10's Ridging
- AA/2 - 2/10's Rafting
- ∩/1 - 1/10 Hummocking
- Sn/3 - 3/10's Snow covered
- Pd/2 - 2/10's Puddling

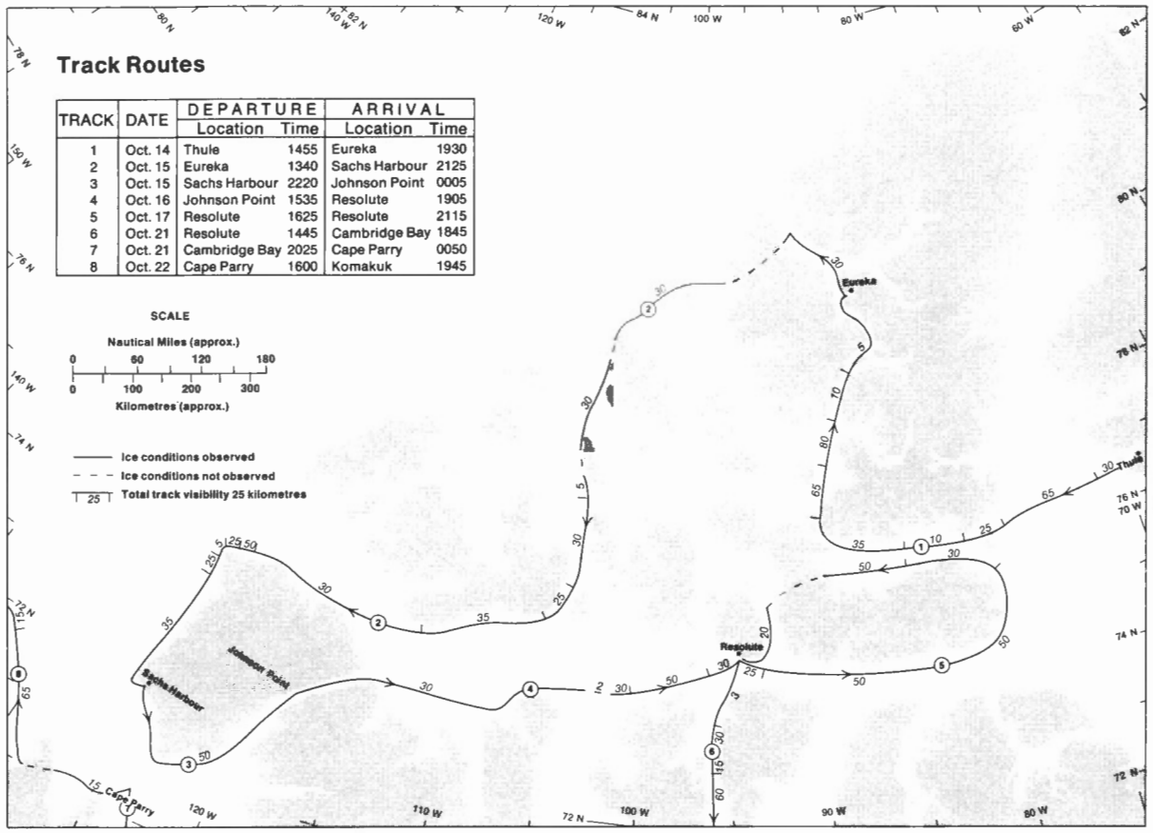
SURFACE FEATURES

- MM - Ridging
- AA - Rafting
- ∩ - Hummocking
- Sn - Snow covered
- Pd - Puddling
- Th - Thaw holes
- F - Frozen puddles
- T - Ice thickness
- D - Snow depth

- Th/0 - No Thaw holes
- F/0 - No Frozen puddles
- Tmy/89 - 89cm thickness of Multi year ice
- D/9 - 9 cm depth of Snow

SCALE

0 30 60 90 120
0 50 100 150 200



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 14	Thule	1455	Eureka	1930
2	Oct. 15	Eureka	1340	Sachs Harbour	2125
3	Oct. 15	Sachs Harbour	2220	Johnson Point	0005
4	Oct. 16	Johnson Point	1535	Resolute	1905
5	Oct. 17	Resolute	1625	Resolute	2115
6	Oct. 21	Resolute	1445	Cambridge Bay	1845
7	Oct. 21	Cambridge Bay	2025	Cape Parry	0050
8	Oct. 22	Cape Parry	1600	Komakuk	1945

MAP 9-1971 East
October 14-22

Flight Effectiveness

Only three tracks were completed over the eastern part of the region during the last Flight of the 1971 season. Visibility during these tracks was variable but generally good. Many areas were not observed and the Flight was judged to be about 50 per cent effective.

Ice Conditions

No unanticipated changes developed during the brief interval separating Flights 8 and 9. New and grey ice had formed in all areas previously ice-free. Grey-white and thin first-year ice had started to form a solid cover across the smaller, more protected bays. The ice cover in the larger channels remained in motion but freeze-up was imminent because the young ice types were rapidly forming and had started to cement the larger and older floes together.

Unobserved Areas

Multi-year ice would continue to move south through Nares Strait for three or four weeks while the thickness of the newly-formed ice increased to the point where it consolidated all the existing floes and created a solid ice cover. Although Nares Strait is shown mainly as multi-year, it is likely that areas of new, grey and grey-white as well as thin first-year ice were present. Probably a solid cover of thin first-year ice had developed in the fiords on either side of Bache Peninsula. Small areas of open water would be present at the narrows in these fiords.

Along the northern coast of Ellesmere Island and Axel Heiberg Island the solid ice cover extended across the fiords and moving multi-year ice in the Arctic Ocean would be separated from the coast by a thin band of landfast ice. The ice in northern Nansen Sound was still moving. Probably a solid ice cover would develop over this channel within two weeks.

A moving cover of predominantly multi-year ice likely existed over most of the unobserved area north of Penny Strait. Probably the young ice forms predominated in Danish Strait, the southern part of Hassel Sound, throughout Hendriksen Strait and Belcher Channel. Final freeze-up in these and the surrounding areas was probably about four weeks away.

The ice conditions in Hazen Strait, Hecla and Griper Bay, Ballantyne Strait, Wilkins Strait and the channels around Eglinton Island would be very similar to those shown on Map 8-1971 East. The thickness of the ice forming in Prince Regent Inlet was increasing, but the size of the channel left room for winds to constantly shift the ice around so that a consolidated ice cover could not develop. On the other hand the narrow, protected channels such as Admiralty Inlet, Navy Board Inlet and Pond Inlet allowed a solid ice cover to form.

Comments

The ice cover on Sverdrup Channel remained solid throughout the season. This is very unexpected considering that the ice cover in all the channels around it broke up at the beginning of August. Usually Sverdrup Channel breaks up shortly after the others.

The visibility during the tracks was very changeable as observing altitudes during most surveys ranged from 100 feet to 7,000 feet. Very strong winds grounded the aircraft at Resolute from October 17 to 20. This delay precluded a number of planned surveys.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\,C_{sy} + C_{fy}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy} \quad N_{fy}\,N_{gw}\,N_g\,N_n}$$

Example $\frac{2}{1}/\bullet\frac{3410}{23}$ MM/3 AA/2 ∩/1 Sn/3 Pd/2 Th/0 F/0 Tmy/89 D/9

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New of Nilas

$\frac{MM}{3}$ - 3/10's Ridging
$\frac{AA}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

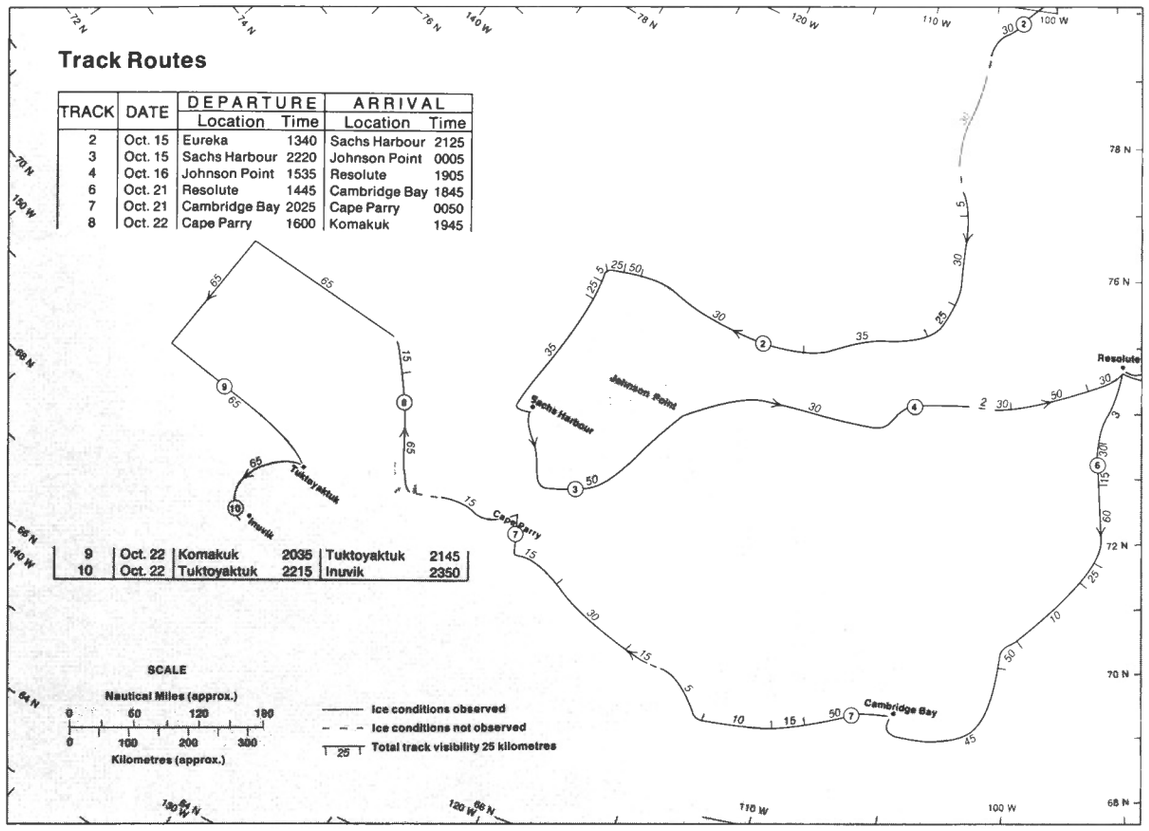
SURFACE FEATURES

MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

Alert
Ward Hunt Ice Shelf
Eureka
Isachsen
Mould Bay
Sachs Harbour
Resolute
Arctic Bay
Qaanaaq
Thule
Grise Fiord
OW

MAP 9 - 1971 EAST

October 14-22, 1971



MAP 9-1971 West
October 15-22

Flight Effectiveness

Low cloud, snow and some fog restricted observations during some part of most of the seven tracks carried out over the western region for Flight 9. Overall, visibility was good and the Flight was at least 80 per cent effective. Usually at this time of year about 40 per cent of the area is observed.

Ice Conditions

A number of indicative changes took place between Flights 8 and 9. In the Beaufort Sea the multi-year ice had moved about 50 kilometres further north. Nilas, grey and grey-white ice spread over the entire 150 kilometre-wide band separating the multi-year ice from the coast. A solid cover of thin, first-year ice had developed on Liverpool Bay, Kugmallit Bay and Mackenzie Bay. The multi-year ice in M'Clure Strait drifted toward the western entrance of Viscount Melville Sound. Multi-year ice had also entered the area through Byam and Austin Channels. The influx through the latter channels appeared to be short-lived and the total area of ice that entered Viscount Melville Sound through this gateway was rather small compared with other years. The ice types in Victoria Strait appeared to change from multi-year to the younger forms between the two flights. Actually the multi-year ice was still present, but the concentrations of the young ice types were such that they were the dominant type as indicated by the green colour on the map. During the 17-day interval separating the surveys over Peel Sound the young ice types had developed over most of the Sound and a solid cover had developed in sheltered areas like Browne Bay.

Unobserved Areas

Although ice conditions in the central part of M'Clintock Channel were not observed, it is likely that they remained unchanged from the previous track. Undoubtedly, the young ice had grown thicker during the interval. Probably new ice types as well as grey and grey-white ice were forming in sheltered parts of Queen Maud Gulf and Rasmussen Basin.

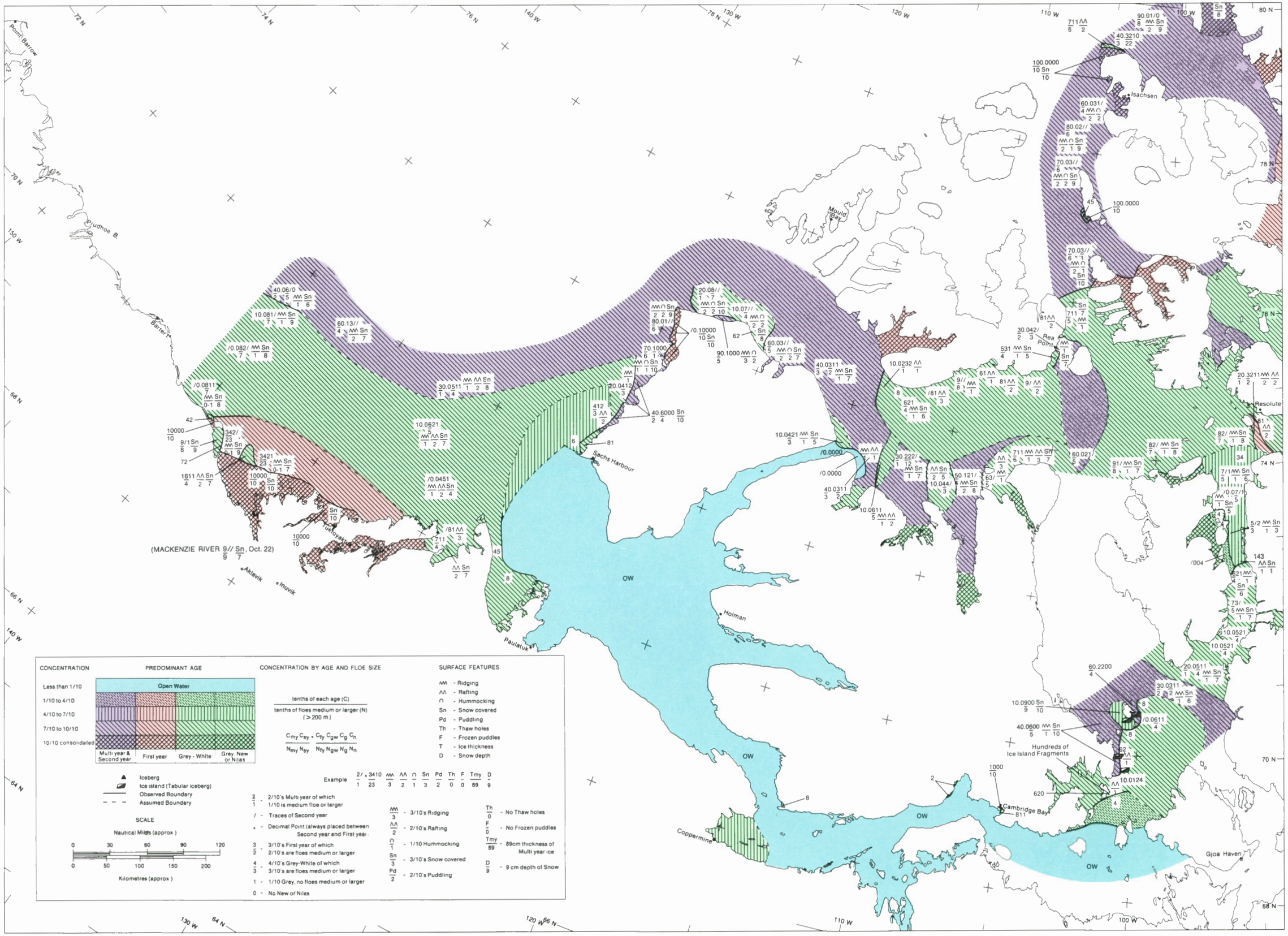
The ice conditions in the eastern channels of the Mackenzie River between Kugmallit Bay and Point Separation were surveyed on October 22 during the southbound ferry flight. Generally nine to ten tenths of grey-white ice covered the river as far as Point Separation. Here concentrations declined to six tenths with traces of new and grey ice in the main channel.

Comments

When Amundsen Gulf and Queen Maud Gulf were surveyed on October 21 only limited areas of the younger ice types were observed. Usually most of these channels support a nine tenths cover of new and grey ice by this time in the season.

While this area remained relatively ice-free, the ice in Mackenzie Bay, Kugmallit Bay and Liverpool Bay grew faster than usual and a solid cover of thin first-year ice had developed.

Between November 14 and 20 strong east winds created 30 kilometres of open water north of Herschel Island and in the western part of Amundsen Gulf.



MAP 9 - 1971 WEST

October 15-22, 1971

SEASONAL SUMMARY: 1972

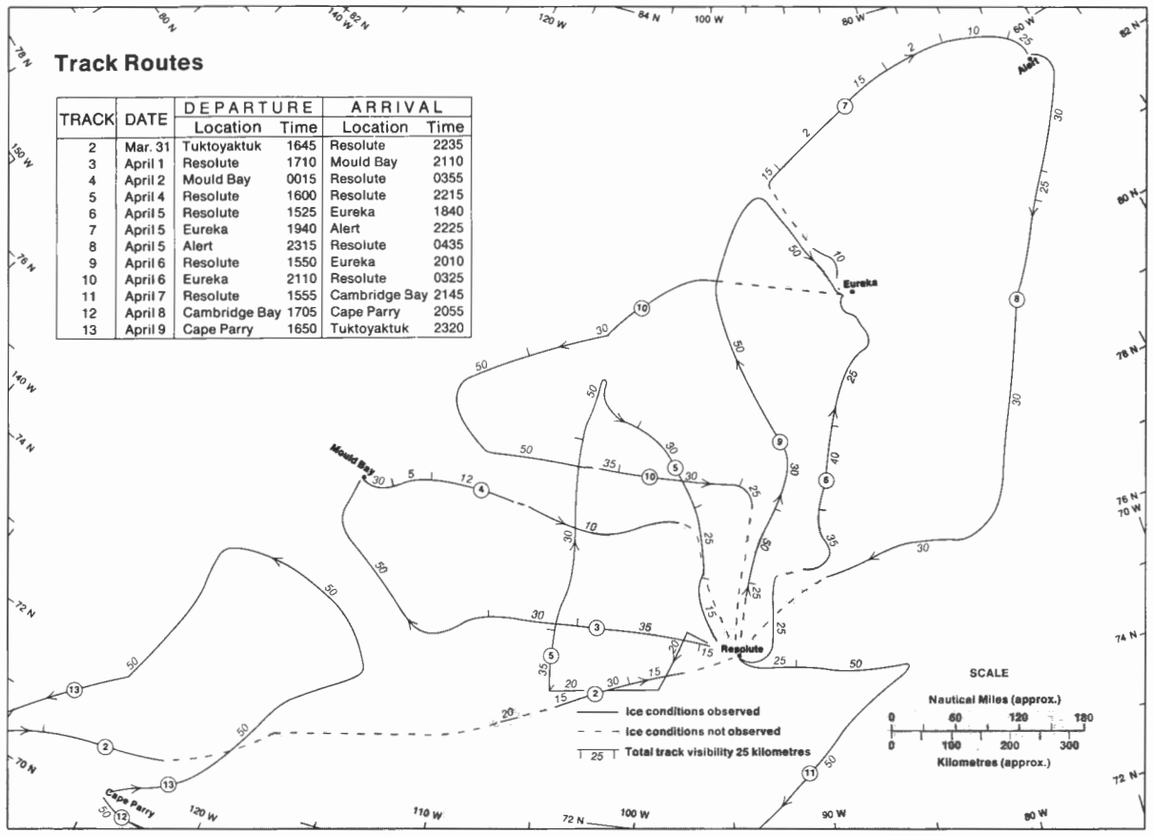
The ice conditions observed in all the straits and channels of the Canadian Arctic Archipelago during the summer of 1972 were very bad according to ships' captains and others who had experienced the relatively hospitable conditions of the previous summer. In reality, the ice conditions which developed throughout the 1972 season, with the exception of those in the Beaufort Sea, represented the normal or 'average' type of season. The timing, advance of break-up, development of ice-free areas, movement and progression of freeze-up followed the typical patterns.

The ice cover across the northern channels of the Queen Elizabeth Islands remained unbroken and no ice from the Arctic Ocean was able to move through them and into the archipelago. After a rather sporadic start, the ice in the southern part of the Beaufort Sea disappeared leaving a very large area of open water that persisted from the end of July until new ice began to form in early October. While this area of open water in the Beaufort Sea existed for the entire summer its extent was not much greater than usual.

The weather during the first five Flights between March 30 and September was generally good and more than 75 per cent of the area was observed during each flight. Poor weather reduced the extent and effectiveness of the last flights leaving up to 50 per cent of the area unobserved at the end of each series of surveys.

The scope for navigation and exploration activities in the waters of the Canadian Arctic Archipelago during the summer of 1972 was considerably hampered by sea-ice conditions. Unfortunately the operators assumed that the very favourable ice conditions which developed in 1971 would recur the following year. The situation which developed during the 1972 season, as shown on the following maps, was typical of a normal or average season.

Patterns, distributions and concentrations observed and mapped in 1972 are the basic ones that planners must take into consideration when they try to develop programs for any season.



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
2	Mar. 31	Tuktoyaktuk	1645	Resolute	2235
3	April 1	Resolute	1710	Mould Bay	2110
4	April 2	Mould Bay	0015	Resolute	0355
5	April 4	Resolute	1600	Resolute	2215
6	April 5	Resolute	1525	Eureka	1840
7	April 5	Eureka	1940	Alert	2225
8	April 5	Alert	2315	Resolute	0435
9	April 6	Resolute	1550	Eureka	2010
10	April 6	Eureka	2110	Resolute	0325
11	April 7	Resolute	1555	Cambridge Bay	2145
12	April 8	Cambridge Bay	1705	Cape Parry	2055
13	April 9	Cape Parry	1650	Tuktoyaktuk	2320

MAP 1-1972 East
March 31-April 9

Flight Effectiveness

A total of eight separate tracks or surveys were conducted over the straits and channels in the eastern part of the archipelago during Flight 1-1972. The Flight was about 65 per cent effective. The main reason for reduced visibilities was a haze resulting from ice crystals near the ice. Moreover, problems caused by this haze were periodically accentuated by the low sun angle.

Ice Conditions

The patterns shown on Map 1-1972 generally reflect the conditions appearing on Map 9-1971. This similarity suggests that freeze-up during the fall of 1971 took place soon after the last flight was completed. During freeze-up, some movement did take place. It is apparent from a comparison of the two maps that a northerly drift took place in Viscount Melville Sound and that ice moved south into Penny Strait. While the amount of multi-year ice present in the eastern part of the archipelago was less than usual, the distribution of ice types and the extent of broken ice and solid ice was typical for this time of year.

Unobserved Areas

A number of small areas of open water had developed in the channels separating Baillie-Hamilton Island from Dundas Island and the southwest tip of Devon Island. These open areas usually develop at this time. However, they are too small to be shown on the map.

Other features too small to include on this map were some small ice island fragments located in Byam Channel, near the southeast tip of Melville Island and along the west coast of Axel Heiberg Island between Middle Fiord and Strand Bay.

Three small icebergs were spotted in the south central part of Prince Regent Inlet and many were sighted in Nansen Sound and along the east coast of Ellesmere Island between Cape Isabella and Coburg Island where the solid ice cover had trapped them in the fall. As expected Jones Sound hosted icebergs which were strung out along the southern coast of Ellesmere Island.

Comments

The broken ice cover in Lancaster Sound and Prince Regent Inlet is a normal occurrence and the boundary separating solid ice from moving ice between Somerset Island and Devon Island regularly appears in the same place. Although the ice in the southern part of Prince Regent Inlet was solid, it is probable that a moving ice cover existed in the central part of the Gulf of Boothia.

The open areas around Baillie-Hamilton Island and Hell Gate are typical. To some extent, the open area to the northeast of Meighen Island is also a regular annual feature because it has appeared at the same time and in the same place in previous years.

The reduced amounts of roughness throughout most of the eastern part indicated a fairly quiet freeze-up in most areas. The roughest ice was noted in the south central part of Barrow Strait near Russell Island where pressure ridging over four tenths of the surface was recorded. This area normally supports first-year ridges in these concentrations.

SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT

CONCENTRATION

Less than 1/10 .....
1/10 to 4/10 .....
4/10 to 7/10 .....
7/10 to 10/10 .....
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi-year & Second year	First year	Grey - White	Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N)}\ (>200\ \text{m})}$$

$$\frac{C_{my}\ C_{sy} \ldots C_{ty}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy} \quad N_{ty}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2/}{1} \ast \frac{3410}{23}$ MM/3 AA/2 ∩/1 Sn/3 Pd/2 Th/0 F/0 Tmy/89 D/9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

SURFACE FEATURES

MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

MM/3 - 3/10's Ridging
AA/2 - 2/10's Rafting
∩/1 - 1/10 Hummocking
Sn/3 - 3/10's Snow covered
Pd/2 - 2/10's Puddling

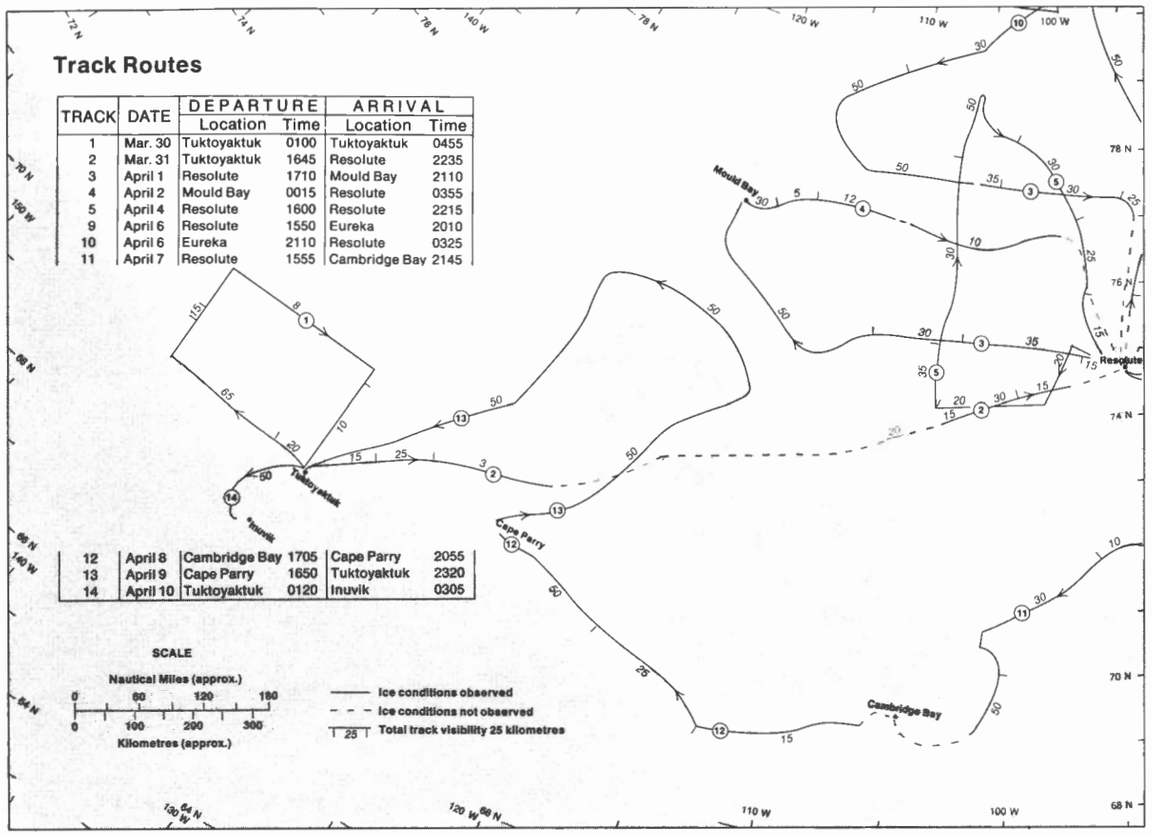
Th/0 - No Thaw holes
F/0 - No Frozen puddles
Tmy/89 - 89cm thickness of Multi year ice
D/9 - 9 cm depth of Snow

E.S.S.A. - Enviromental Science Services Administration

Ward Hunt Ice Shelf
Alert
Eureka
Isachsen
Sachs Harbour
Resolute
Arctic Bay
Qaanaaq
Thule
Grise Fiord
E.S.S.A. - 8 April 8

MAP 1 - 1972 EAST

March 31 - April 9, 1972



MAP 1-1972 West
March 30-April 10

Flight Effectiveness

The first Flight over the western part of the archipelago during the 1972 season was between 50 and 60 per cent effective. Although the skies were cloud free, visibility near the ice surface was restricted by ice crystals. The adverse effects of this ice fog or ice haze were augmented by the low sun angle and the snow cover.

Ice Conditions

During the winter months, first-year ice had developed over all the ice-free areas observed the previous fall. More than the usual amounts of first-year ice appeared in the northern half of the Beaufort Sea while in M'Clintock Channel the amount of first-year ice reached a record peak.

A number of narrow, refrozen cracks were noted in the area north of Herschel Island indicating that the ice was recently in motion and would soon be broken up once again.

Thousands of ice island fragments were spread out along the southeast coast of Victoria Island from Gateshead Island to Jenny Lind Island. The largest piece, measuring four by four kilometres, was spotted at 69° 44'N, 101°W.

Compared with the previous season, there was much more pressure ridging in the eastern half of Amundsen Gulf.

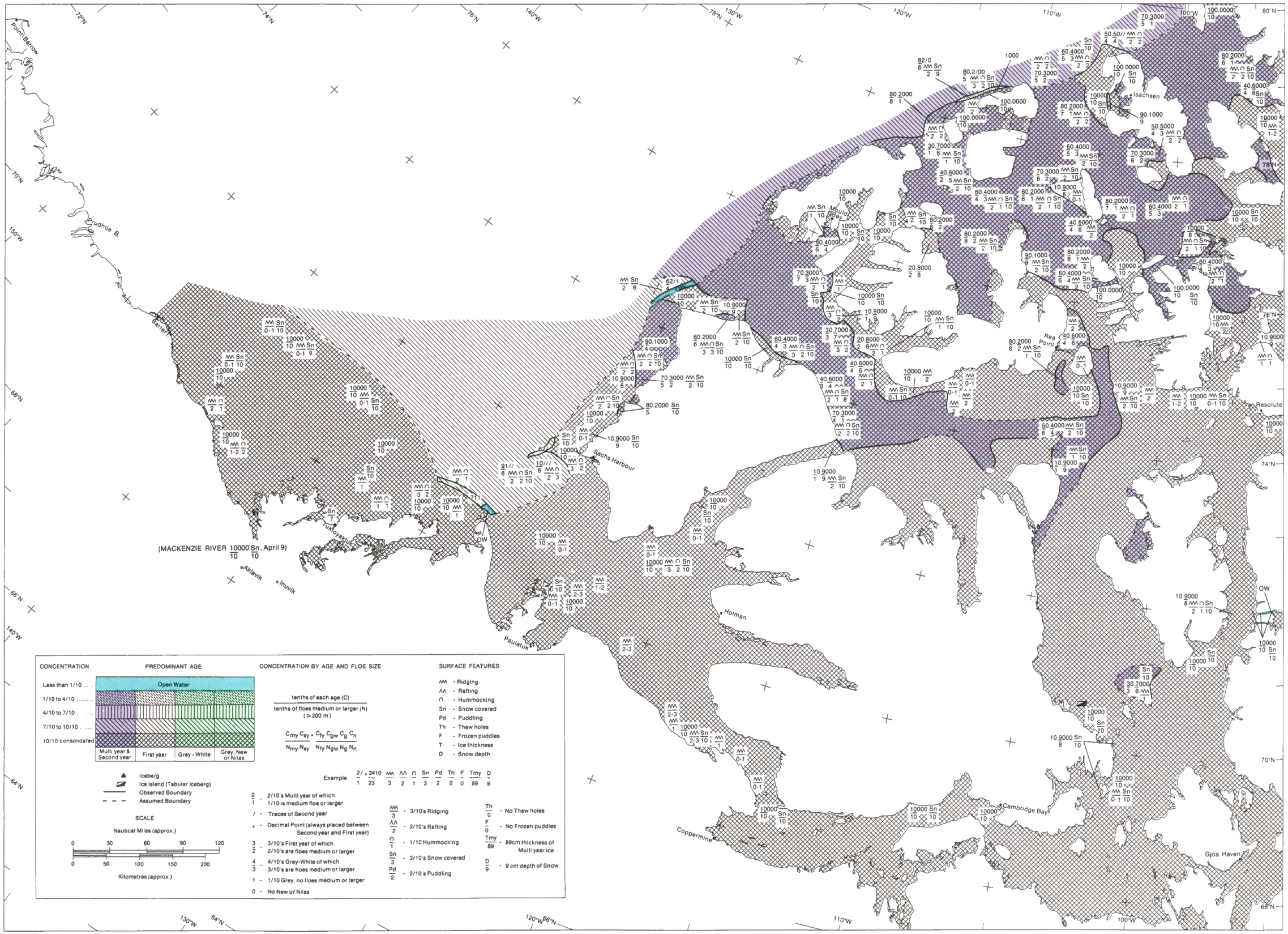
Unobserved Areas

Ice conditions in the central M'Clintock Channel and Parry Channel were determined during subsequent surveys. The Mackenzie River supported a solid first-year ice cover with a ten tenths snow cover from Kugmallit Bay to Point Separation.

Small fragments of ice islands were located at 72° 31'N, 126° 15'W near the west coast of Banks Island and in the southern entrance to Franklin Strait.

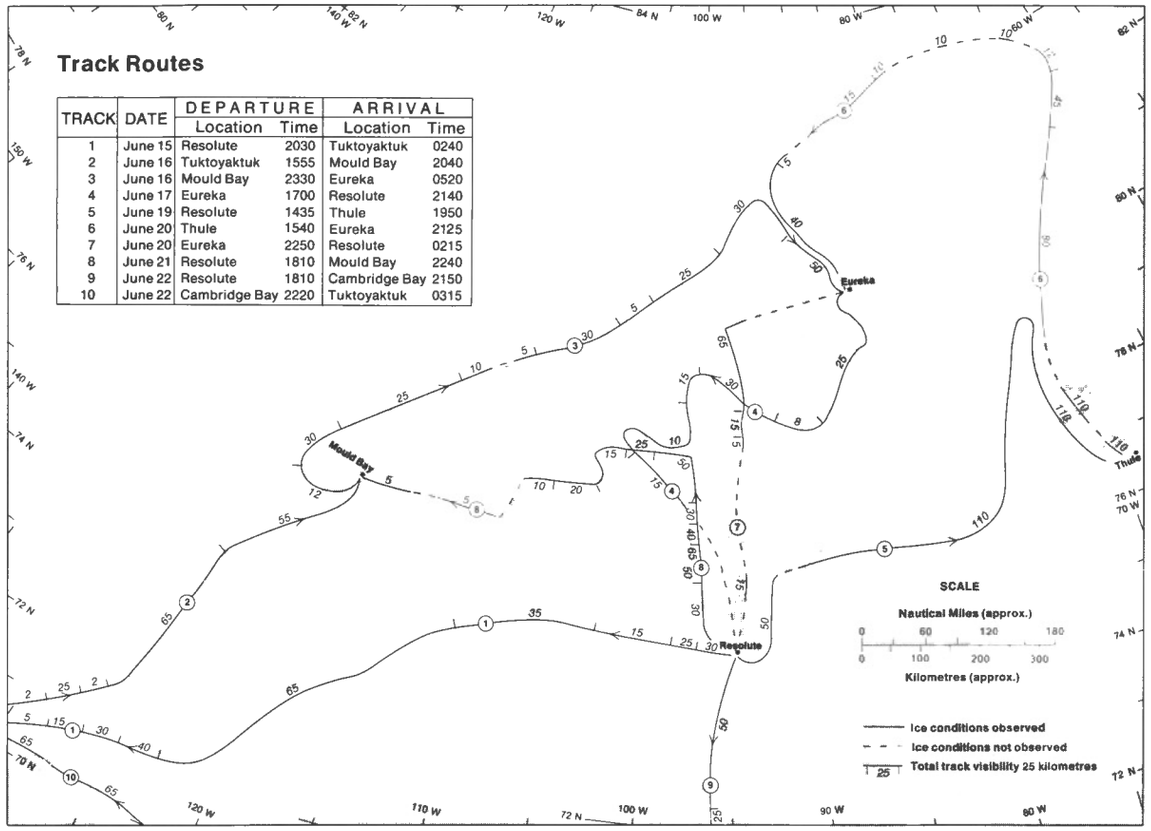
Comments

Three camps were set out on the ice in the Beaufort Sea for the AIDJEX (Arctic Ice Dynamics Joint Experiment) program. The main camp was established at 75° 22'N, 147° 41'W on February 28 and was removed on April 22 from 75° 02'N, 151° 11'W. The second camp, I-W, was set out on March 8 at 75° 29'N, 151° 52'W and was evacuated on April 22 from 75° 11'N, 155° 5'W. The third camp, II-N, was located at 76° 12'N, 149° W on March 8 and was removed from 75° 59'N, 152° 02'W on April 22. During the period the camps were occupied they drifted to the southwest until March 25 and from April 1 to 22 they drifted west. The net westerly drift ranged from 100 kilometres for the main camp, to 95 kilometres for I-W and 85 kilometres for II-N. The mean net daily drift for all three camps was nearly two kilometres per day.



MAP 1 - 1972 WEST

March 30 - April 10, 1972



MAP 2-1972 East June 15-22

Flight Effectiveness

The results from the surveys carried out over the eastern part of the region during Flight 2 were disappointing. Low stratus clouds, fog, snow, aircraft icing and rain showers were generally responsible for reduced visibility. The Flight was judged to be 45 per cent effective.

Ice Conditions

No unexpected changes took place during the ten-week interval between the first and second Flights. The massive clearing in Lancaster Sound and the northern part of Baffin Bay usually takes place during this interval. The ice edges separating solid ice from open water in Lancaster Sound and Smith Sound had developed in the usual places and had hardly changed shape during the two Flights.

Generally all the ice in the straits and channels north of Parry Channel was free of puddles although the snow cover in some areas was rapidly melting. However, puddles would soon develop throughout the region. Other signs of the approach of the ablation season were indicated by the appearance of small areas of open water where they normally develop along the shores in the southeast and northwest parts of Kennedy Channel, at the mouths of major rivers in the areas as well as near the northwest extremity of Robeson Channel. Similar indicators evolved in the south part of Belcher Channel and in the southwest part of Queens Channel.

Unobserved Areas

Large areas in the central part of the region remained unobserved after Flight 2 was completed. Fortunately, the ice conditions in these areas could be deduced and shown on Map 2-1972 East from information gathered during other flights and on the basis of the situation noted in previous years.

It is likely that patches of open water had developed in the eastern part of Belcher Channel and it appeared that a band of open water paralleled the west coast of Borden Island. Several ice island fragments were observed along the north coast of Prince Patrick Island and a few icebergs were sighted in the southeastern part of Kennedy Channel. It is difficult to distinguish between very small ice islands and small, flat icebergs. The location of the feature suggests its identity on the basis of its probable origin, but this is not always a reliable indicator. When no definite decision can be made these relatively small features are referred to as ice masses. Hundreds of these small, flat-topped ice masses spread along the east and south coasts of Ellesmere Island between Smith Sound and Grise Fiord. Many similar features, probably icebergs, were spread throughout the length of Nansen Sound and Eureka Sound.

Comments

The season seemed to be advancing in its usual fashion but at a rate slightly ahead of normal. The Northwater boundary in Smith Sound was a little further north than it ordinarily is at this time.

There were no signs to indicate the type of season to follow.

SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy} * C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2/*3410}{1\ 23}\ \frac{\wedge\wedge}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{\wedge\wedge}{3}$ - 3/10's Ridging
$\frac{\wedge\wedge}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

SURFACE FEATURES

$\wedge\wedge$ - Ridging
$\wedge$ - Rafting
$\cap$ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

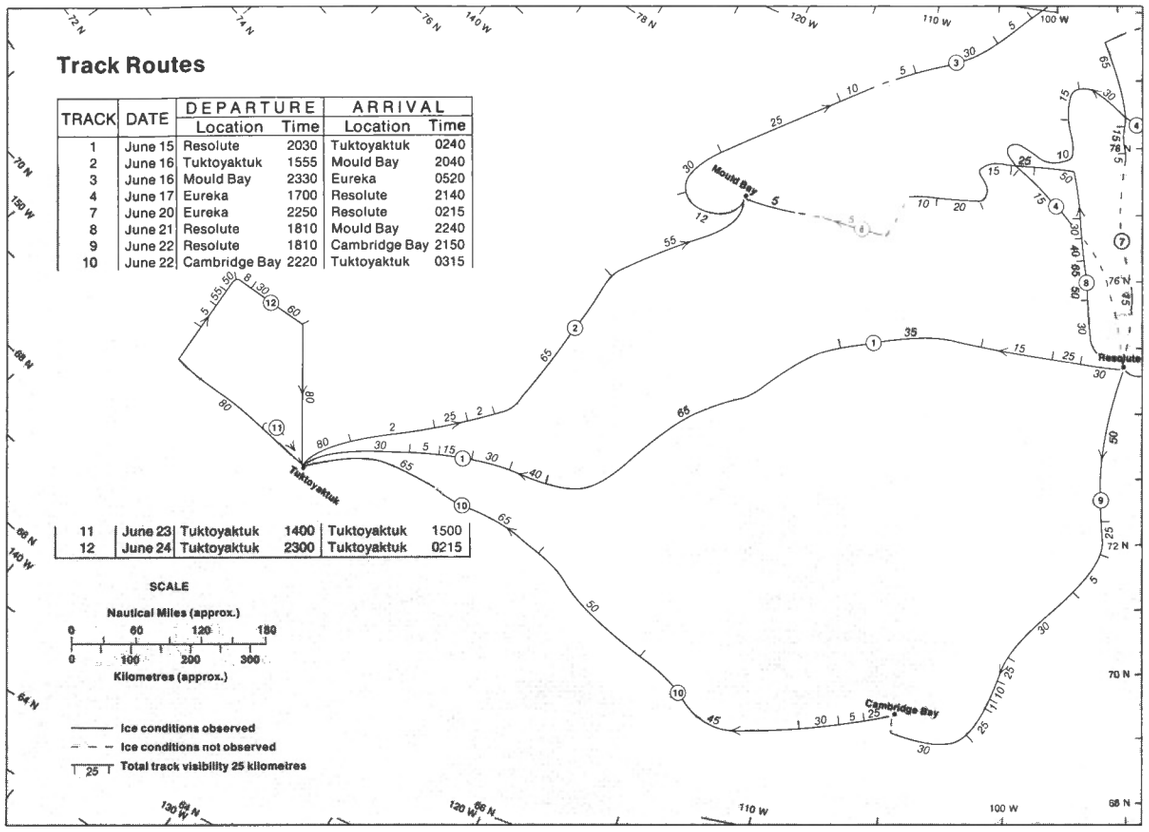
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)

E.S.S.A.- Enviromental Science Services Administration

Alert
Ward Hunt Ice Shelf
Eureka
Isachsen
Mould Bay
Many
Danad
Thule
Grise Fiord
Resolute
Arctic Bay
Sachs Harbour
E.S.S.A. - 8 June 22
OW



MAP 2-1972 West June 15-24

Flight Effectiveness

Low cloud obstructed observations during some part of each of the surveys carried out and during one mission, track 10, heavy rain was responsible for reducing the visibility for a few kilometres. Overall, however, visibility was good and ice conditions in most of the channels in the western region were observed and mapped. This part of Flight 2 was judged to be at least 70 per cent effective.

Ice Conditions

The changes that took place between the two flights ranged from the immediately obvious development of the large ice-free area in the southern part of the Beaufort Sea to the appearance of open water in Mackenzie Bay and Kugmallit Bay and the puddles which covered about 10 per cent of the ice in Parry Channel and almost 40 per cent of the channels to the south of it. No departures from the normal trends of break-up were noted. The season appeared to be advancing at its normal rate.

Puddling gradually increased from north to south. Maximum concentrations of puddles were noted near the southern tip of Banks Island and in Dease Strait. The ice in the latter area was totally flooded in some sections. This was probably caused in part by the heavy rain encountered during the survey of this area. These concentrations would soon decline to four tenths as the drainage patterns developed.

A solid ice cover existed in most areas. However, many cracks extended across Peel Sound, Dease Strait and Prince of Wales Strait. In the latter area patches of open water were developing at the mouths of major rivers.

In most areas the sequence of break-up generally follows a definite and predictable pattern. Unfortunately, the timing can not be predicted with the same degree of accuracy. In most seasons it can be forecasted that the development of open water in Mackenzie Bay and Kugmallit Bay will be separated from the moving ice or open water in the Beaufort Sea by a solid tongue of ice which hooks around the main part of the delta. The classic development of this feature appears on Map 2-1972 West. Similar situations are shown on Map 2-1969 West and Map 2-1973 West. The beginnings or the vestiges of this tongue are shown on the maps for other years.

Ice island fragments were once again spotted in Franklin Strait and by the hundreds from Gateshead Island through Victoria Strait to Jenny Lind Island. Additional pieces were sighted along the northwest coast of Banks Island and in the open water of the Beaufort Sea about 40 kilometres east of Herschel Island.

Unobserved Areas

From observations made on both sides of Amundsen Gulf it appeared as if the cracks across this area were oriented in a north-south direction. The ice conditions in the unobserved areas shown on Map 2-1972 West were confirmed during subsequent surveys.

Comments

Probably the large area of open water in the southern half of the Beaufort Sea developed in April. This ice-free area roughly corresponds with the drifts of the ice camps as documented and described with Map 1-1972 West.

E.S.S.A. - Enviromental Science Services Administration

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey New or Nilas

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$\frac{C_{my}\ C_{sy} * C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$

Example $\frac{2/*3410}{1\ 23}\ \frac{\wedge\wedge}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

SURFACE FEATURES

- Ridging
- Rafting
- Hummocking
- Sn - Snow covered
- Pd - Puddling
- Th - Thaw holes
- F - Frozen puddles
- T - Ice thickness
- D - Snow depth

Iceberg
Ice island (Tabular Iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
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$\frac{Th}{0}$ - No Thaw holes
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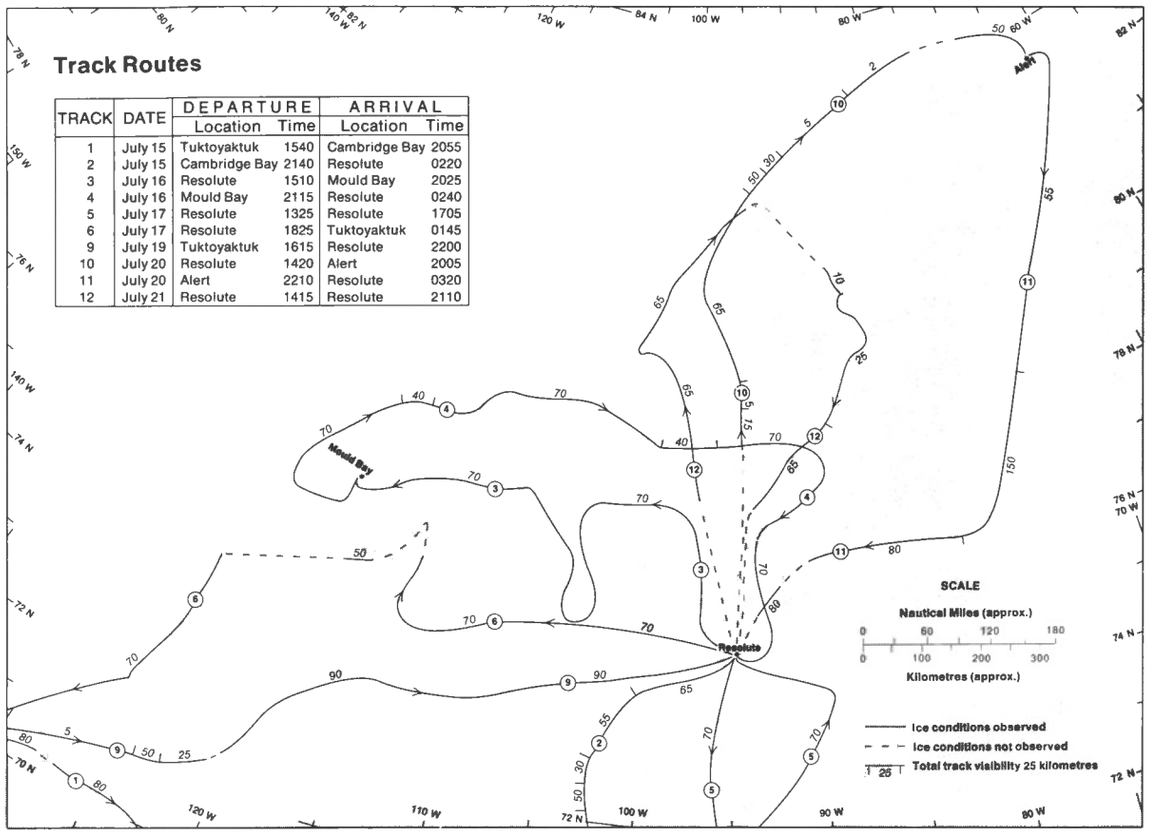
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

MAP 2 - 1972 WEST

June 15 - 24, 1972



MAP 3-1972 East July 15-21

Flight Effectiveness

Fine weather persisted for most of the surveys of Flight 3 East. Reduced visibilities resulted from low cloud and rain. Flight 3 was at least 85 per cent effective.

Ice Conditions

Very few readily noticeable changes took place during the four-week interval separating Flights 2 and 3. The typical patterns of break-up and clearing were observed in all areas.

Compared with other years, the general ice conditions observed during this series of surveys indicated that the season was slightly ahead of usual. The expansion of the ice-free areas in Penny Strait, Belcher Channel, Hell Gate combined with signs of weakness observed in other areas meant that break-up was about two weeks ahead of the normal time.

The floe sizes, the concentrations and the distribution of the ice in the eastern half of Barrow Strait indicated that the solid ice cover in this area had just recently broken. Probably, break-up took place early in the second week of July.

The solid plug of ice in the southern half of Prince Regent Inlet was in its normal place. A moving ice cover extended south from this plug into the Gulf of Boothia. By the last week in July the ice in the southern half of Prince Regent would break.

Puddles had developed everywhere and thaw holes were beginning to appear in some areas.

Unobserved Areas

The ice conditions along the northern coast of Ellesmere Island probably resembled those shown on Map 2-1972 East. The extent of open water in Baffin Bay as well as Lancaster Sound and the ice conditions in Admiralty Inlet and the inlets around Bylot Island were deduced from satellite photographs.

The visibility in Kane Basin on July 20 was very good but not quite good enough to tell whether the ice in Peabody Bay was broken or not. If it was not broken it soon would be.

Comments

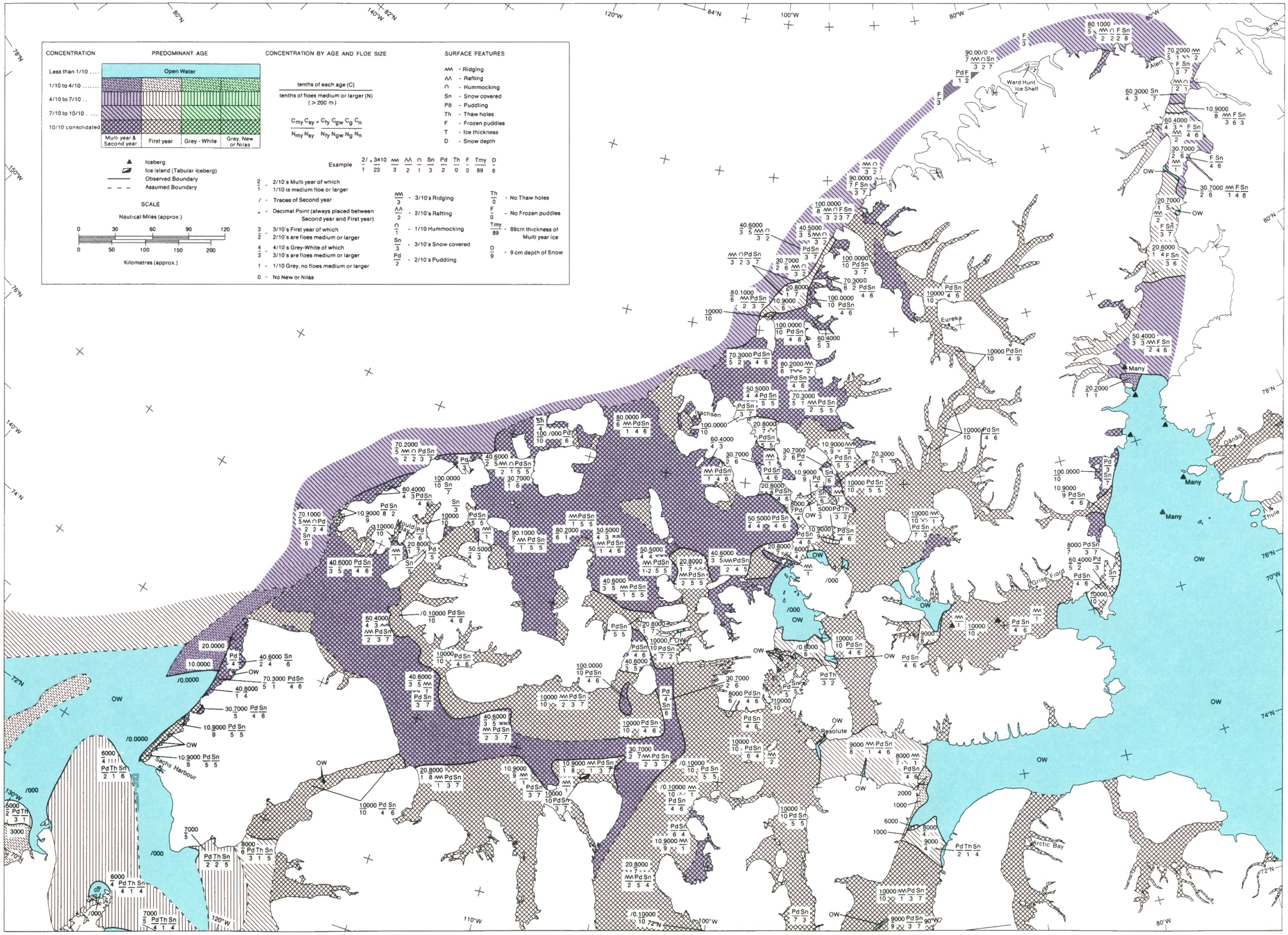
Fresh snow and frozen puddles were observed on the seas adjacent to northern and eastern Ellesmere Island. These winter conditions appeared at the same time that the melting rate in these areas normally reaches its peak.

While the ominous indications of freeze-up were appearing in the northern areas, firm signs of break-up were appearing in the southern channels. The weak area shown along the south coast of Bathurst Island indicates that the ice cover in the northern half of Barrow Strait would soon break up.

Some areas of open water are too small to show on the map. One of these appeared in the south part of Austin Channel midway between Bathurst Island and Byam Martin Island. A shoal exists in the same area and when this area is ice-free the observer can see the bottom through about two or three metres of water.

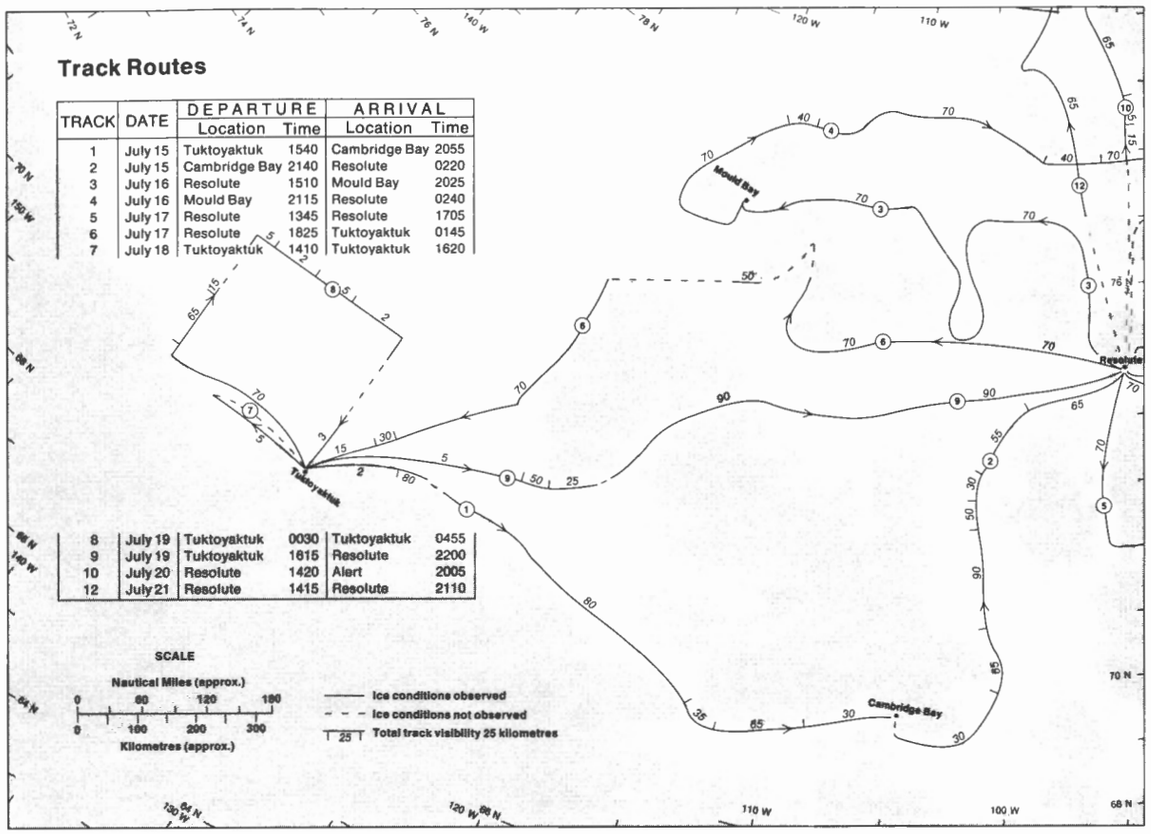
Many icebergs were observed in Baffin Bay close to the coast of Ellesmere Island. One ice mass, either a small, flat iceberg or a piece of an ice island, was spotted near the southeast tip of Cornwall Island.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 3 - 1972 EAST

July 15 - 21, 1972



MAP 3-1972 West July 15-21

Flight Effectiveness

Low stratus clouds affected observations during a few of the surveys and caused the cancellation of track 7 shortly after take-off. Overall, visibility throughout the surveys over the channels in the western part of the archipelago was very good and most of the area was surveyed. As a result Flight 3 was judged to be 85 per cent effective.

Ice Conditions

Limited changes occurred during the month-long interval which separated the series of surveys over the western part of the region. The landfast ice along the southern part of the Beaufort Sea had disappeared and the ice cover in Amundsen Gulf and the eastern part of Dolphin and Union Strait had broken up. With the exception of the development of thaw holes, an increase in the number of cracks and a general thinning, ice in the remaining areas appears the same.

The break-up in Amundsen Gulf and Dolphin and Union Strait was following the usual sequence and the timing was normal. The area of open water in the Beaufort Sea was typical, and there were no signs to indicate the massive clearing which was about to take place in the Beaufort Sea.

The advent of break-up in the southern channels between Victoria Island and the mainland and in Prince of Wales Strait was indicated by the large numbers of cracks across them. In Barrow Strait the development of the weak area along the south coast of Bathurst Island indicated that the ice in this channel would soon break up.

Hundreds of chunks of ice island were strewn across the area to the southwest of Gateshead Island. Three large pieces, the largest two kilometres by six kilometres, were sighted in the same area.

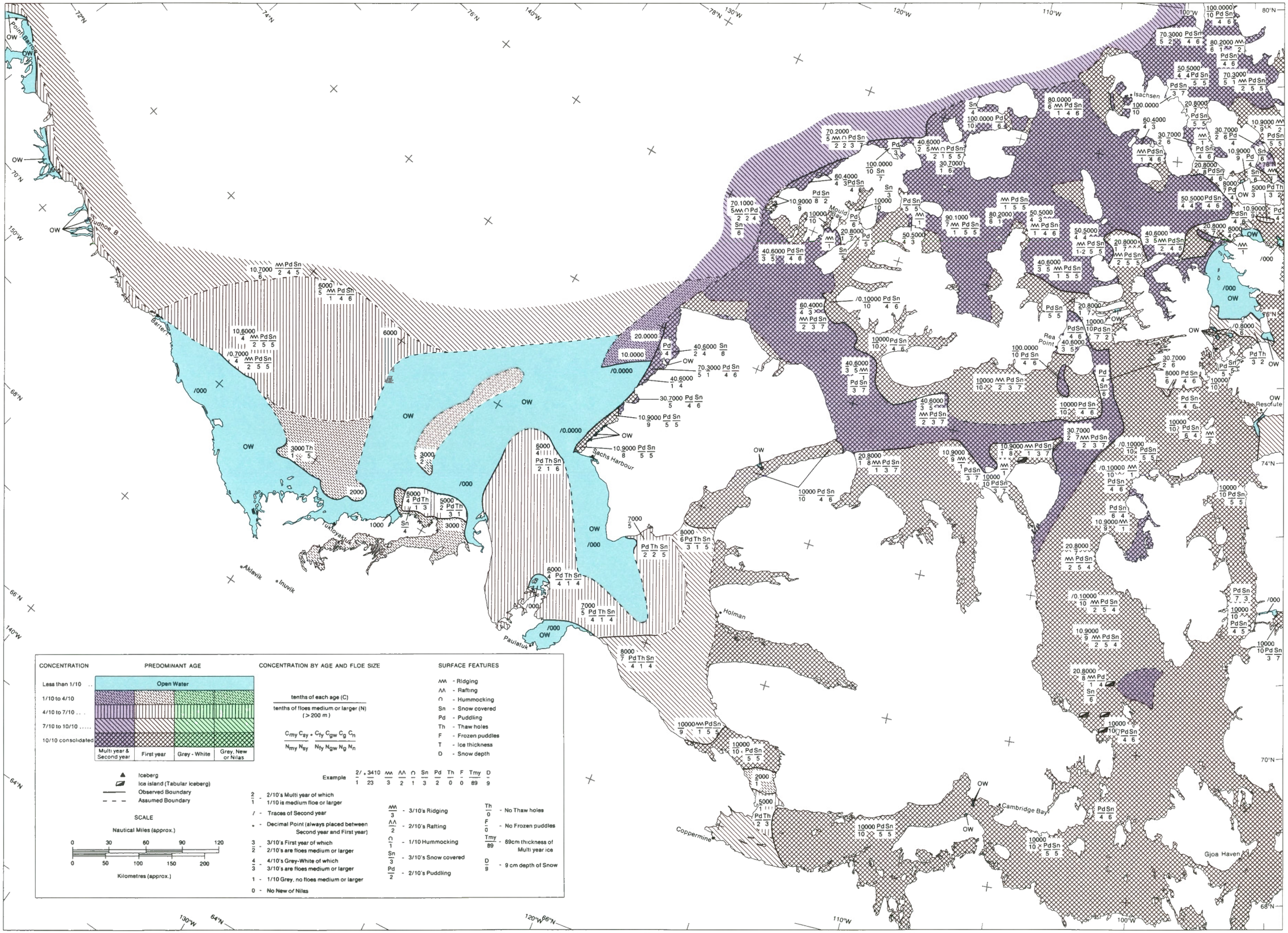
Unobserved Areas

Ice conditions in the channels surrounding King William Island were determined on the basis of observations in adjacent areas and the conditions noted at the same time in other years. Ice conditions along the coast of Alaska are based on surveys made by other agencies including the Ministry of Transport.

Comments

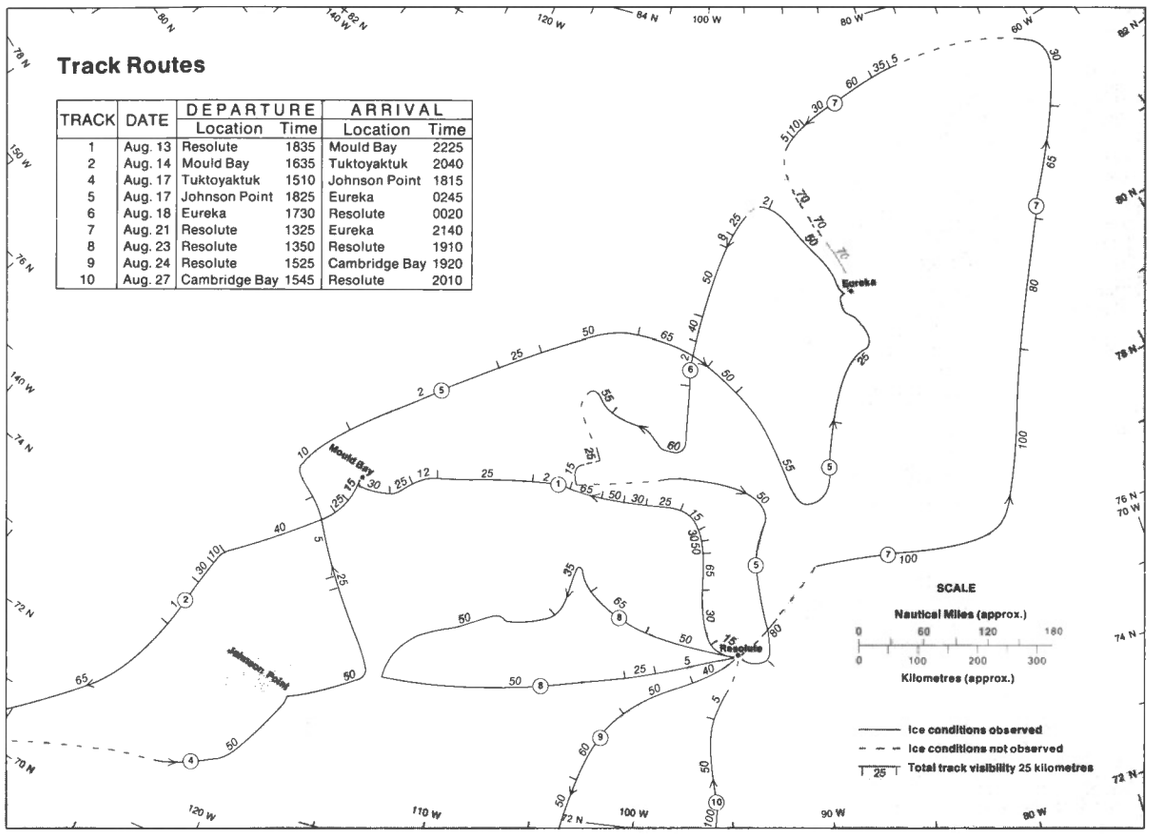
Normally, the boundary separating the moving ice from the solid ice across the western entrance to M'Clure Strait is further east than the position it takes on Map 3-1972 West.

The ice island fragment shown to the north of Stefansson Island measured one by two kilometres. Two other small pieces were observed near Ommanney Bay on Prince of Wales Island. Heavy rain was encountered during a portion of track 1 over Coronation Gulf.



MAP 3 - 1972 WEST

July 15 - 21, 1972



MAP 4-1972 East
August 13-27

Flight Effectiveness

Unfavourable weather conditions hindered efforts to survey ice conditions in the channels of the eastern part of the archipelago during Flight 5. Generally, low cloud reduced visibility for varying intervals during each track while winds, rain and snow grounded the aircraft and extended the surveys over a two-week period and doubled the time usually required to complete the program. However, poor flying weather is expected at this time of year and, in spite of it, most of the area was surveyed. Flight effectiveness would range between 70 and 85 per cent.

Ice Conditions

Limited changes took place during the three-week interval between Flights 3 and 4, and it appeared that the season would only be slightly better than average as far as ice conditions were concerned. The break-up of the ice cover in the unnamed sea to the north of Penny Strait occurred about two weeks earlier than the normal date; the patterns and progression of break-up in this area and in the southern Norwegian Bay were following the normal sequence.

The general ice conditions noted above indicated that the season was only a little better than average and the extent of frozen puddles, fresh snow and new forms of ice which reflected freezing conditions indicated that ice conditions would not improve very much in September.

The effects of reduced ablation were also evident in other areas including Nares Strait where ice was being exported into Baffin Bay.

Unobserved Areas

Satellite photographs were used to interpret the ice conditions in the central part of Baffin Bay and in the channels leading south from Lancaster Sound. The solid ice cover in Admiralty Inlet was a temporary feature since the next storm would set the ice in motion once again.

Ice conditions in Peabody Bay probably were very similar to those in the adjacent area of Kane Basin and the ice in the unobserved area north of Ellesmere Island would likely be very similar to the distributions shown on Map 6-1972 East except that the areas of young ice would not be present.

Comments

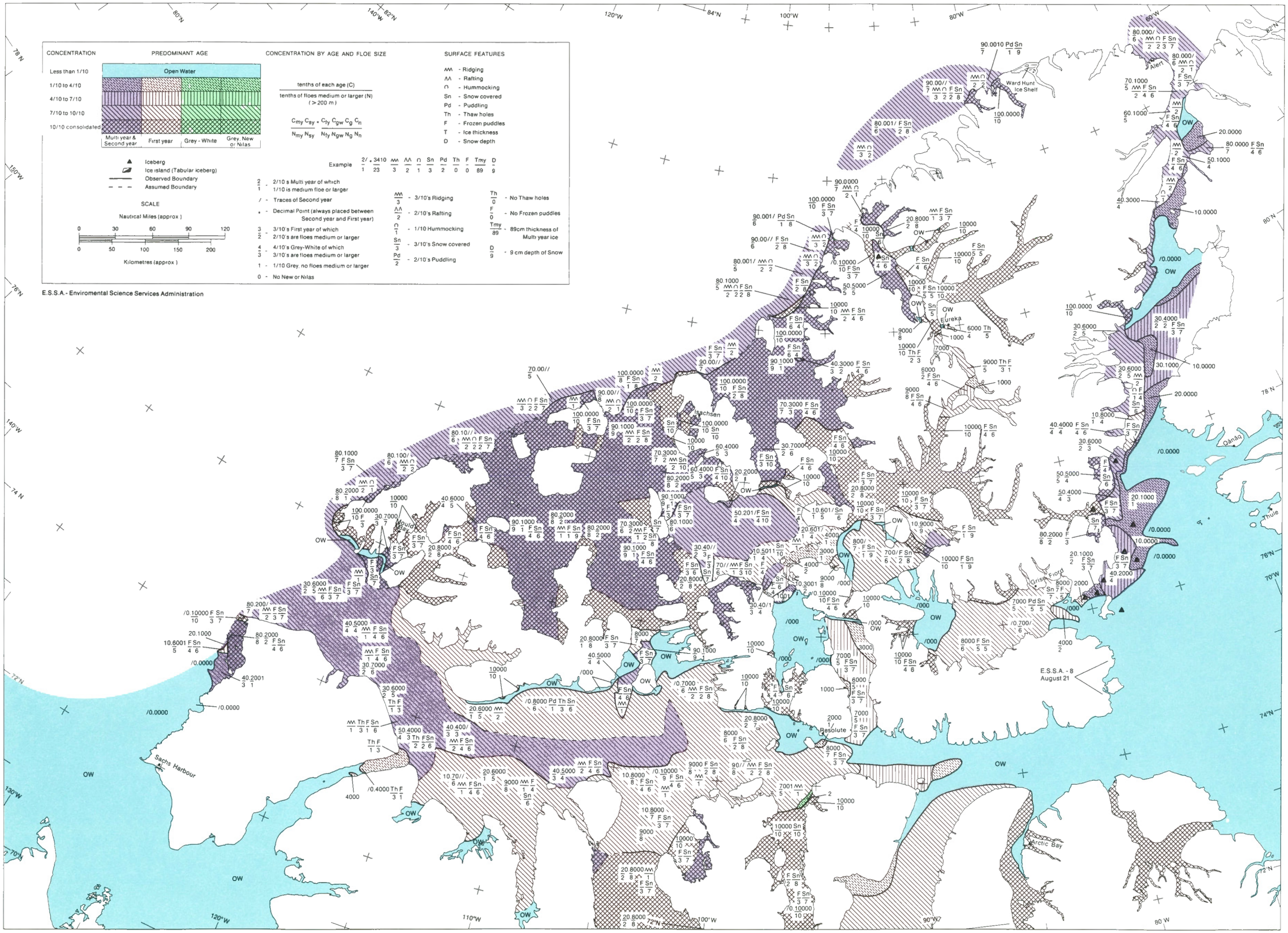
The first track of Flight 4-1972 encountered the type of weather generally anticipated in the latter part of the summer. The reduced visibilities and the great variability of weather are indicated on the route map shown above. During track 1 the survey encountered low cloud, clear skies, rain, aircraft icing and snow showers. The observing altitude varied from 100 feet to 1,000 feet with 300 feet as an average.

A number of icebergs were observed in Nansen Sound and thousands of these masses were waiting in Otto Fiord to join the group in Nansen Sound. Numerous icebergs also appeared to be moving south along the southeast coast of Ellesmere Island. Some of these were entering Jones Sound through Glacier Strait.

Two ice island fragments were spotted in the centre of the southern entrance to Massey Sound.

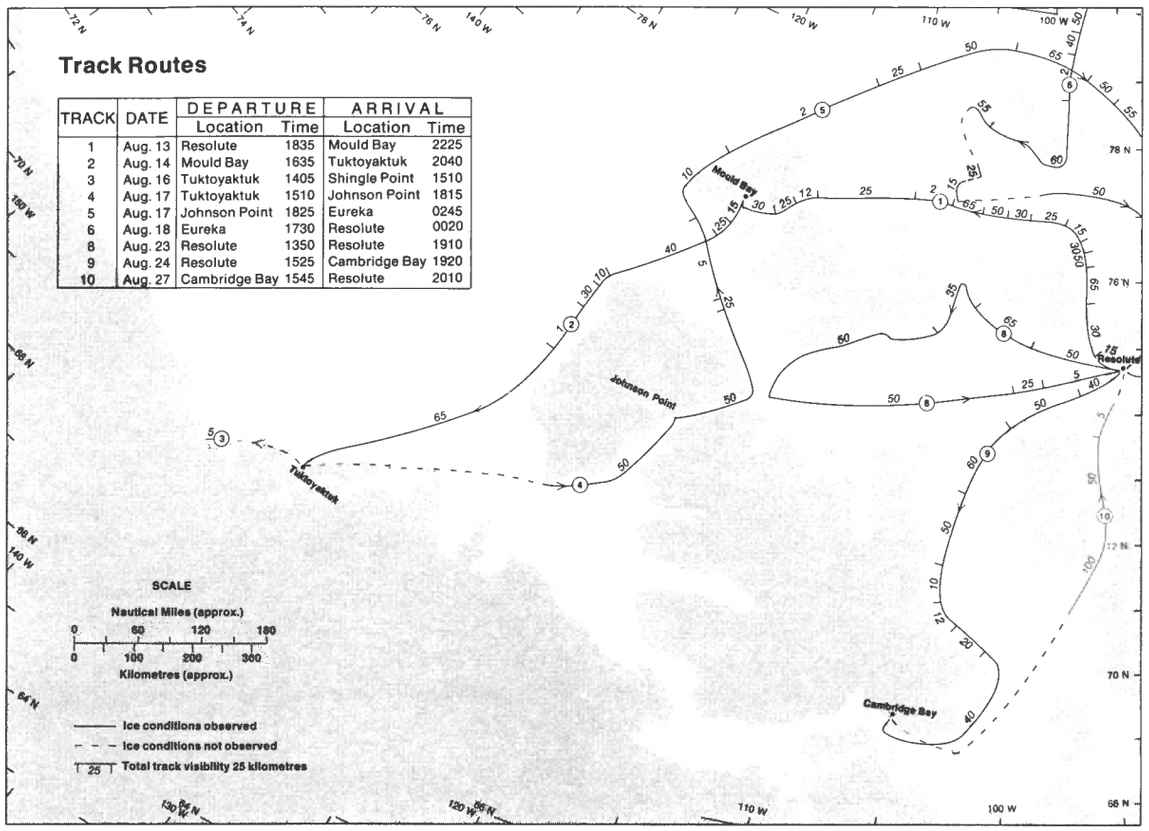
Freezing conditions seemed to have arrived in the area about two weeks earlier than expected.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 4 - 1972 EAST

August 13 - 27, 1972



MAP 4-1972 West
August 13-27

Flight Effectiveness

Low cloud and aircraft icing hindered observations during most of the tracks in the western part of the region while intense storm systems prolonged the Flight by grounding the aircraft. As a result of these factors, many areas remained unobserved at the end of Flight 4-1972 West. The Flight was about 75 per cent effective.

Ice Conditions

Almost four weeks separated the surveys carried out over the western area between Flights 3 and 4. Many changes took place during this interval. The most obvious was the tremendous expansion of the open water area in the Beaufort Sea. The break-up and subsequent ablation of all the ice in the channels separating Banks and Victoria Islands from the mainland was not as spectacular as the clearing in the Beaufort Sea, but was still a considerable change to happen in the four-week period.

Break-up in M'Clure Strait and Viscount Melville Sound had taken place at least two weeks ahead of normal. In northern M'Clintock Channel break-up was also about two weeks earlier than usual.

The solid ice cover on Peel Sound and central M'Clintock Channel reflected the normal ice conditions for the time of year. Floe sizes and concentrations indicate that break-up in Franklin Strait and the adjacent part of M'Clintock Channel had been recently completed. This was accomplished at least one week ahead of normal.

Unobserved Areas

The ice conditions, or lack of ice, in the southern channels and in the Beaufort Sea, were established from satellite photographs. Unfortunately, cloud and the path of the satellite's orbit hid the boundary between open water and ice in the Beaufort Sea. Probably the ice in the Beaufort Sea was north of a line joining Prudhoe Bay to the northwest tip of Banks Island.

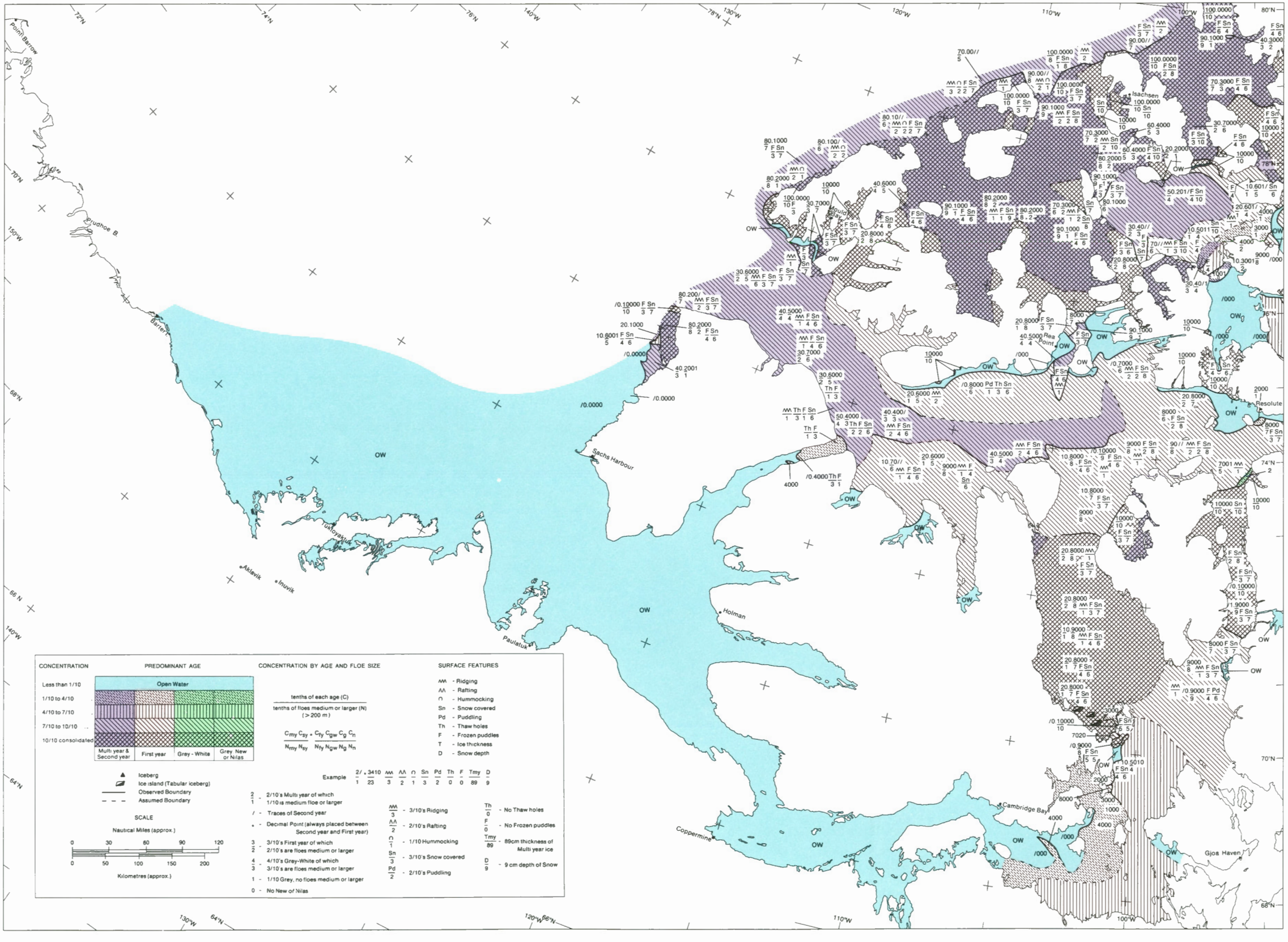
In the central part of Rasmussen Basin the concentrations probably reached five tenths while the narrow channels and the areas near lee shores were probably ice-free.

Comments

There are two possible explanations for the rapid development of open water in the Beaufort Sea. Either winds from the south may have caused the ice to move north or high temperatures may have caused the ice to melt. Probably both of these factors were partially responsible. Storms in the area provided the wind strength and the ablation in the southern channels and the appearance of thaw holes in M'Clure Strait and western Viscount Melville Sound indicated that melting temperatures had existed.

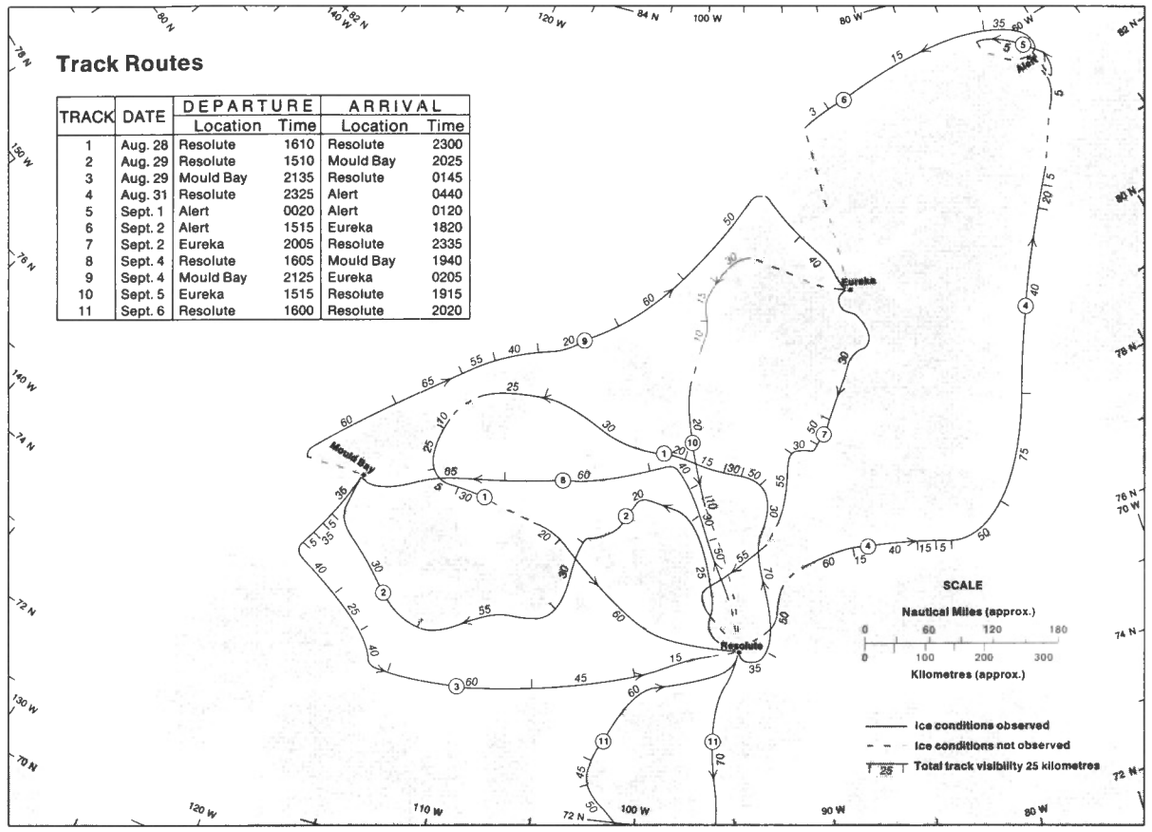
Thousands of ice island fragments were observed west of Gateshead Island; three pieces were seen at the northeast entrance to M'Clintock Channel and two pieces were sighted in Central Peel Sound. Peel Sound supported a number of cracks, but the ice still seemed quite thick and solid. No signs of weakness, such as thaw holes, were noted.

As in the eastern area freezing temperatures, frozen puddles and fresh snow had arrived in the western part of the archipelago about two weeks ahead of usual.



MAP 4 - 1972 WEST

August 13 - 27, 1972



MAP 5-1972 East
August 28-September 6

Flight Effectiveness

The results of the series of tracks carried out over the eastern part of the archipelago for Flight 5 were very good considering that the weather at this time of the year usually restricts flying. Some low stratus cloud and periodic fog patches did reduce the visibility but overall the Flight was at least 80 per cent effective.

Ice Conditions

A comparison of the distribution and concentrations shown on Map 4 with those indicated on Map 5-1972 East shows that break-up scarcely progressed at all. In spite of this apparent slowdown in the rate of advance, many channels developed characteristic and predictable ice conditions. In Byam Martin Channel the boundary between solid ice and open water was in its usual position. Similarly, the boundaries across Maclean Strait, Hassel Sound and Norwegian Bay had assumed typical positions.

The solid cover in McDougall Sound, Viki Fiord and the southern part of Eureka Sound combined to reinforce the opinion that the advance of break-up had almost ceased. These conditions together with the relatively high concentrations in Jones Sound and Norwegian Bay reflect the typical situation for this time of year.

Although most of the channels maintained an ice cover which corresponds with a normal or average year, there were two exceptions. The solid fringe of ice along the west coast of Prince Patrick Island appeared before it normally does while the amount of open water observed in Arnott Strait, south of Cameron Island, was greater than usual.

The southerly drift of ice was limited, but some clearing and subsequent expansion of open water areas had taken place in Kane Basin, Wellington Channel and in the northern part of the unnamed sea south of Hassel Sound.

A thick layer of fresh snow covered the ice off the north coast of Ellesmere Island. The onset of freezing conditions was further in evidence from the amount of frozen puddles and the development of the various forms of new ice.

Unobserved Areas

Probably some ice floes and numerous icebergs were present in Peabody Bay just beyond the limits of visibility of track four as it passed over Kane Basin. A solid fringe of ice likely extended along the northwest coast of Ellesmere Island for a few kilometres before the change to nine tenths multi-year. The conditions in Lancaster Sound and the adjacent channels to the south were determined from photographs taken from the E.S.S.A.-8 satellite.

Comments

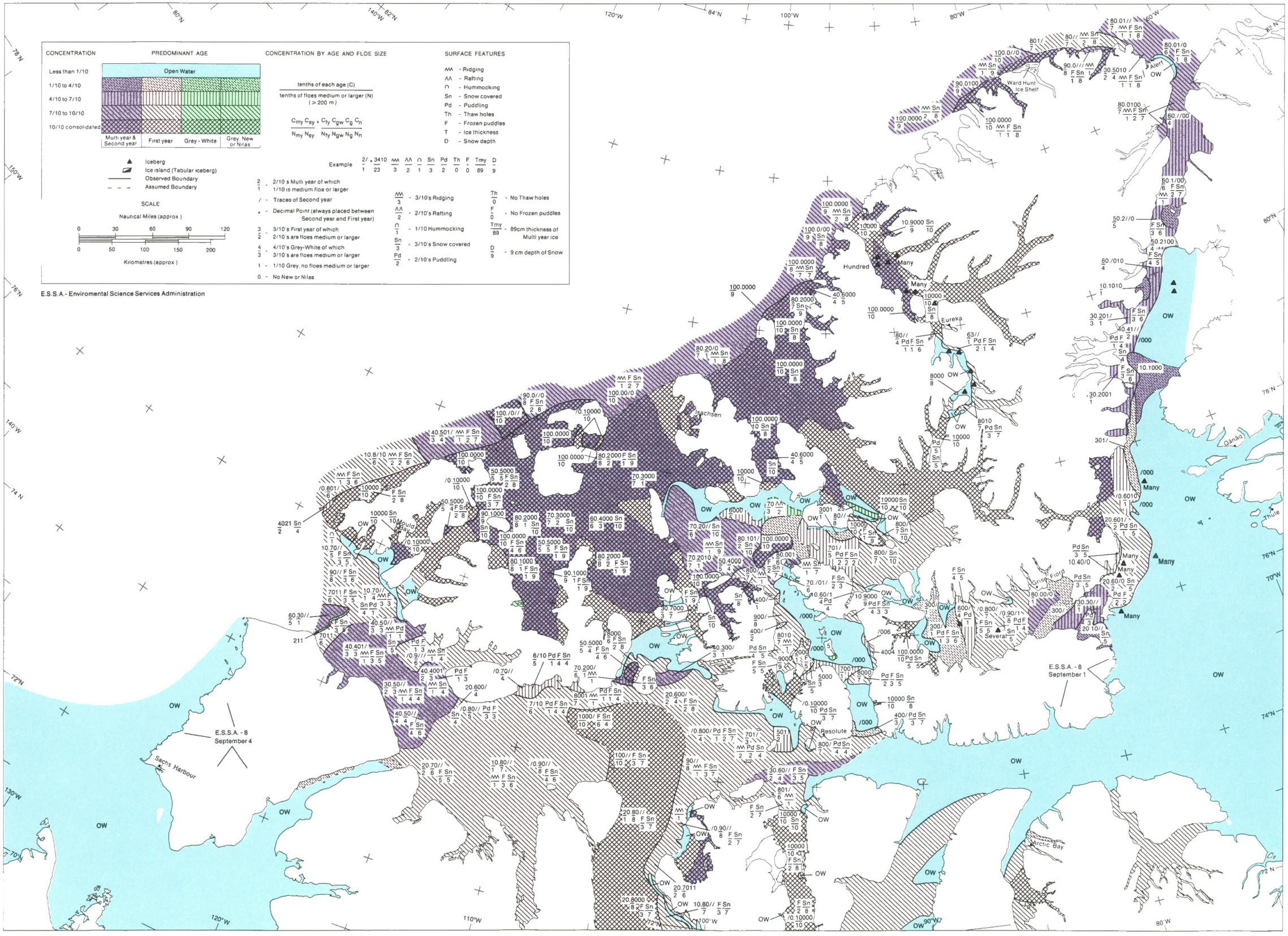
The channel cut through the solid ice cover by the northbound convoy of one icebreaker and two ships was clearly defined across northern Norwegian Bay and the southern part of Eureka Sound.

The overall ice conditions shown by Map 5-1972 East were normal for the time of year.

The low sun angle and the shortening periods of daylight were beginning to limit observations.

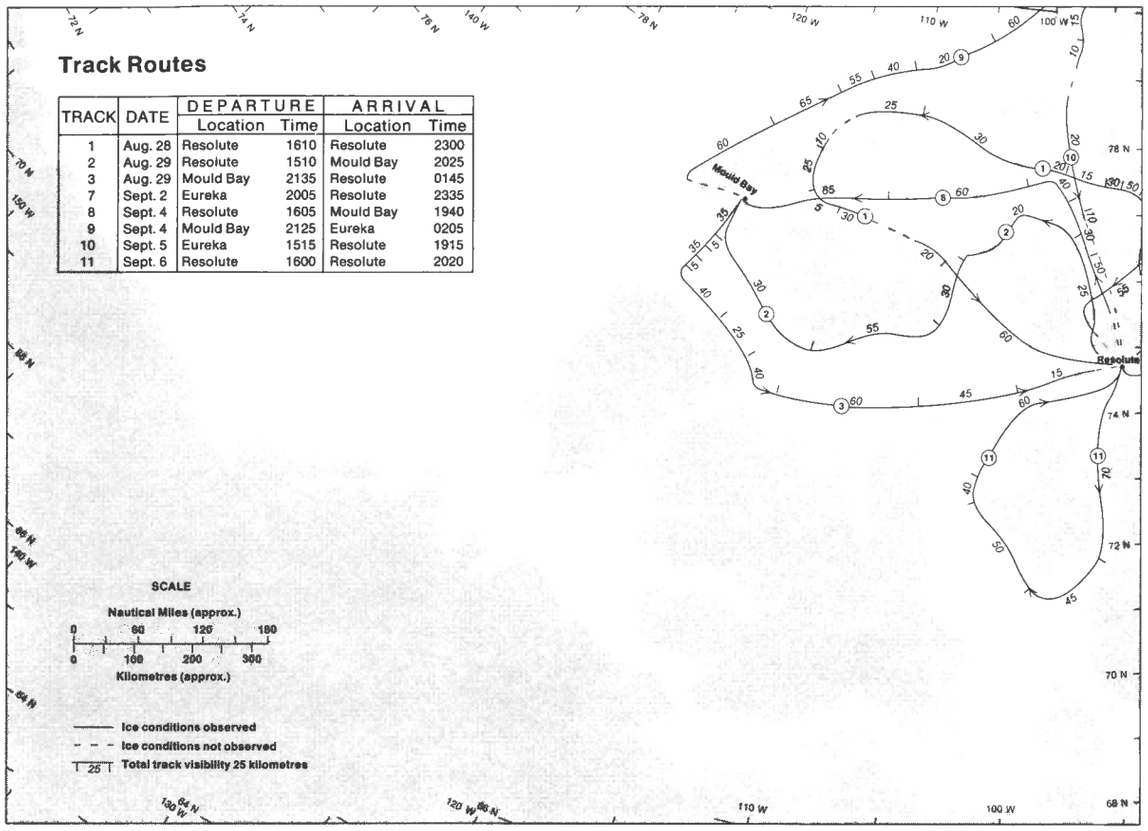
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 5 - 1972 EAST

August 28 - September 6, 1972



MAP 5-1972 West
August 28-September 6

Flight Effectiveness

The three tracks flown in the western part of the archipelago resulted in very good coverage of ice conditions in the western half of Parry Channel as well as Peel Sound and most of M'Clintock Channel. The planned surveys over the Beaufort Sea and in the vicinity of Victoria Strait were postponed due to weather and other demands made on the aircraft. In spite of this the Flight was still more than 65 per cent effective.

Ice Conditions

Freezing conditions continued in the western part of Parry Channel and M'Clintock Channel. The new types of ice were forming and the puddles in these areas remained frozen.

Considerable changes had taken place in M'Clure Strait and Viscount Melville Sound. The concentrations and distribution of multi-year ice observed in these areas during Flight 4 hovered around three tenths and a purple colour is used on the map to show that this type of ice predominates. During the interval between the ends of Flight 4 and Flight 5 the ice in both these areas moved and the floes were mixed, dispersing multi-year ice among the younger types. On Map 5-1972 West the area of predominantly multi-year ice declined in these two channels. This change does not mean that the multi-year ice had melted and disappeared but rather that considerable movement had rearranged the distributions. The overall amount of multi-year ice present in both channels at the end of Flight 4 would be equivalent to that observed at the end of Flight 5.

The large area of solid ice observed in the central part of Viscount Melville Sound and in the adjacent northern portion of M'Clintock Channel was a temporary situation. Winds would soon break the weak bonds of new ice which had recently formed between the older floes. See Map 6-1972 West.

Peel Sound remained solid but numerous east-west trending cracks were spread out along the length of the Sound.

Unobserved Areas

The extent of open water in the vicinity of Banks Island and east along the mainland coast was established from satellite photographs, pilot reports and on the basis of subsequent surveys. Data from M.O.T. surveys were the basic source for the conditions shown along the coast of Alaska and in the vicinity of King William Island.

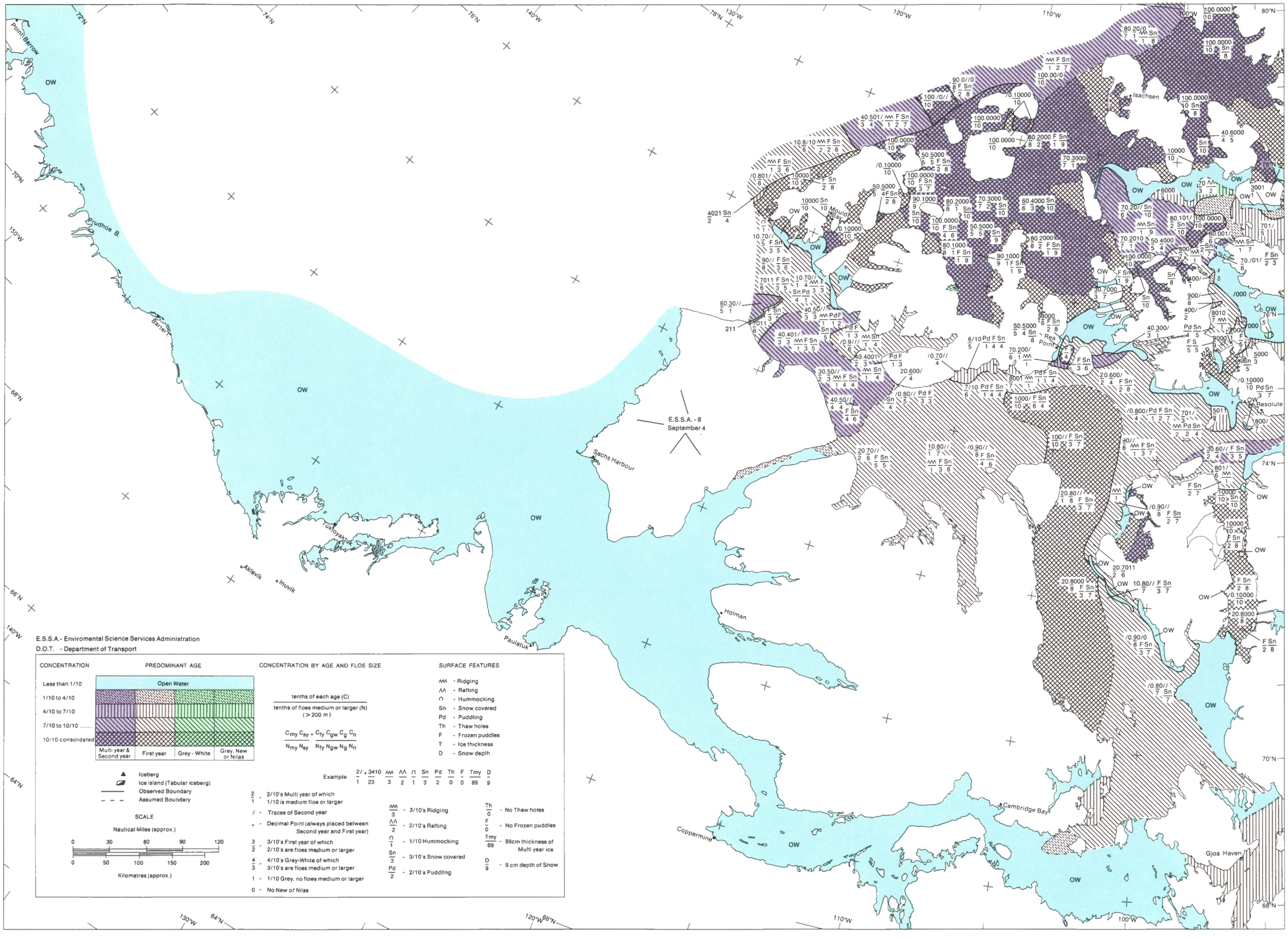
Probably, multi-year ice in concentrations ranging from eight to ten tenths extended across the Beaufort Sea to the northern extent of open water shown on Map 5-1972 West. The ice cover in Browne Bay, adjacent to Peel Sound, remained solid.

Comments

Rapid changes in distributions and concentrations may take place in the latter part of August and the first half of September as ablation reduces the concentrations of older ice types to their minimum and the winds have more room to shift the ice around. The conditions shown along the southern coast of Bathurst Island on Map 5-1972 West were observed on August 28. One week later the area of open water along this coast had tripled in width as northerly winds forced the ice cover to the south. This type of expansion normally occurs each year in the early part of September.

SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



E.S.S.A.- Enviromental Science Services Administration
D.O.T. - Department of Transport

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10 .....
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\,C_{sy} \bullet C_{ty}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy}\;\;N_{ty}\,N_{gw}\,N_g\,N_n}$$

Example $\frac{2/\bullet 3410}{1\;\;23}\;\frac{MM}{3}\;\frac{AA}{2}\;\frac{\cap}{1}\;\frac{Sn}{3}\;\frac{Pd}{2}\;\frac{Th}{0}\;\frac{F}{0}\;\frac{Tmy}{89}\;\frac{D}{9}$

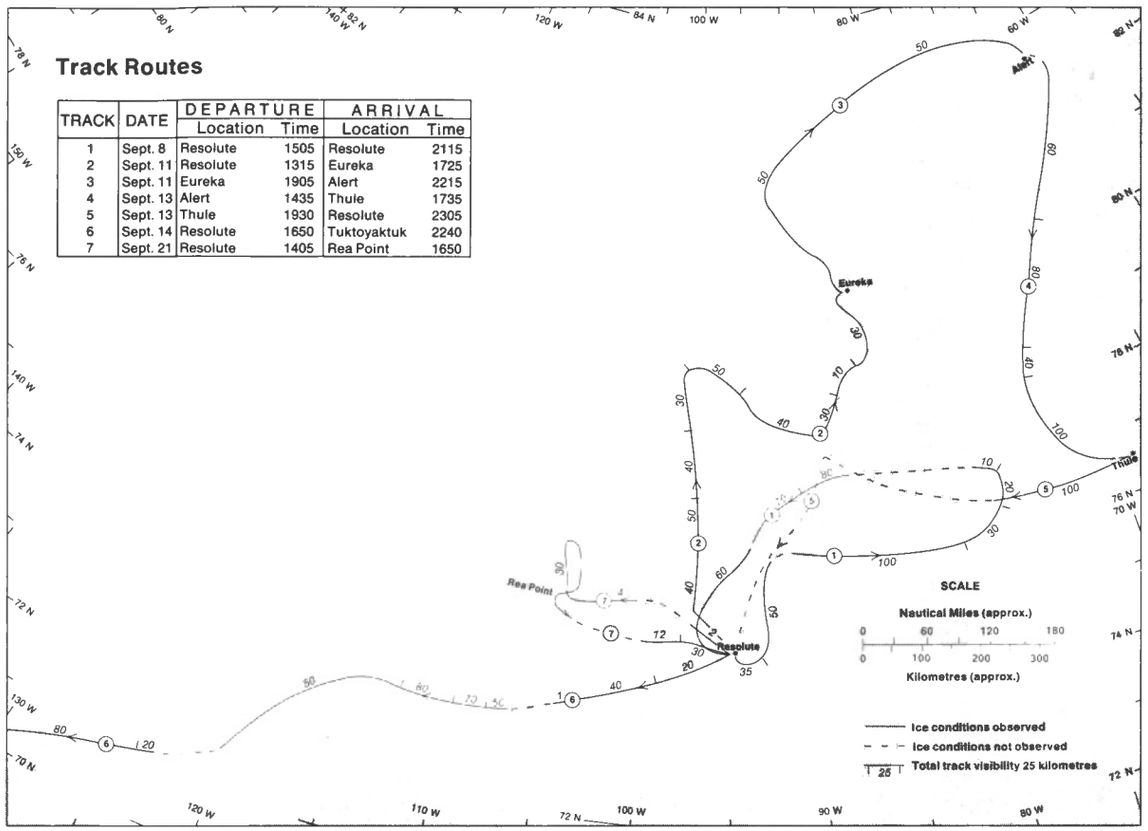
$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{MM}{3}$ - 3/10's Ridging
$\frac{AA}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow



MAP 6-1972 East
September 8-21

Flight Effectiveness

Only six tracks were completed over the eastern part of the archipelago during Flight 6. Many factors including weather, low sun angle, maintenance problems and other demands on the aircraft combined to restrict the scope of observations and to prolong the length of the Flight. Although the visibility during most of the tracks was fairly good, the limited number of tracks left many areas unsurveyed and reduced the flight effectiveness to slightly more than 50 per cent. This assessment includes sporadic observations made when the observer accompanied the aircraft on other tasks. These flights are not shown on the track chart.

Ice Conditions

The changes which occurred during the interval between the ends of Flights 5 and 6 were typical of those expected at this time during a normal or average ice year such as 1972. Generally, all the ice edges separating moving ice or open water from the solid ice had remained stationary and the new types of ice had developed in areas that were ice-free. Rafting was very common where the ice had reached a thickness which permitted distinct floes to develop. Considerable pressure ridging in the shear zone, that thin band between solid ice and the moving pack, existed along the northern coast of Ellesmere Island.

Winds had broken the solid area which had previously developed in the central part of Viscount Melville Sound. On the other hand, the lack of persistent winds near Graham Island permitted a solid cover to develop in the central eastern part of Norwegian Bay. In Prince Regent Inlet it appears as if the winds had moved the ice toward the Gulf of Boothia. The combination of wind and current had moved a tongue of ice toward the east in the southern part of Barrow Strait.

Multi-year ice had drifted south into Penny Strait and Queens Channel. This multi-year ice from the unnamed sea was also being exported into the western part of Belcher Channel.

Many small icebergs, about twice the size of a large house, were sighted during this flight. These masses were concentrated by the hundreds in Otto Fiord and in the eastern part of Greely Fiord. At least 50 had escaped from Otto Fiord the previous year and were being held by the ice in Nansen Sound. Hundreds of larger icebergs were observed in Peabody Bay and similar numbers populated the waters of Inglefield Fiord and the area around Thule. Reduced concentrations were noted in the northern part of Baffin Bay as well as in Glacier Strait.

Unobserved Areas

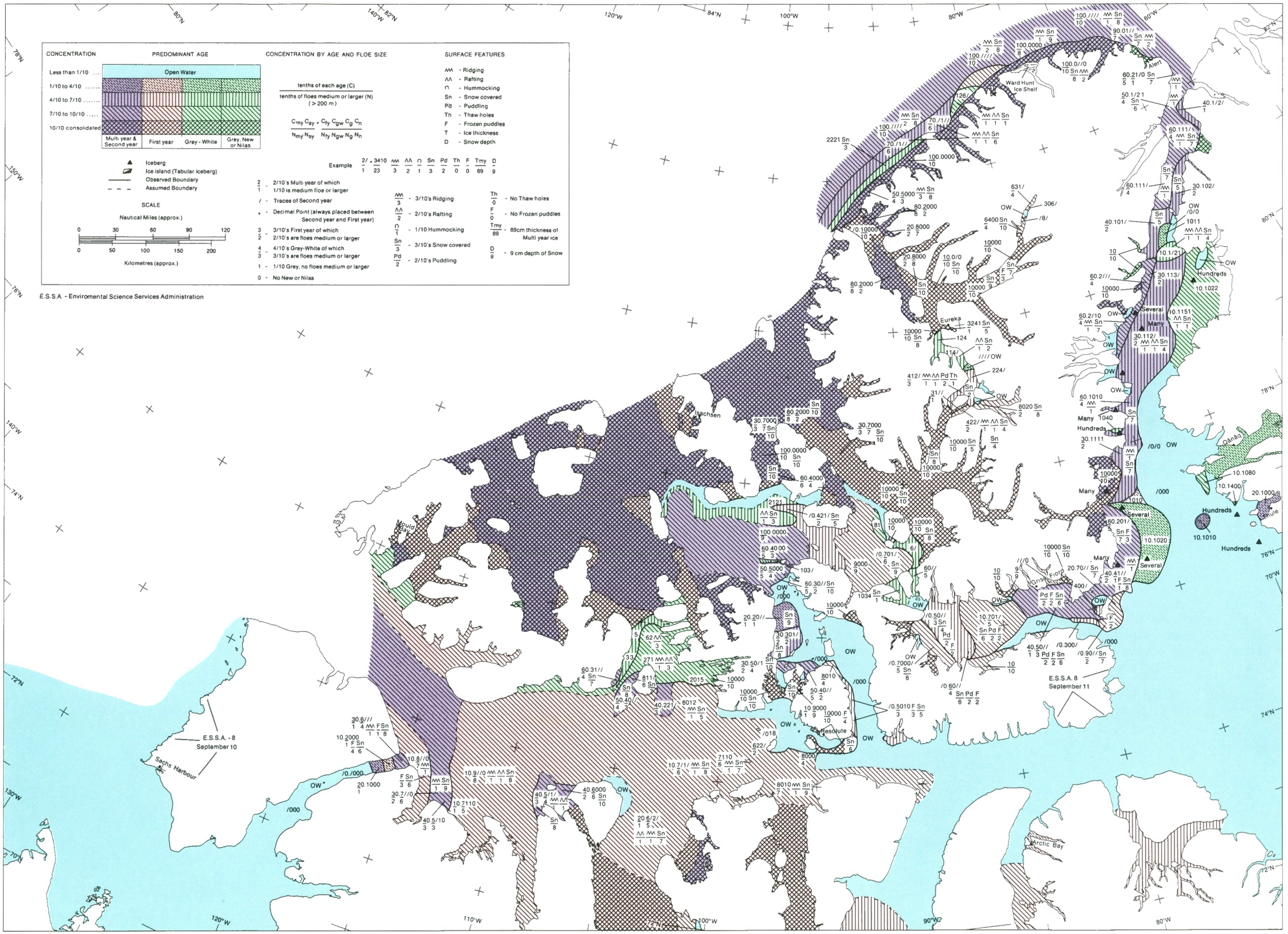
Ice conditions along the western fringe of the archipelago from southwest Prince Patrick Island to the northern tip of Axel Heiberg Island likely resembled the distributions shown on Map 5-1972 East.

Comments

By September 11 about 15 cm of new ice had formed on Slidre Fiord and the area was completely frozen over. While freezing conditions had returned throughout the area there were exceptions. On September 21 freezing drizzle was encountered during the low-level legs of track seven.

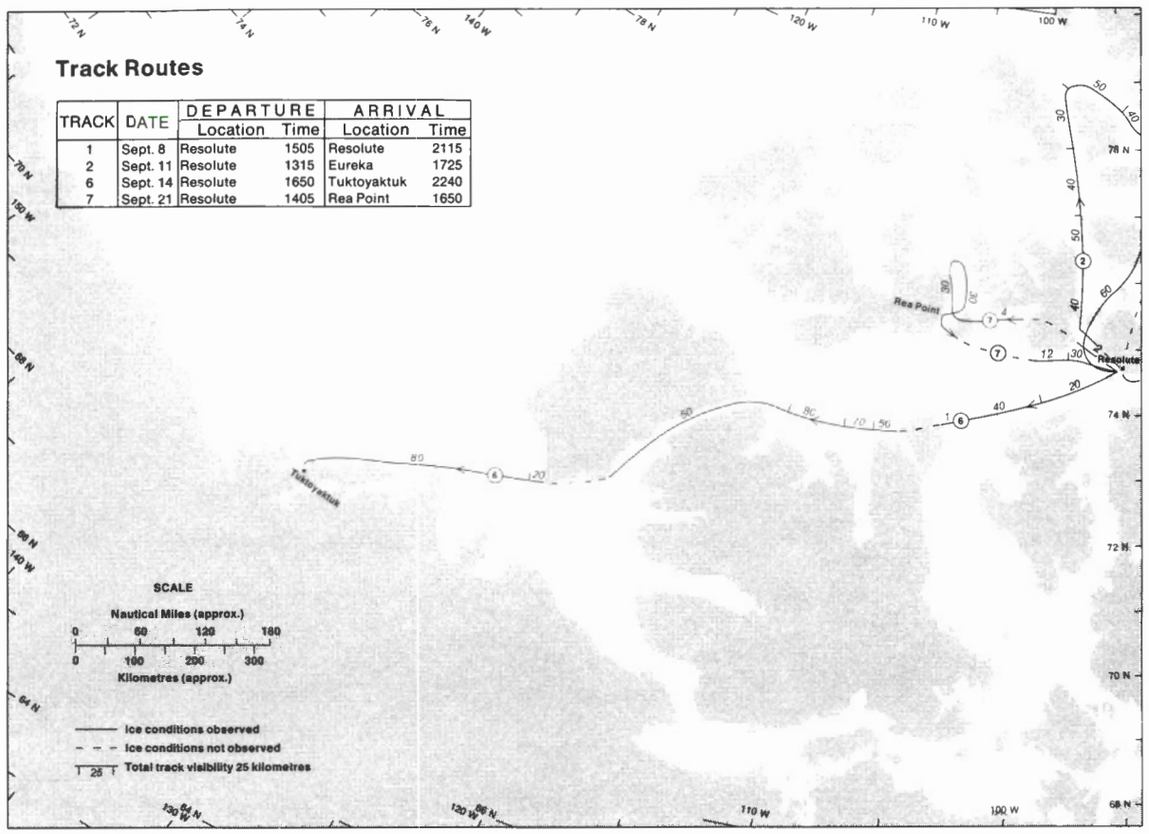
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 6 - 1972 EAST

September 8 - 21, 1972



MAP 6-1972 West
September 8-21

Flight Effectiveness

One track, number six, on September 10 was completed over the western part of the archipelago during Flight 6. Fortunately, a number of random observations were made when the observer accompanied the aircraft on other missions. As a result, the Flight effectiveness was increased from between 25 and 30 per cent to almost 60 per cent.

Ice Conditions

Ice conditions observed during Flight 6 were almost the same as those shown on Map 5-1972 West. A broad band of ice had moved south through Victoria Strait into Queen Maud Gulf and some of the solid ice in M'Clintock Channel had broken up once again. A similar break-up had taken place in Viscount Melville Sound.

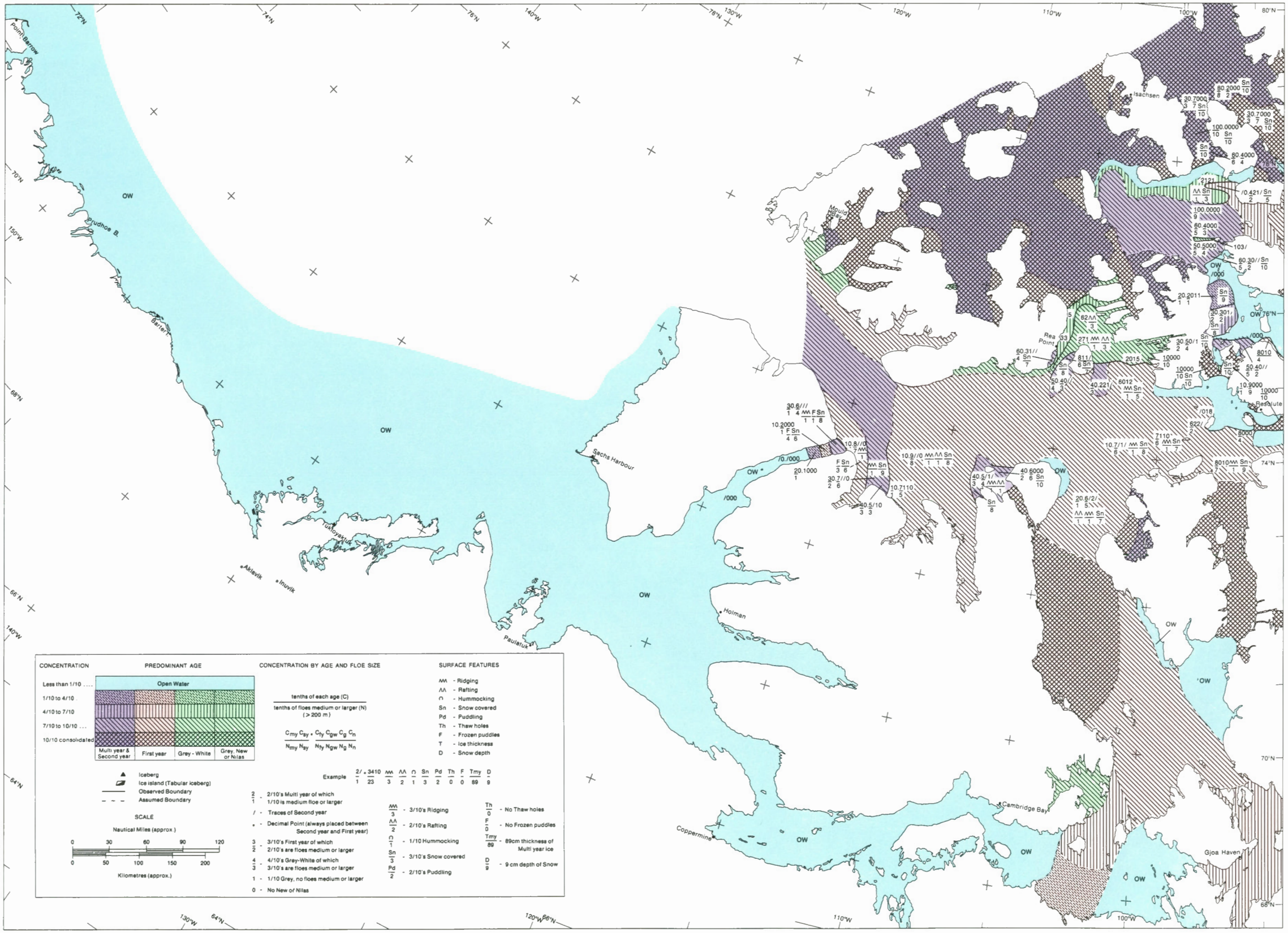
Unobserved Areas

Probably a variety of concentrations and ice types were present in M'Clure Strait and multi-year ice would predominate in the southern half of the strait. Concentrations would increase from about four tenths in west M'Clure Strait to about six tenths in the eastern part. A similar increase in the amount of multi-year ice could be expected from north to south. Two east-west bands of ice, one primarily first-year and the other mainly new ice, would occupy the northern and western third of M'Clure Strait and, overall, concentrations in the strait would range between seven and nine tenths.

Sporadic pilot reports combined with previous and later observations and ice conditions noted in other years were used to determine the extent of open water along the northern coast of Alaska and in the western part of the Beaufort Sea. The extent of open water in the straits separating Banks and Victoria Islands from the mainland was established from observations made while the aircraft was moving cargo between Tuktoyaktuk, Cambridge Bay and Resolute.

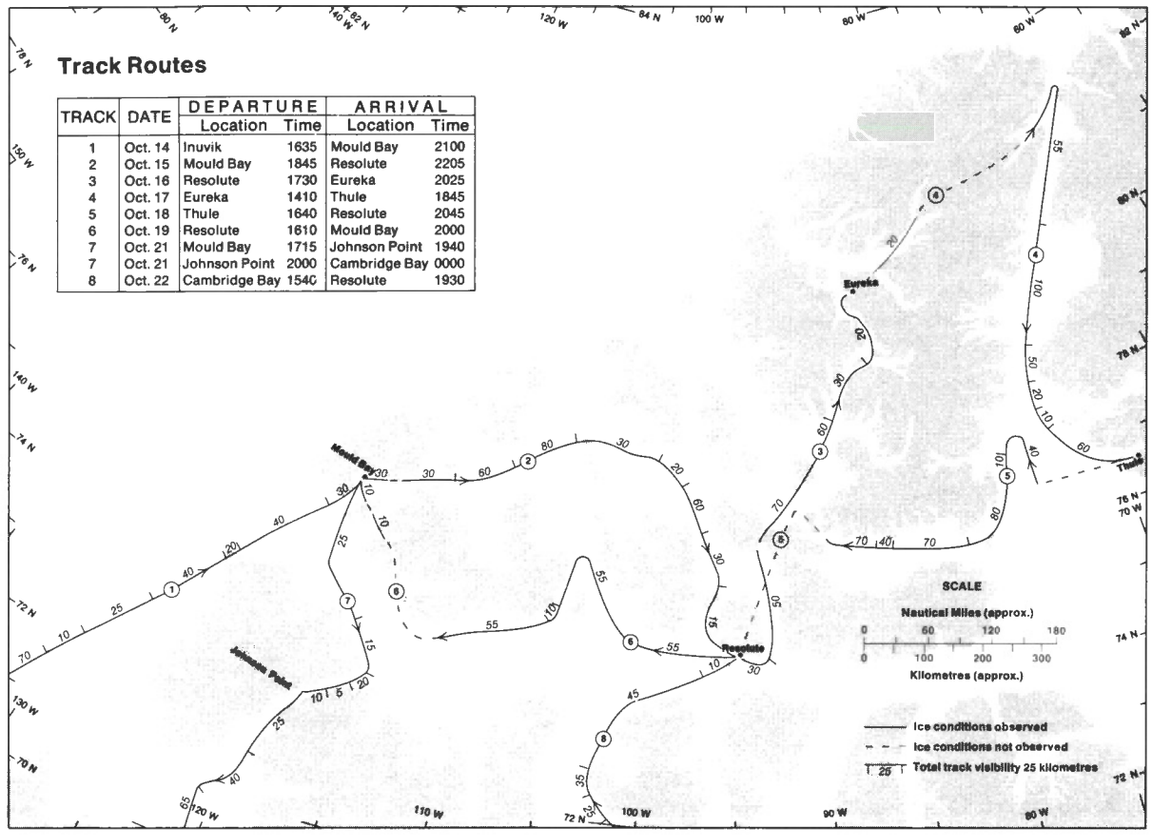
Comments

While ice conditions in the eastern part of this region had developed at a normal rate and had reached a typical distribution, the Beaufort Sea was mainly open water. Usually the multi-year ice remains closer to the coast than was the case during the 1972 season. No new ice had started to form, but this would soon occur. The freezing temperatures were gradually moving south. At this time of year the boundary between the two temperature regimes can be identified when aircraft icing occurs. Severe aircraft icing indicated that the boundary lay over the northern part of Amundsen Gulf on September 14.



MAP 6 - 1972 WEST

September 8 - 21, 1972



MAP 7-1972 East

October 14-22

Flight Effectiveness

All observations made during the four tracks over the eastern part of the archipelago were reduced by varying amounts as a result of the low sun angle. Fog, ice fog, low cloud ceilings and occasional aircraft icing combined with the lack of light to further complicate the observer's task. Overall, the Flight was judged to be slightly more than 50 per cent effective.

Ice Conditions

Two major changes had developed during the three-week interval separating Flights 6 and 7. The most obvious difference was the transformation of first-year ice into second-year ice. For the sake of convenience any first-year ice remaining in the channels is designated as second-year ice at the beginning of October. This birthday is an arbitrary date which generally coincides with the development of the newer forms of ice and an appropriate interval between two flights. The second change was the expansion and growth of the various forms of new ice over all the areas that were previously ice-free.

The expansion of the new ice forms was well established by the third week in September. By mid-October some of this ice had increased in thickness to such an extent that it was designated as first-year ice. Admittedly this ice was not very thick, but it had developed throughout Prince Regent Inlet as well as southern Lancaster Sound and in the channels around Byam Martin Island.

The advent of freezing conditions in September had stopped the advance of break-up with the result that the solid ice cover in the northern channels remained and no multi-year ice was allowed to enter the archipelago. New ice was cementing the older floes together and a solid ice cover had formed over Norwegian Bay. Probably a similar condition had recently developed over the area to the north of Penny Strait. However, recent winds had broken the fragile bonds established by the new ice and the ice cover was in motion when it was observed on October 15.

The ice in Nares Strait was active and pressure ridging and rafting in Kennedy Channel and Kane Basin was well developed.

Unobserved Areas

The ice conditions shown in Lancaster Sound and the adjacent channels to the south appeared to be solid. Without a doubt this condition was only temporary in Lancaster Sound and Prince Regent Inlet. The other channels would remain unbroken until the following summer.

A solid cover of mainly grey-white ice likely covered the channels in the vicinity of Bache Peninsula. Ice conditions along the northern fringe of the archipelago were similar to those shown on previous maps although north of Ellef Ringnes Island a wide lead separated the moving pack ice from the solid ice in the archipelago. Probably traces of new ice were developing in the open water in Baffin Bay.

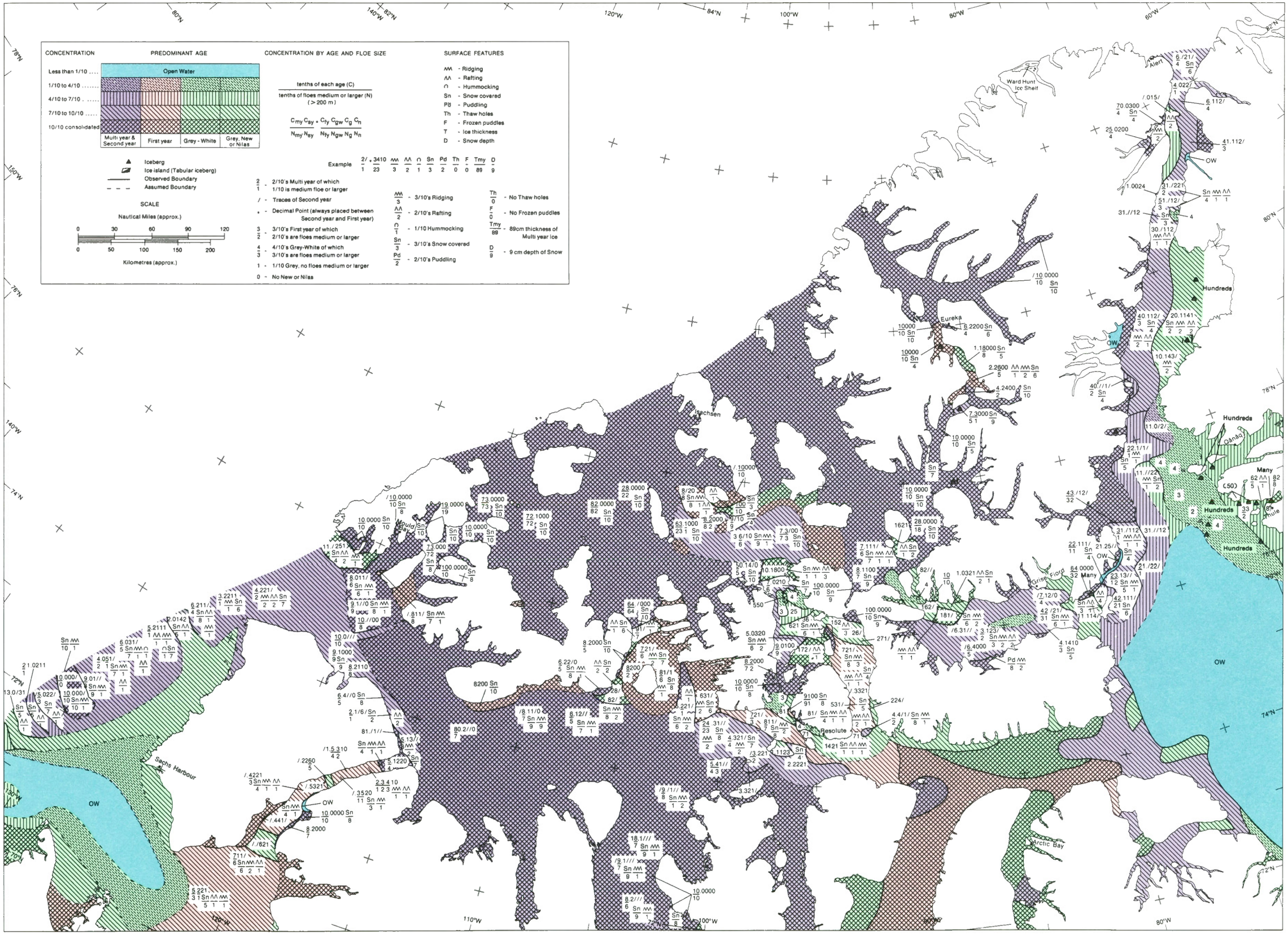
Comments

Very little movement had taken place in the northern part of Baffin Bay because the track made by the icebreakers as they moved north through this area on September 2 and then south on September 11 was still visible on October 16.

Hundreds of icebergs were sighted in Peabody Bay and similar numbers paralleled the Greenland coast from Inglefield Fiord to Thule and as far south as could be seen.

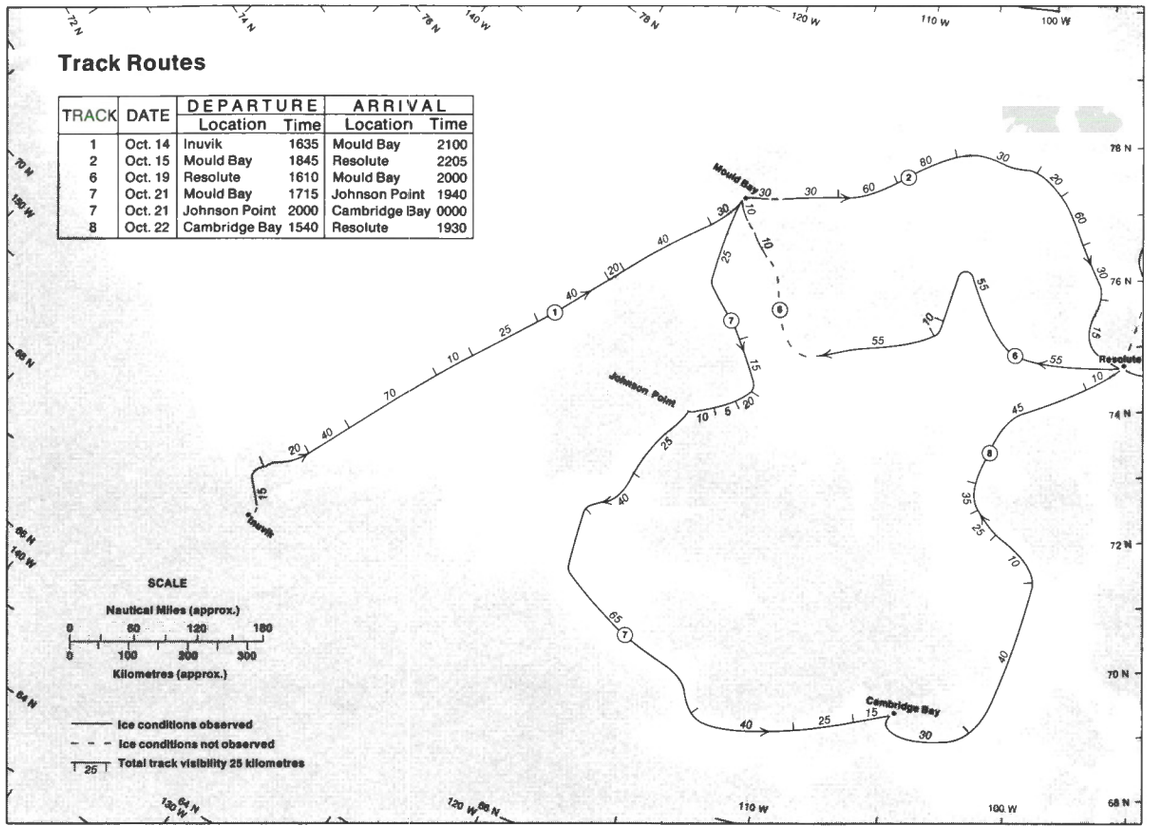
Pilots flying out over the Arctic Ocean indicated that multi-year ice in concentrations between six and seven tenths along with three tenths of the younger forms of ice continued for about 700 kilometres west of Isachsen.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 7 - 1972 EAST

October 14 - 22, 1972



MAP 7-1972 West

October 14-22

Flight Effectiveness

The effects of low stratus clouds, ice fog, freezing drizzle, and glare from the low sun angle hampered observations during the four tracks over the western part of the archipelago. However, these conditions seldom combined to totally interrupt the surveys and the Flight effectiveness ranged from 60 to 70 per cent.

Ice Conditions

Three obvious and expected changes had taken place in the western part of the archipelago during the three-week interval between Flights 6 and 7. The first occurred October 1 when all existing first-year ice becomes one year older and is designated as second-year ice. Thus the purple colour which denotes a predominant ice cover of second-year and multi-year ice must be used in channels such as Viscount Melville Sound and M'Clintock Channel where a red colour was used to show the preponderance of first-year ice during the previous flight. The second variation was caused by the development of the new ice types. Practically all of the areas that were ice-free at the end of Flight 6 now maintained a complete or partial cover of various combinations of new, grey and grey-white ice. In some cases such as Queen Maud Gulf, Dease Strait, Amundsen Gulf and its adjoining bays and straits, the thickness had increased to the point where it was interpreted as being first-year ice. The third variation took place in the Beaufort Sea. Here, for the first time in the season, multi-year ice was observed. This ice had advanced across this sea to its usual position about 100 kilometres north of Tuktoyaktuk and 50 kilometres west of Banks Island.

The growth of new ice and its associated forms had cemented the existing floes together and a solid ice cover was observed in many areas. However, this bond was thin and fragile and it is likely that the ice cover in M'Clure Strait, Viscount Melville Sound, in the northern and southern third of M'Clintock Channel as well as Queen Maud Gulf could break up once again if appropriate winds developed.

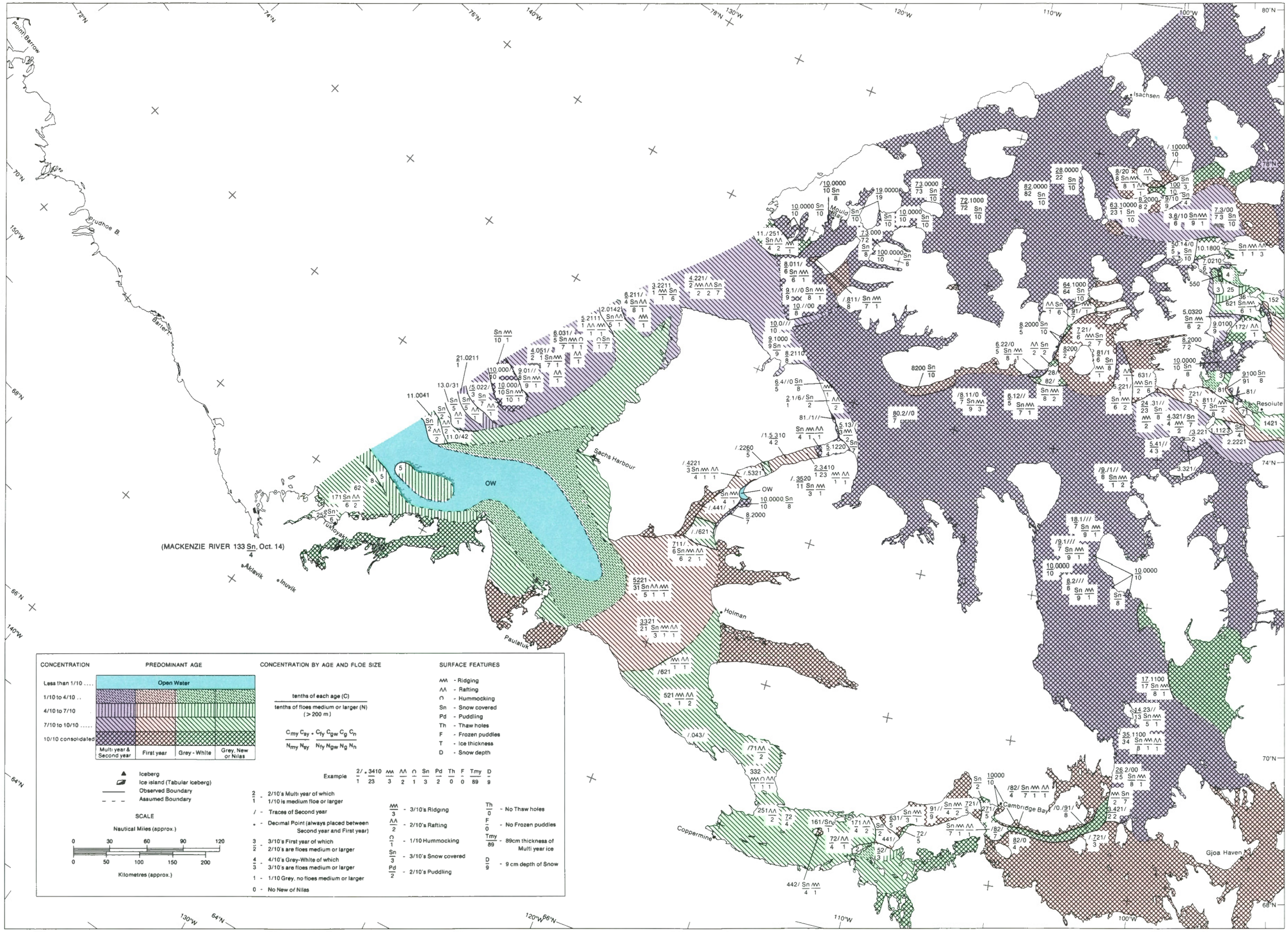
Unobserved Areas

It was difficult to establish the type of ice covering Prince Albert Sound. A series of thickness measurements made on the ice would determine whether it should have been designated as grey-white ice or thin, first-year ice.

Comments

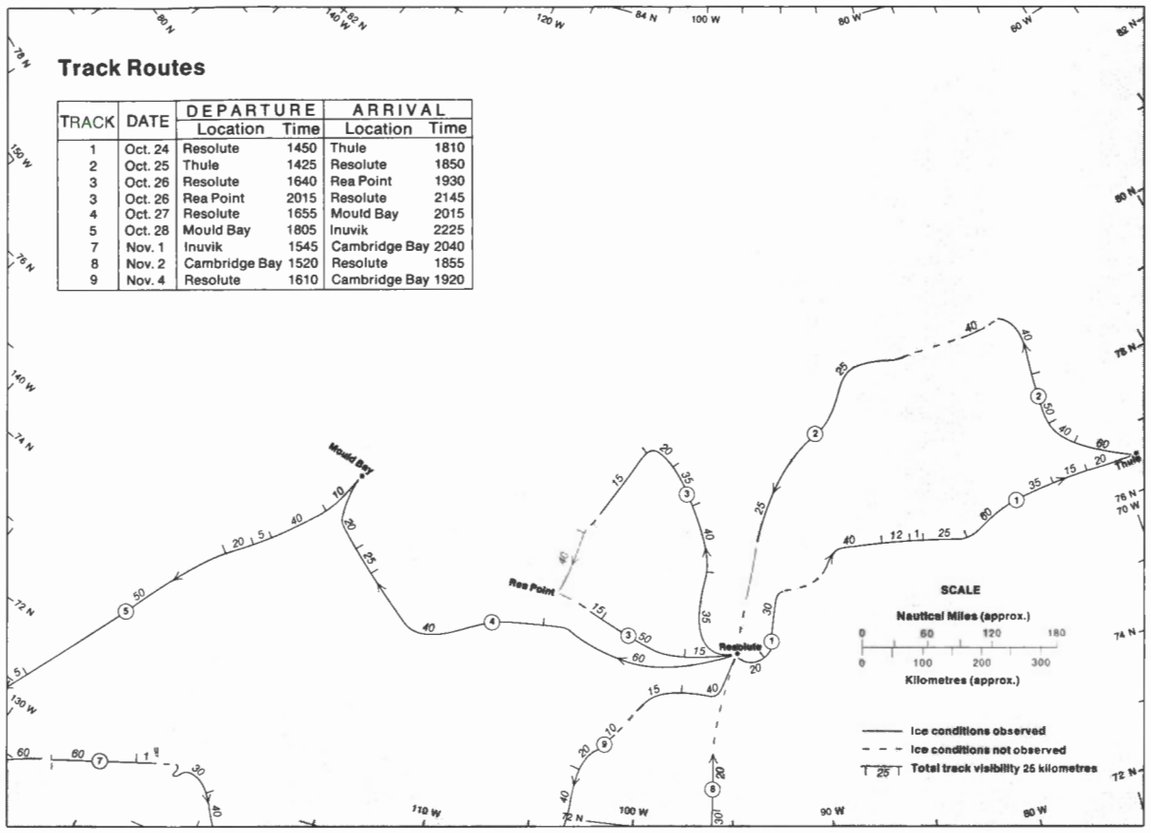
The ice conditions in the Middle Channel of the Mackenzie River were observed on October 14 during the initial part of track one. Most of the five tenths cover was new ice, although some grey ice existed closer to the banks. Two tenths of the ice was snow covered. The lakes adjacent to the river were completely frozen over.

A number of ice island fragments were observed in Queen Maud Gulf to the north of Jenny Lind Island and near Acland Bay along the west coast of Prince of Wales Island. One mass of ice resembling an ice island fragment was sighted in the Beaufort Sea about 225 kilometres north of Tuktoyaktuk. It was located at 71° 25'N, 131° 27'W.



MAP 7 - 1972 WEST

October 14 - 22, 1972



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 24	Resolute	1450	Thule	1810
2	Oct. 25	Thule	1425	Resolute	1850
3	Oct. 26	Resolute	1640	Rea Point	1930
3	Oct. 26	Rea Point	2015	Resolute	2145
4	Oct. 27	Resolute	1655	Mould Bay	2015
5	Oct. 28	Mould Bay	1805	Inuvik	2225
7	Nov. 1	Inuvik	1545	Cambridge Bay	2040
8	Nov. 2	Cambridge Bay	1520	Resolute	1855
9	Nov. 4	Resolute	1610	Cambridge Bay	1920

MAP 8-1972 East

October 24-November 4

Flight Effectiveness

While the weather had improved during the latter part of October, the number of daylight hours continued their dramatic decline with the overall result that only three short tracks were completed over the eastern part of the archipelago during Flight 8. The effects of the reduced amount of light were occasionally compounded by sporadic areas of ice fog. At this time of year the patches of ice fog are usually fairly small and, although the horizontal visibility is temporarily restricted, it is usually possible to see the ice directly beneath the aircraft. Flight 8-1972 East was about 40 per cent effective.

Ice Conditions

The main change that occurred between the two last flights of the 1972 season was the final consolidation of the ice cover in the unnamed sea to the north of Penny Strait. Throughout the remainder of the area the new ice continued to increase in thickness while all the main boundaries separating moving from solid ice covers remained stationary.

The ice in Wellington Channel and Jones Sound was very active and there were no signs that freeze-up would come to these areas for the next few weeks. In the case of Wellington Channel the ice cover might not stop mass movements until mid-December. The ice cover in Lancaster Sound continued to move throughout the winter.

Some movement may have taken place in Byam Martin and Austin Channel, but by mid-November the large movements in these channels would be checked by the continued development of new ice.

Vast areas of pancake ice had developed in the central part of Baffin Bay. These rather unique features are seldom seen in such large quantities in the channels of the archipelago.

Unobserved Areas

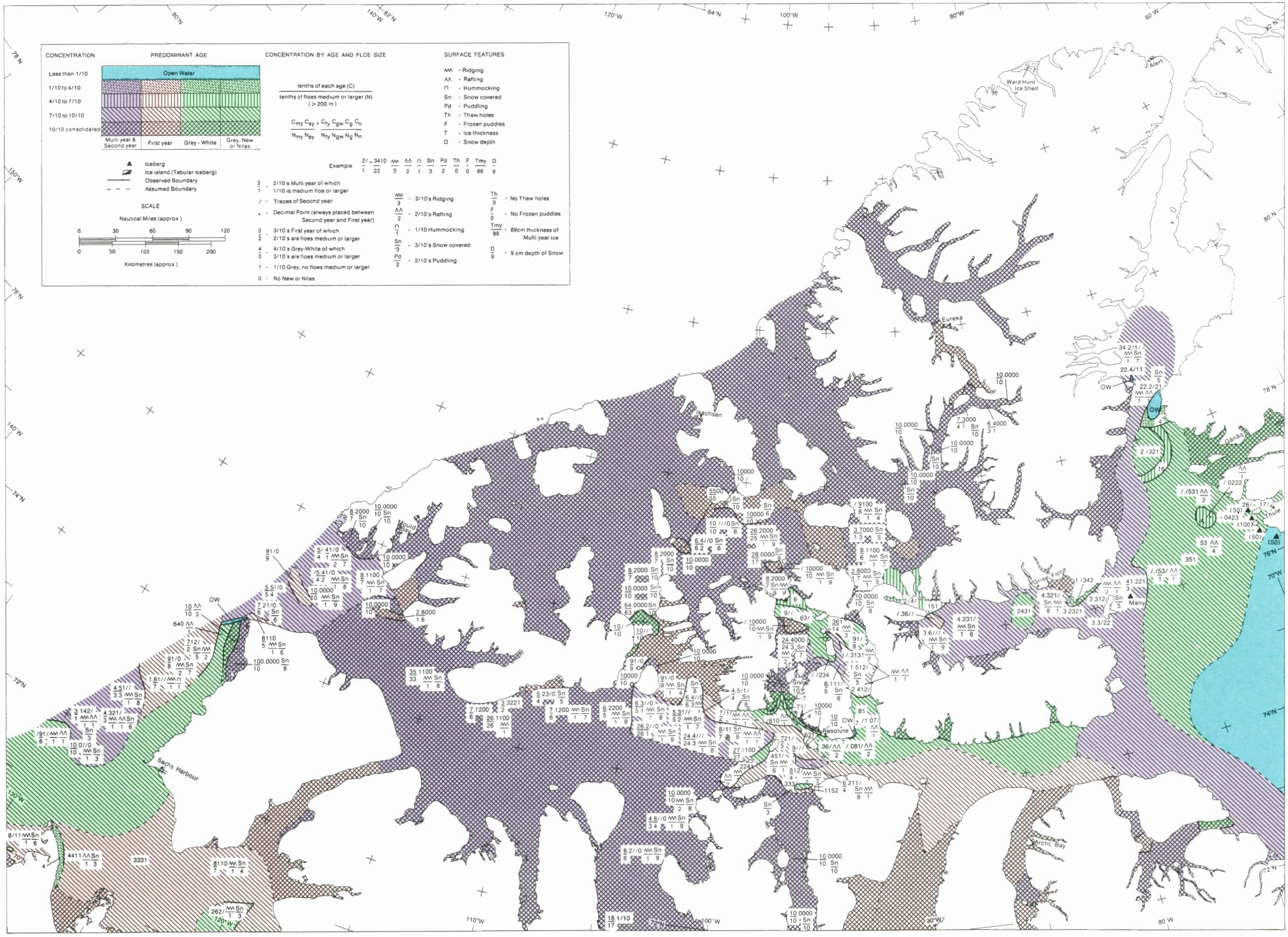
Probably the moving pack of multi-year ice in the Arctic Ocean pressed close to the northwestern coasts of the archipelago and the boundaries separating this from the solid ice in the interior channels were likely located close to those shown on Map 8-1972 East. It can be assumed that the ice throughout the length of Nares Strait continued to move although the ice cover on Robeson Channel and Hall Basin would soon solidify and movements would cease until the following summer. All the bays and fiords along Nares Strait maintained a solid ice cover.

Comments

Freeze-up was progressing in its usual pattern and timing.

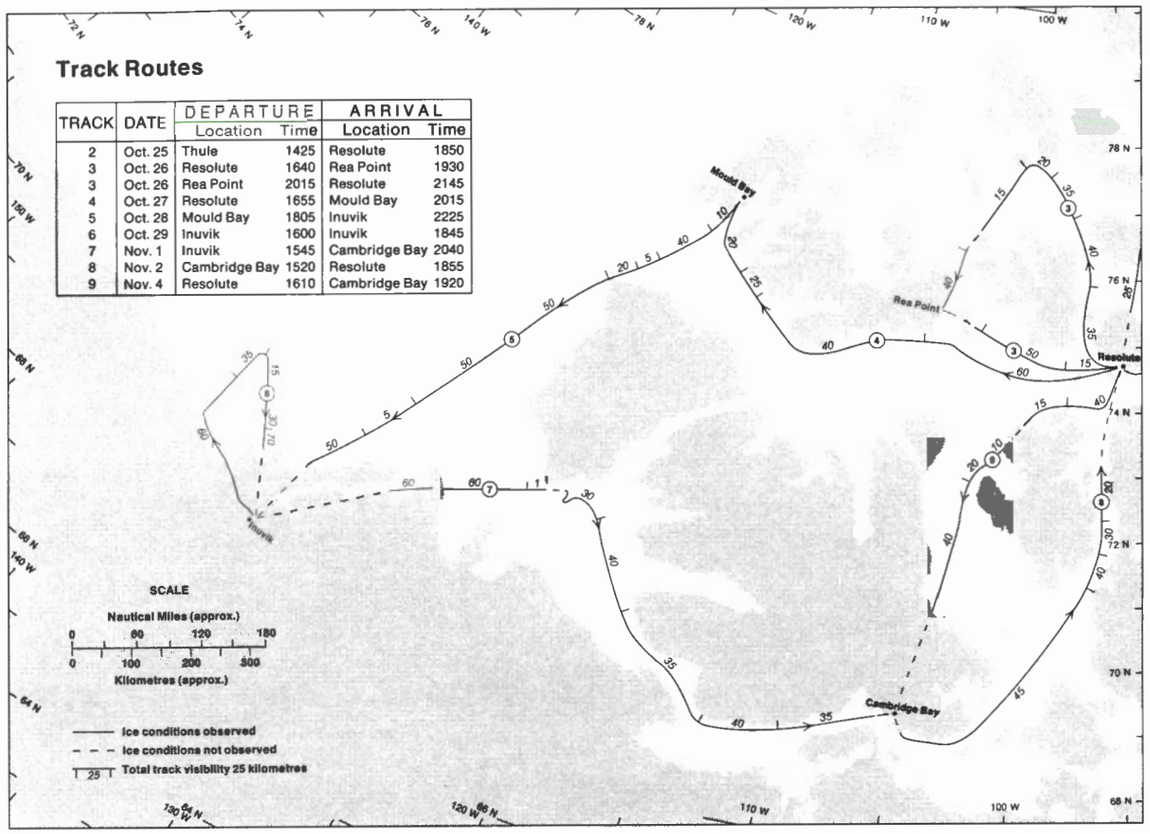
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 8 - 1972 EAST

October 24 - November 4, 1972



MAP 8-1972 West

October 25-November 4

Flight Effectiveness

Despite the low sun angle and the additional restrictions caused by aircraft icing, ice fog, ice crystals, low cloud and maintenance problems resulting from low temperatures, six tracks were completed over the western part of the archipelago during Flight 8-1972. Considering the time of year and the associated problems, the results of these surveys were very good and the Flight was judged to be between 75 and 85 per cent effective.

Ice Conditions

Between the last two flights of 1972 new ice types continued to form and grow and areas previously covered with new ice now supported a thin cover of first-year ice. In other channels the increased thickness of new ice between the older floes greatly reduced the possibilities of further movement. Movement in the southern part of Viscount Melville Sound could take place if winds with sufficient strength from the requisite quadrant persisted. The ice in the northern half of this sound would break up and move before the ice in the southern half. The bonds holding the floes together in eastern M'Clure Strait were even weaker. Final freeze-up of the ice cover in Viscount Melville Sound and the eastern part of M'Clure Strait probably came during the latter part of November. The ice in the western half of M'Clure Strait breaks and re-freezes at sporadic intervals throughout the winter.

The solid ice cover shown in Prince of Wales Strait, Peel Sound, M'Clintock Channel and the adjoining channels to the south would remain unbroken until the following summer. Freeze-up in Coronation Gulf and Dolphin and Union Strait was rapidly advancing and final consolidation probably resulted by mid-November. Although the ice in the eastern part of Amundsen Gulf probably stopped moving in late November, the ice in the western part may break up and shift a number of times throughout the winter depending on the frequency, direction and intensity of winter storms visiting the area.

A solid cover would soon develop across Mackenzie Bay, Kugmallit Bay and Liverpool Bay while the ice a few kilometres offshore would continue to move throughout the winter.

Freeze-up was advancing in a typical fashion in all channels. In Amundsen Gulf the oldest ice and the greatest snow cover were found in the southern part. The thickness and the extent of snow gradually decreased toward the north and Banks Island. Rafting was very common in Amundsen Gulf while ridging occupied the central part of Victoria Strait.

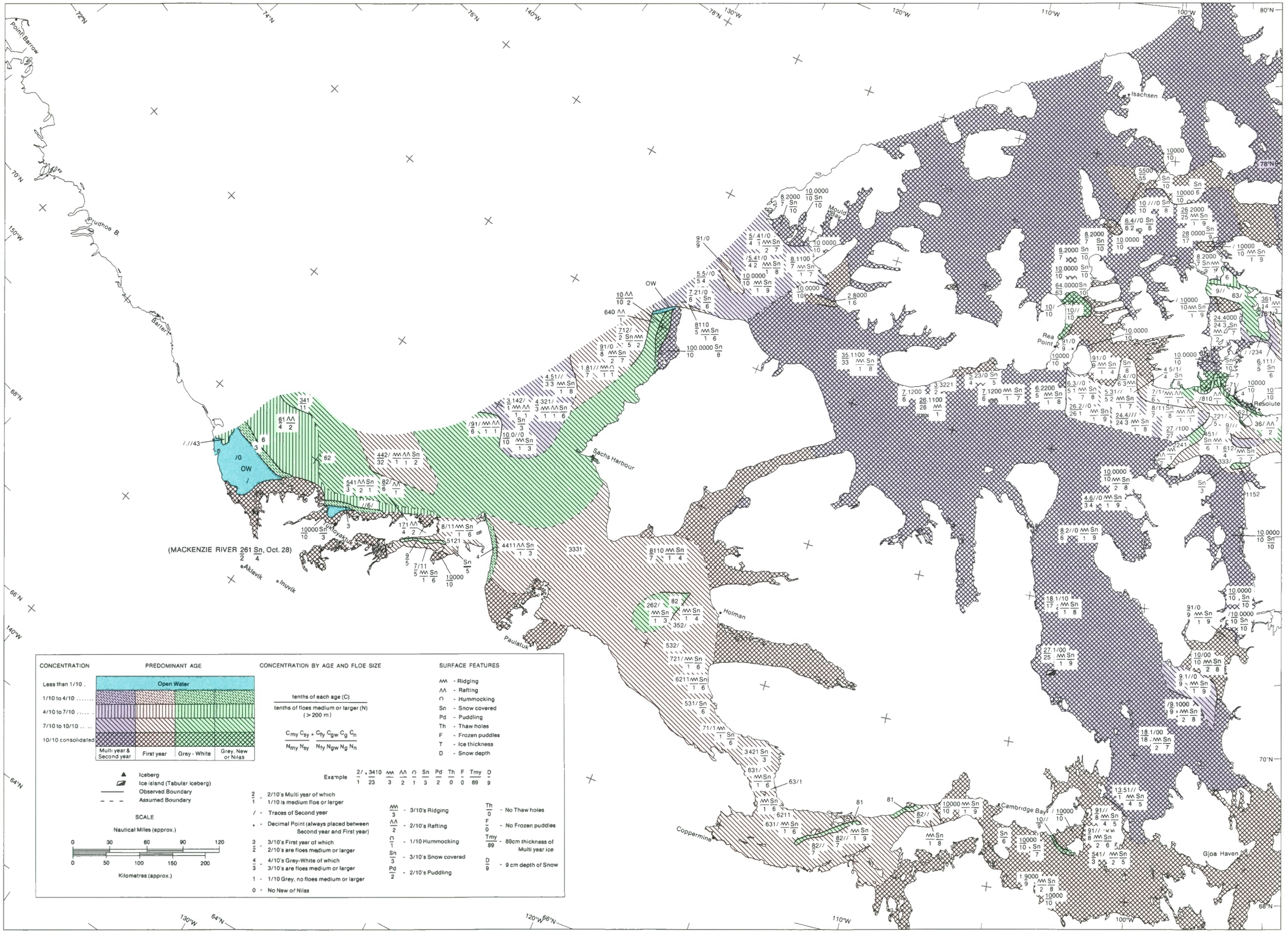
Unobserved Areas

Ice conditions in Prince of Wales Strait and Rasmussen Basin were not observed. Conditions shown for these areas were deduced from previous observations and from conditions noted in the following spring.

Comments

A few pieces of ice island were observed in Victoria Strait and along the east coast of Banks Island near Norway Bay.

Observations on October 28 showed that the Mackenzie River generally supported a solid ice cover of first-year ice as far as Tununuk. South of this, toward Inuvik, a cover of grey-white ice prevailed. Unfrozen areas appeared near the bends in the river and at periodic intervals in midchannel. Some of the latter areas were up to one half a kilometre in diameter. Overall, the snow cover along the northern part of the river ranged from four to seven tenths.



CONCENTRATION

Less than 1/10 .
1/10 to 4/10 .....
4/10 to 7/10 .....
7/10 to 10/10 ...
10/10 consolidated

PREDOMINANT AGE

Open Water			
Multi year & Second year	First year	Grey - White	Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy} \quad N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example: 2/1 • 3410 MM/3 AA/2 ∩/1 Sn/3 Pd/2 Th/0 F/0 Tmy/89 D/9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

MM/3 - 3/10's Ridging
AA/2 - 2/10's Rafting
∩/1 - 1/10 Hummocking
Sn/3 - 3/10's Snow covered
Pd/2 - 2/10's Puddling

Th/0 - No Thaw holes
F/0 - No Frozen puddles
Tmy/89 - 89cm thickness of Multi year ice
D/9 - 9 cm depth of Snow

SURFACE FEATURES

MM - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

SEASONAL SUMMARY: 1973

The ice conditions that developed in the channels of the Canadian Arctic Archipelago during the 1973 summer season were very favourable for navigation. Large areas of ice broke up and melted while only limited quantities of multi-year ice moved south to reoccupy the ice-free channels. Compared with the summer ice conditions shown for all the years in this atlas, those that developed in 1973 were much better than any other year including the ice-free season which developed during the summer of 1971. The maximum amount of open water recorded in any season appeared in 1962, and the summer of 1973 almost duplicated the record set 11 years earlier. Even though the timing of break-up and subsequent clearing during the summer of 1973 took place in some areas about four weeks ahead of the usual date, the patterns of movement, melting and freeze-up were typical.

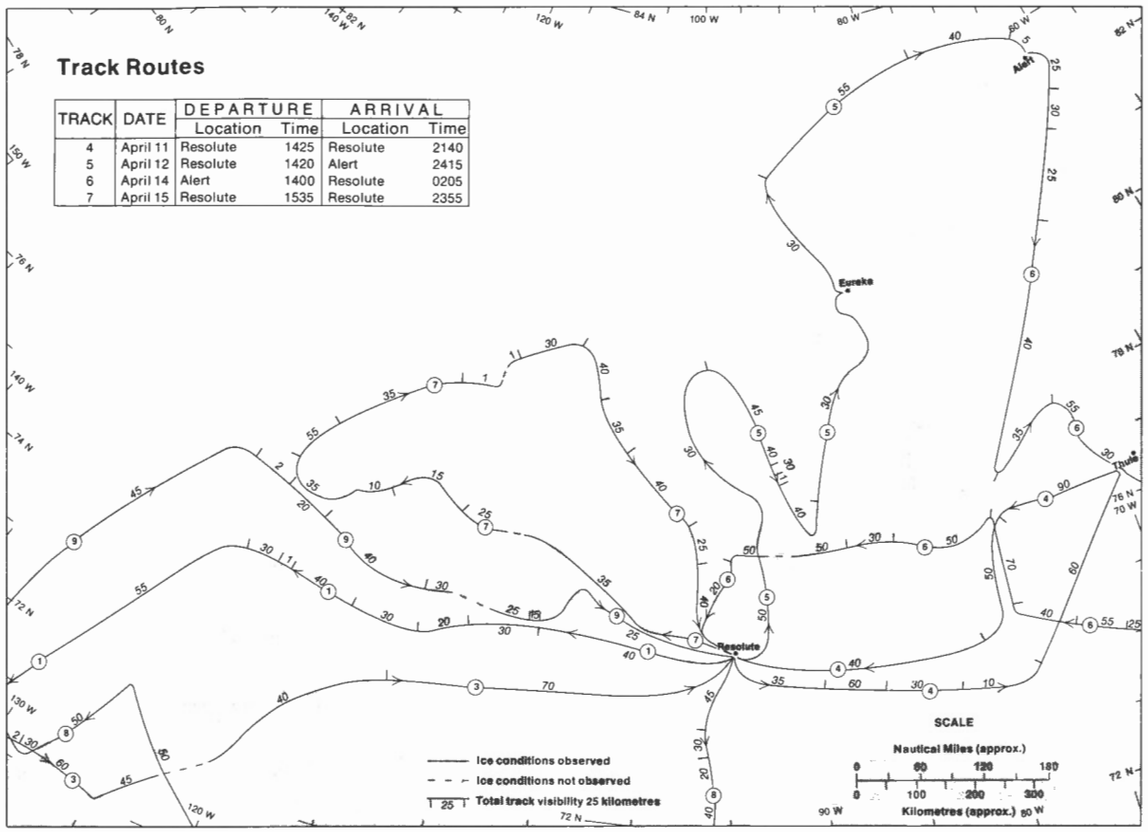
The ice barriers across Prince Gustaf Adolf Sea, Peary Channel and Ballantyne Strait broke up. Although the multi-year ice in the Arctic Ocean remained close to the northern fringe of the archipelago throughout the season, only limited quantities managed to move into the interior channels through Prince Gustaf Adolf Sea. The ice cover across Nansen Sound and Sverdrup Channel remained solid throughout the summer and stopped the multi-year ice from drifting into the archipelago.

The extent of open water was much greater than usual with portions of Norwegian Bay, Viscount Melville Sound and M'Clintock Channel being almost ice-free at the end of August. In general, concentrations in these areas normally remain at five tenths or more.

While the ice conditions in the eastern part of the arctic were much better than expected the situation in the Beaufort Sea was normal.

Fine weather during the season provided very good visibilities and observing conditions. Even the fall surveys were very effective because the weather was better than usual.

Many small ice island fragments, the last remains of T-1, were spread out across the southern part of M'Clintock Channel. One ice island was located in the Arctic Ocean northwest of Prince Patrick Island.



MAP 1-1973 East April 11-15

Flight Effectiveness

The majority of the straits and channels of the eastern part of the archipelago were surveyed during the first Flight of the season. One factor, ice crystals, limited the visibility during some part of each track. Occasionally, ice fog, low cloud and a low sun angle added to the problem created by the ice crystals. Overall, the visibilities ranged from good to very good and the Flight was judged to be between 75 and 85 per cent effective.

Ice Conditions

Ice conditions observed in the eastern region during the first surveys of the 1973 season closely resembled those noted during the last part of 1972. This similarity proved that only minor movements took place during the months from November through March. The general pattern of ice types, concentrations and features noted on Map 1-1973 East were typical of those normally expected except in the eastern part of Queens Channel where the ice had recently broken and was extremely ridged. Little movement was possible and the area would soon freeze up once again. The nearby area of open water north of Dundas Island developed in its usual place and the conditions in Hell Gate and Lancaster Sound followed the classic pattern.

The snow cover ranged from seven tenths in some areas where the combination of winds and younger ice types had kept the ice relatively clear to ten tenths throughout the rest of the area. Deep snow covered the ice at the extremities of Ellesmere Island off Clements Markham Inlet and in Glacier Strait. A partial development of the solid ice tongue indicated that the conditions in the northwest part of Baffin Bay were developing in a regular fashion.

Many icebergs were observed in addition to those shown on Map 1-1973 East. The greatest concentrations occurred along the west coast of Greenland south of Thule. Similarly, hundreds were caught in the solid ice cover off the east coast of Coburg Island. About 70 were concentrated in the central part of Nansen Sound and a comparable number were spread out along the length of Eureka Sound. A few were scattered in the southern half of Massey Sound and in Jones Sound. Probably the greatest concentration of icebergs was in Peabody Bay, but poor visibility restricted horizontal visibility toward the Greenland coast and hid the icebergs from view. The appearance of two small icebergs in the northwestern part of Belcher Channel was an interesting find as they generally remain in the eastern part of this channel. A few small icebergs were spread along the western part of Queens Channel near Bathurst Island and one had arrived at the northern entrance of Pullen Strait. It is very curious that no icebergs were sighted during the surveys over Lancaster Sound. One small fragment of an ice island was located in the Arctic Ocean near the northern tip of Brock Island.

Unobserved Areas

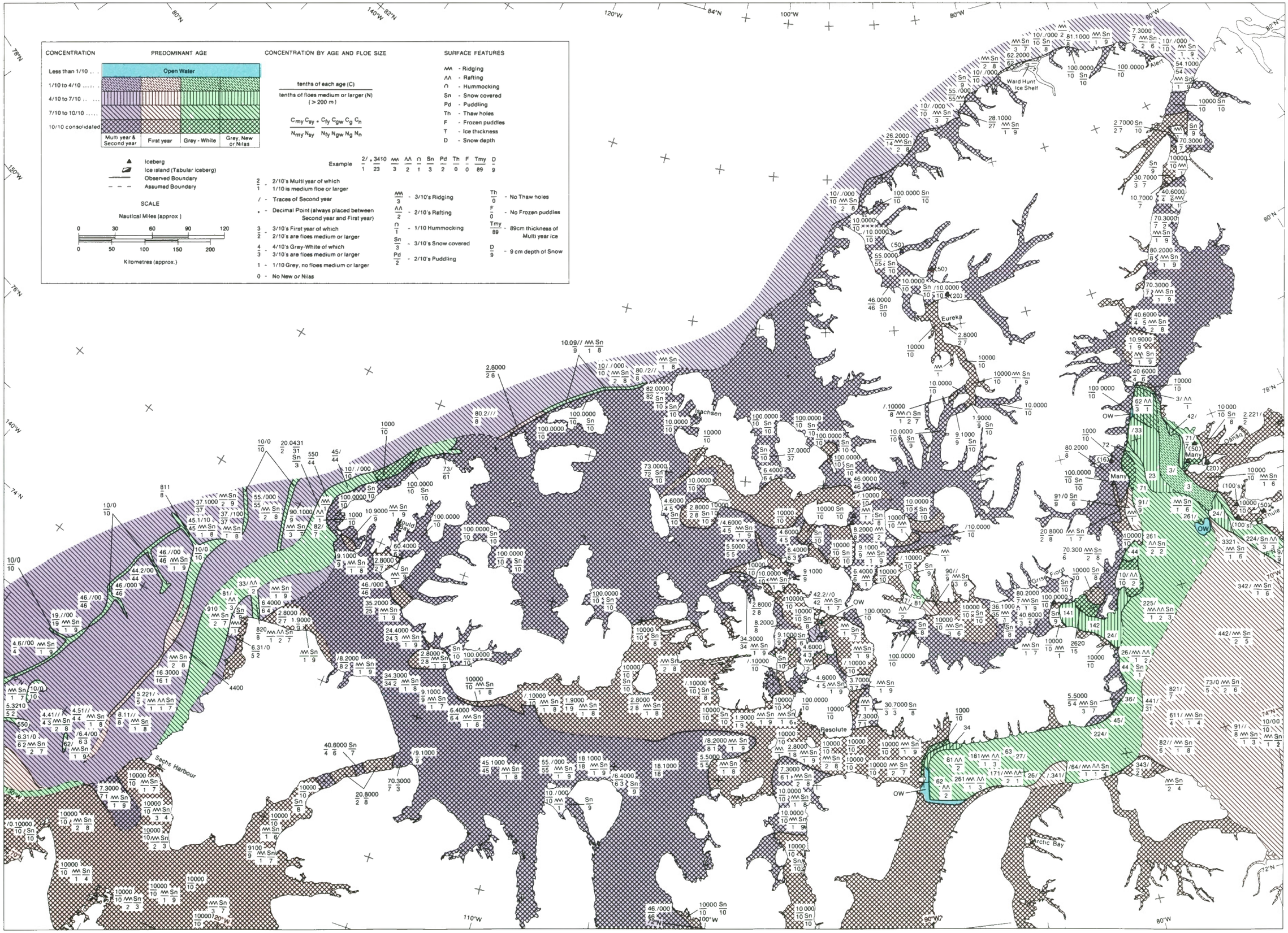
The ice conditions shown on Prince Regent Inlet and the other channels running south from Lancaster Sound were determined on the basis of subsequent surveys along with a knowledge of their typical state at this time of year. A similar set of criteria together with pilot reports were used to establish the ice conditions between the nortnern tips of Ellef Ringnes Island and Axel Heiberg Island.

Comments

The first surveys showed no unusual patterns, types or distributions. The fact that the northern part of Prince Regent Inlet was solid was not indicative of things to come because the early spring ice conditions in this channel vary considerably from year to year.

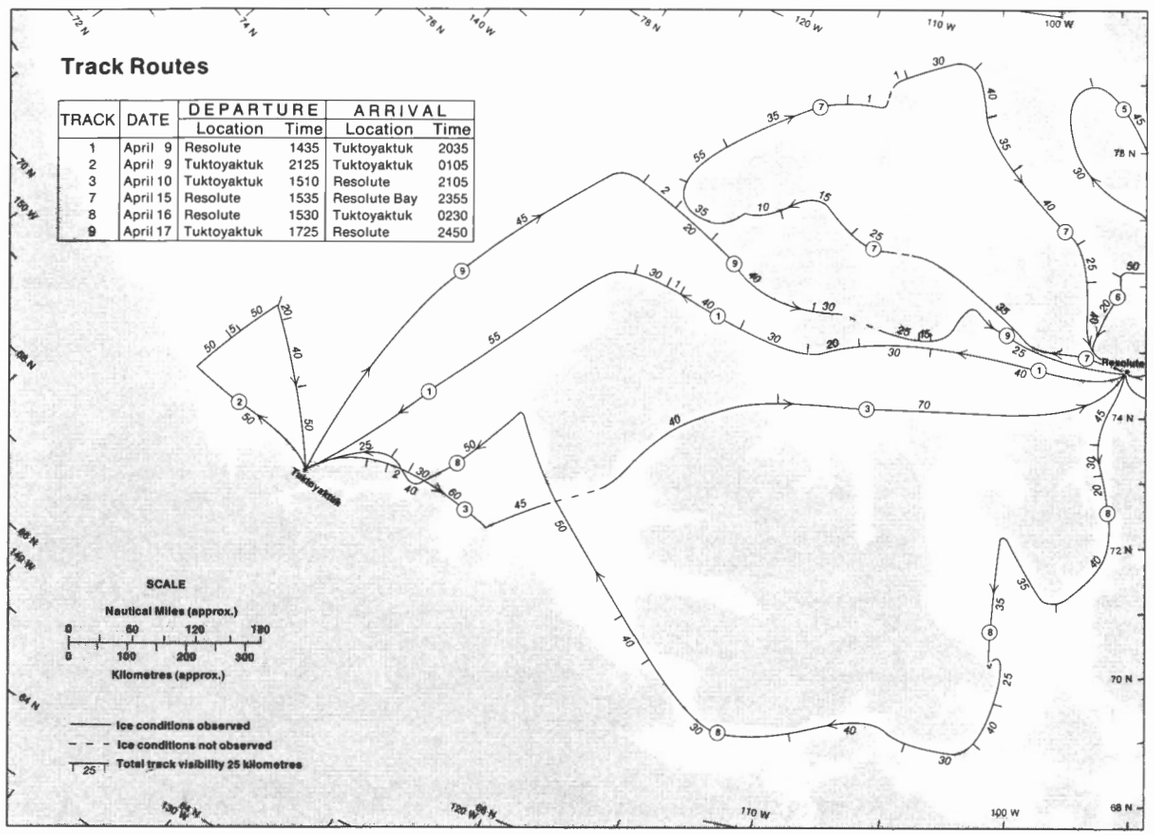
The icebreaker track broken through the solid ice cover in the southern part of Eureka Sound during the first week of September, 1972 was still visible in April, 1973.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 1 - 1973 EAST

April 11-15, 1973



MAP 1-1973 West April 9-17

Flight Effectiveness

A very comprehensive series of tracks was completed over the western part of the archipelago during Flight 1-1973 West. Generally the visibility accompanying each track was only rated as good because ice crystals, or ice fog or low cloud occasionally reduced the effective range of observations. Ice crystals seldom restrict vertical visibility completely, but they do reduce the horizontal scope considerably and cause the ice surface to appear flat and featureless. In spite of these problems the Flight was one of the most thorough that had yet been completed in the area and it was judged to be between 90 and 100 per cent effective.

Ice Conditions

The patterns, types and distributions shown on Map 1-1973 West closely resembled those noted in the late fall of 1972 indicating that the preceeding freeze-up and the subsequent winter development followed the typical model. Practically no movement occurred in the interior channels while the southerly drift in the Beaufort Sea seemed to be slightly less pronounced than usual.

One departure from the usual situation was the absence of the broken and open area known as the Bathurst Polynya which develops in most winters in Amundsen Gulf midway between Cape Bathurst and Cape Lambton, the southern tip of Banks Island. Observations over this area throughout March and April showed no signs of the polynya. However, thin first-year ice in the vicinity of Cape Lambton indicated that some movement had occurred earlier in the winter. This assumption was further reinforced by the considerable amount of pressure ridging noted in the northern part of Thesiger Bay which runs from Cape Lampton to Sachs Harbour. Judging from the heights of some of the ridges noted in this area the pressures must have been considerable.

The boundary or shear zone which separates the moving ice in the central part of the Beaufort Sea from the solid ice along its shores seemed to be a few kilometres further to the north than usual and much closer to the southwestern coast of Banks Island than normal. The solid cover of first-year ice in the western part of the Beaufort Sea to the north of Herschel Island was temporary and would likely soon break up and begin to move once again.

Snow cover varied considerably from less than four tenths in the southern part of the Beaufort Sea where the ice had recently formed to ten tenths in areas where the ice had remained solid. In these areas the snow masked the surface and by reducing and obliterating the relief of the ice made it difficult to distinguish between first-year and second-year ice.

Unobserved Areas

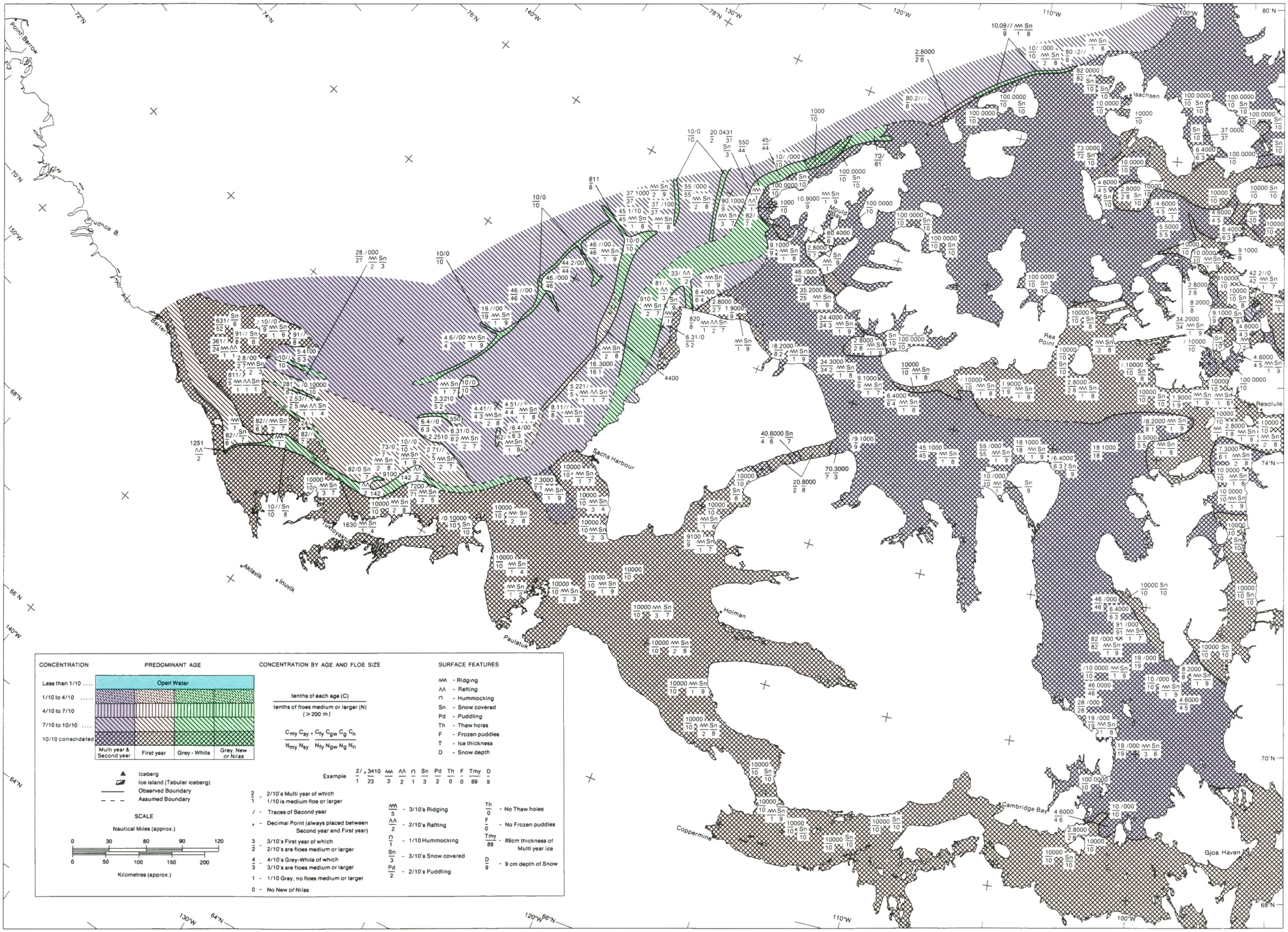
Small areas of open water probably existed in the central parts of Bellot Strait. Normally these areas remain open throughout the winter. The ice conditions in Rasmussen Basin are based on subsequent observations as well as previous knowledge.

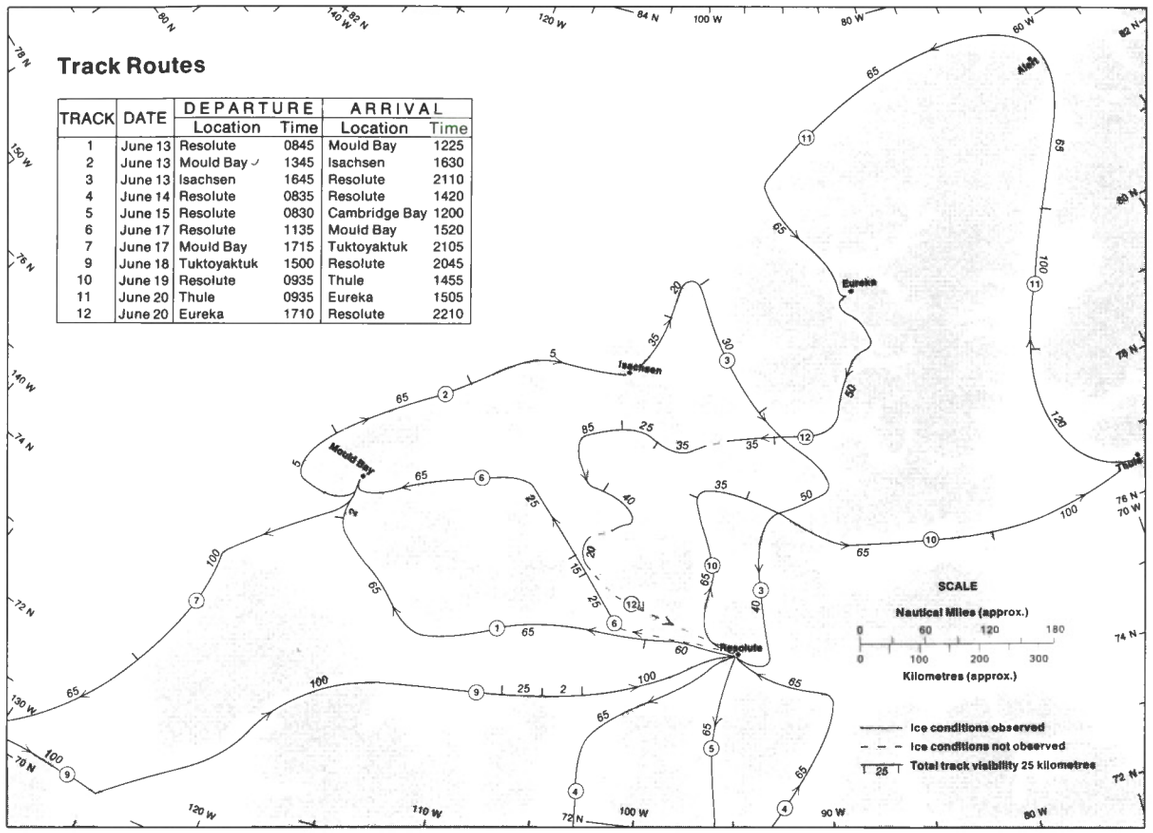
Comments

The observer accompanied 15 flights over the southeast part of the Beaufort Sea from March 9 to March 29. The weather during these flights was excellent and the ice conditions observed and noted during all of these missions correspond with those shown on Map 1-1973 West.

Ice conditions in the Middle Channel of the Mackenzie River between Inuvik and Kugmallit Bay were observed in mid-March and mid-April. Both series of observations indicated that a solid cover of first-year ice with a ten tenths snow cover prevailed.

Many ice island fragments were spread out along the southeast coast of Victoria Island. Numerous pieces were grounded along the shore of Collinson Peninsula. A few fragments were observed in Queen Maud Gulf just west of Jenny Lind Island and some reached Franklin Strait and rested off the southeast coast of Prince of Wales Island. One small mass of ice, either an iceberg or an ice island fragment, had entered Amundsen Gulf and reached the vicinity of Pearce Point. No other ice masses of a similar nature had been sighted in this gulf since 1964 when the Polar Continental Shelf Project started making ice surveys in this area.


Point Barrow
Prudhoe B.
Barter I.
Sachs Harbour
Holman
Paulatuk
Aklavik
Inuvik
Mould Bay
Isachsen
Rea Point
Resolute
Cambridge Bay
Coppermine
Gjoa Haven
CONCENTRATION
PREDOMINANT AGE
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N) (>200 m)
SURFACE FEATURES
Ridging
Rafting
Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Example
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx.)
Kilometres (approx.)
2/10's Multi year of which 1/10 is medium floe or larger
Traces of Second year
Decimal Point (always placed between Second year and First year)
3/10's First year of which 2/10's are floes medium or larger
4/10's Grey-White of which 3/10's are floes medium or larger
1/10 Grey, no floes medium or larger
No New of Nilas
3/10's Ridging
2/10's Rafting
1/10 Hummocking
3/10's Snow covered
2/10's Puddling
No Thaw holes
No Frozen puddles
89cm thickness of Multi year ice
9 cm depth of Snow



TRACK	DATE	DEPARTURE Location	Time	ARRIVAL Location	Time
1	June 13	Resolute	0845	Mould Bay	1225
2	June 13	Mould Bay	1345	Isachsen	1630
3	June 13	Isachsen	1645	Resolute	2110
4	June 14	Resolute	0835	Resolute	1420
5	June 15	Resolute	0830	Cambridge Bay	1200
6	June 17	Resolute	1135	Mould Bay	1520
7	June 17	Mould Bay	1715	Tuktoyaktuk	2105
9	June 18	Tuktoyaktuk	1500	Resolute	2045
10	June 19	Resolute	0935	Thule	1455
11	June 20	Thule	0935	Eureka	1505
12	June 20	Eureka	1710	Resolute	2210

MAP 2-1973 East June 13-20

Flight Effectiveness

Very good weather prevailed during the seven tracks carried out over the eastern part of the archipelago during Flight 2. The average width of ice surveyed for all tracks was better than 40 kilometres with a maximum of 120 kilometres. Some low cloud and a few fog patches did briefly interrupt observations during some of the tracks. The twenty-four hour daylight made it possible to cover the area in seven days. This along with the good visibility combined to make the Flight 90 per cent effective.

Ice Conditions

The normal type of advance in the ice conditions took place between Flights 1 and 2. Clearing had taken place in Lancaster Sound and Baffin Bay and the typical areas of open water had developed in Hell Gate, Queens Channel, Penny Strait, Belcher Channel, Kennedy Channel and at the northeastern tip of Kane Basin. The ice edges across Smith Sound, eastern Jones Sound and eastern Lancaster Sound were occupying their usual positions and showed their typical shape.

A heavy layer of snow covered the ice along the northern coast of Ellesmere Island and there were very few signs of melting along the remainder of the northern part of the archipelago as far west as Borden Island. Signs of considerable melting and subsequent puddling were evident throughout the remainder of the area. Although most of these puddles had refrozen for the interval of Flight 2, their existence signified an earlier period of wram weather which gave the season a head start of between two and three weeks. This advance in the seasonal development was also reflected by the growth of the small areas of open water in Belcher Channel as well as those in Barrow Strait which had appeared along the southern coast of Bathurst Island.

The solid ice cover on Prince Regent Inlet was late in breaking up but the conditions in this channel seem to develop independently and therefore, like Lancaster Sound, its ice conditions seldom reflect or can be used to predict the development in the remainder of the archipelago. Similarly, conditions in the archipelago seldom reflect the condition in either of these channels.

There were a few minor departures from the usual situation. The solid area of first-year ice off Smith Bay in the northwestern part of Baffin Bay seemed to expand during the interval between Flights 1 and 2. The solid cover of multi-year ice in the Arctic Ocean to the north of Alert was temporary and it would soon break up once again and continue its drift. The heaviest pressure ridging near the shear zone along northern fringe of Ellesmere Island ranged from five to six tenths between Phillips Inlet and Nansen Sound.

Unobserved Areas

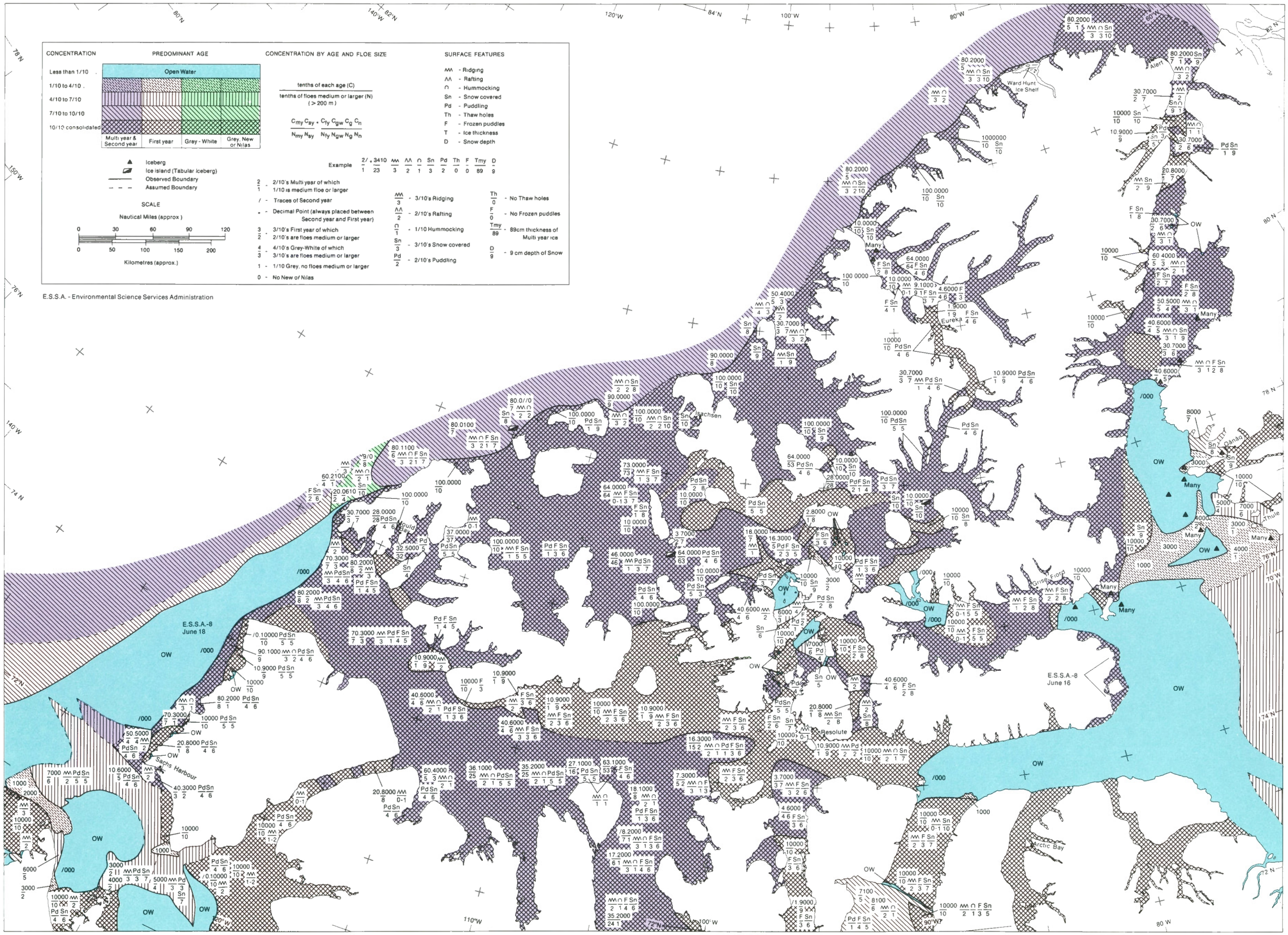
A few areas such as Lancaster Sound and the channels to the south of it as well as the central part of Baffin Bay remained unobserved. Ice conditions in these areas were deduced from satellite photographs. The regime shown to the north of Ellef Ringnes Island and Axel Heiberg Island is based on subsequent observations made during Flight 3. Probably small areas of open water existed in the narrowest parts of the channels around Bache Peninsula and in the central part of Hendriksen Strait.

Comments

The size of the ice island north of Brock Island was approximately four kilometres wide and six kilometres long. It had drifted nearly 20 kilometres during the interval between April 15 and June 13. Small pieces of ice islands were sighted between the southern tip of Meighen Island and the Fay Islands and one small fragment was seen along the northern coast of Ellesmere Island near Cape Aldrich.

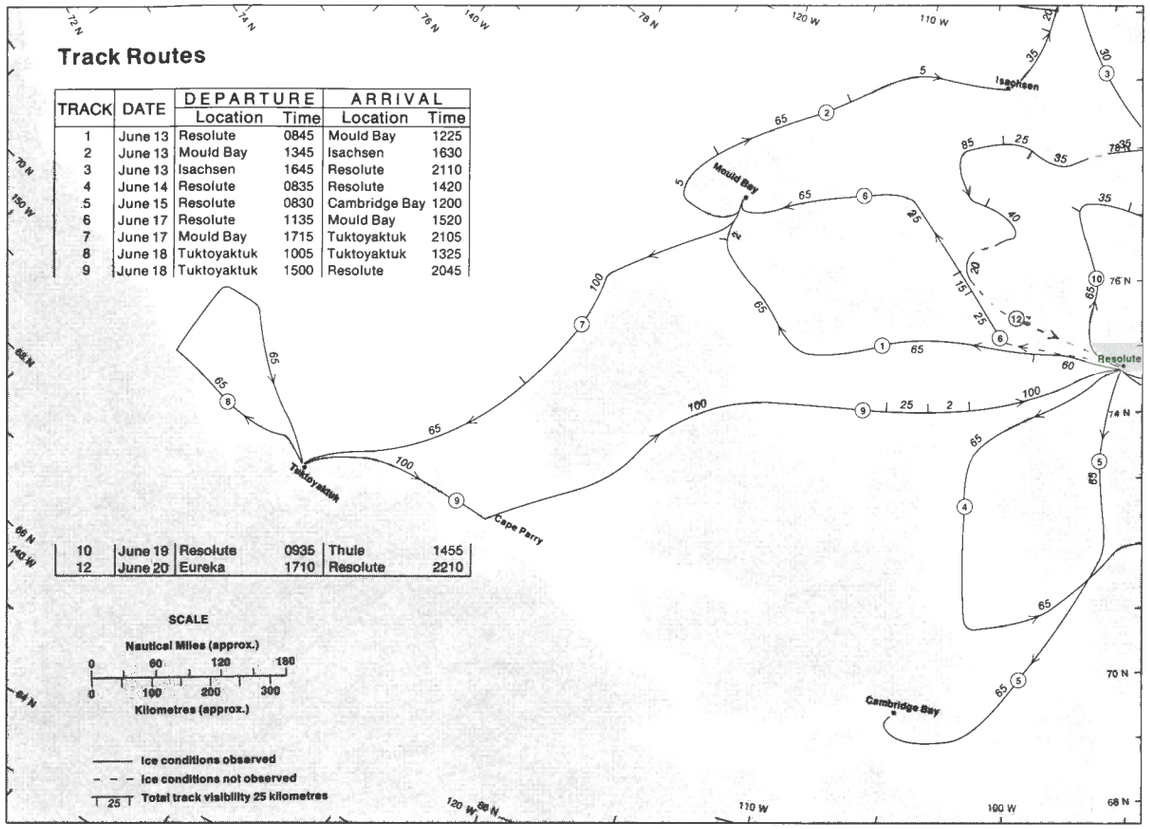
Many icebergs were spread out along the length of the northern half of Jones Sound.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 2 - 1973 EAST

June 13-20, 1973



MAP 2-1973 West June 13-20

Flight Effectiveness

With one minor exception fine weather and excellent visibility prevailed over the western part of the archipelago during all six tracks of Flight 2. Almost all of the area was surveyed and the Flight was considered to be better than 95 per cent effective.

Ice Conditions

The main changes between Flights 1 and 2 took place in the Beaufort Sea and Amundsen Gulf. In the other channels the ice remained solid but puddling had started. Probably southerly winds along with some in-situ melting were responsible for creating the large areas of open water to the west and south of Banks Island. The development of these large ice-free areas does not mean that the season is developing faster or slower than normal. The signs indicating the rate at which the season is progressing are related to the distribution and extent of puddling as well as the date that small areas of open water make their appearance in their usual locations. A fairly good indicator is the strait which separates Dolphin and Union Strait from Coronation Gulf. In 1972 this area had developed to the same degree shown on Map 2-1973 East by the second week in July. In 1971 a situation similar to 1972 was seen by the third week in June, while in 1969 and 1970 it was evident by the second week in June. On this basis it would be proper to anticipate that the season was a little ahead of usual and that the summer's ice conditions would be favourable for navigation. The occurrence of other small areas of open water in Prince of Wales Strait at the mouths of rivers and around the Princess Royal Islands can also be used to assess the rate at which the season is advancing. Although these areas had developed by June 18 they were not large enough to show on Map 2-1973 West.

The solid band of first-year ice across the northern entrances to Kugmallit Bay and Mackenzie Bay recurs in the same place each year. Probably this ice tongue is the result of the protection offered by grounded pressure ridges that build up during the winter months in the fast ice beside the shear zone.

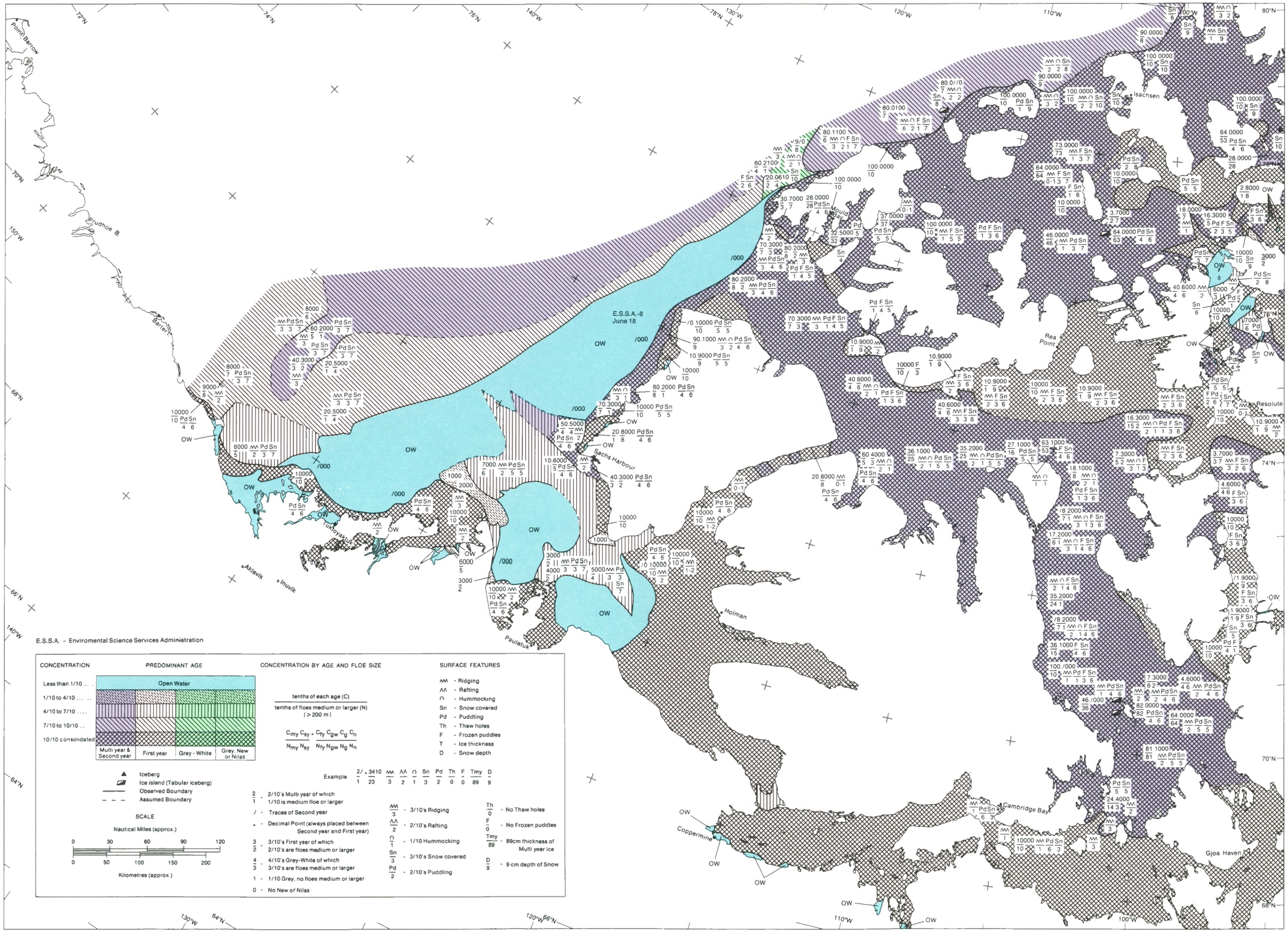
Occasionally the ice edge across the western entrance to M'Clure Strait remains in the position shown on Map 2-1972 West until mid-June. However, by this time in most years the boundary has retreated to the central part of the strait.

Unobserved Areas

The western extent of the open water in the Beaufort Sea was established from satellite photographs. The observer confirmed the large extent during track seven on June 17 by indicating that a distant ice edge was visible. The southbound leg of track eight on June 18 lends additional evidence to prove the extent of open water. The ice conditions from Amundsen Gulf to Cambridge Bay were also established from satellite photographs.

Comments

A multitude of ice island fragments and a few large pieces of ice island were sighted in M'Clintock Channel immediately west of Gateshead Island. These fragments were the remains of the large ice island referred to as T-1. The distribution of other pieces from this island are described in conjunction with Map 1-1973 East. One additional piece was sighted near Prince of Wales Island at the northwestern entrance to Franklin Strait.



E.S.S.A. - Enviromental Science Services Administration

CONCENTRATION

Less than 1/10	Open Water
1/10 to 4/10	
4/10 to 7/10	
7/10 to 10/10	
10/10 consolidated	

PREDOMINANT AGE

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

- Iceberg
- Ice island (Tabular iceberg)
- Observed Boundary
- Assumed Boundary

SCALE

Nautical Miles (approx.)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy} \bullet C_{fy}\ C_{gw}\ C_g\ C_n}{N_{my}\ N_{sy}\ N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example $\frac{2/\bullet 3410}{1\ 23}$ ΛΛ 3 ΛΛ 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9

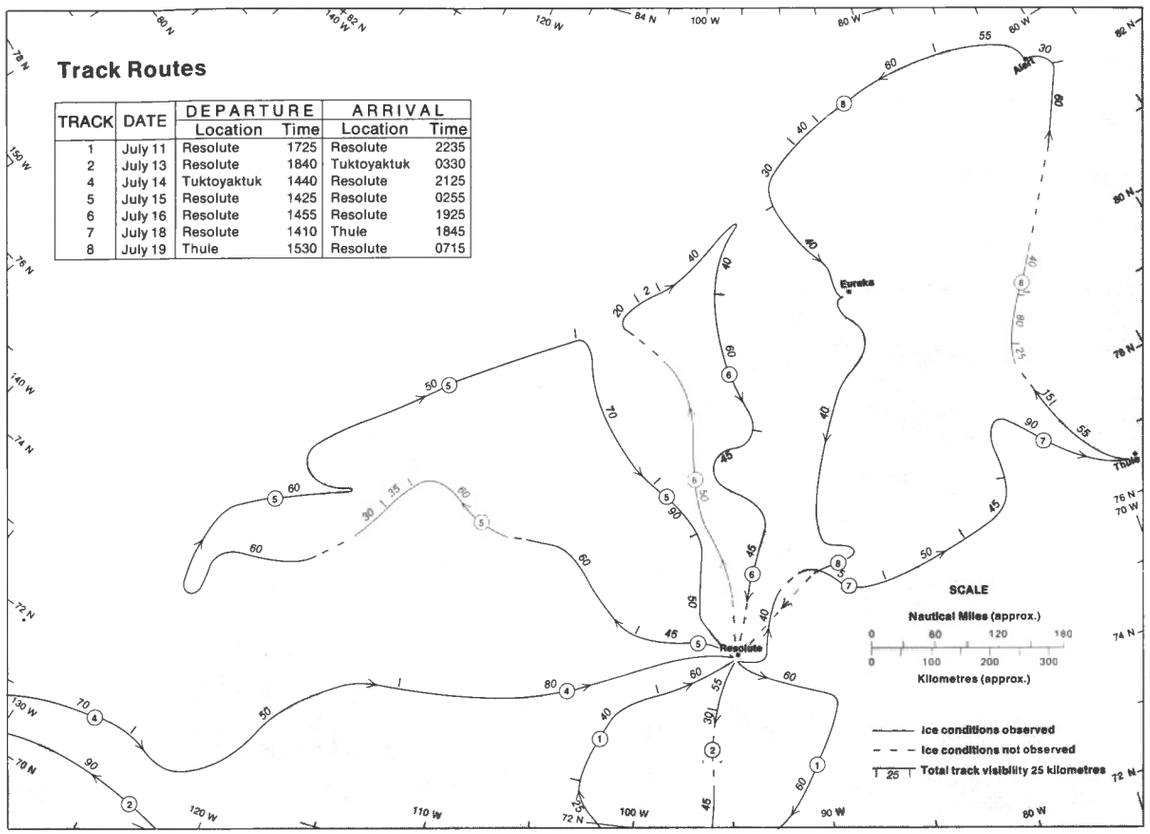
- $\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
- / - Traces of Second year
- • - Decimal Point (always placed between Second year and First year)
- $\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
- $\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
- 1 - 1/10 Grey, no floes medium or larger
- 0 - No New or Nilas

- $\frac{\text{ΛΛ}}{3}$ - 3/10's Ridging
- $\frac{\text{ΛΛ}}{2}$ - 2/10's Rafting
- $\frac{\cap}{1}$ - 1/10 Hummocking
- $\frac{Sn}{3}$ - 3/10's Snow covered
- $\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

- ΛΛ - Ridging
- ΛΛ - Rafting
- ∩ - Hummocking
- Sn - Snow covered
- Pd - Puddling
- Th - Thaw holes
- F - Frozen puddles
- T - Ice thickness
- D - Snow depth

- $\frac{Th}{0}$ - No Thaw holes
- $\frac{F}{0}$ - No Frozen puddles
- $\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
- $\frac{D}{9}$ - 9 cm depth of Snow



MAP 3-1973 East July 11-19

Flight Effectiveness

Low clouds and the occasional fog bank periodically restricted visibilities during each of the five tracks carried out over the eastern part of the archipelago during Flight 3. Flight 3 was 85 per cent effective.

Ice Conditions

Many changes had taken place during the three-week interval which separated Flights 2 and 3. Considerable quantities of ice had disappeared from Penny Strait and Baffin Bay. Break-up had advanced throughout Jones Sound, and Prince Regent Inlet. Almost all the ice in Wellington Channel was in motion and the ice in the eastern half of Barrow Strait had broken and drifted about 75 kilometres to the east. The ice cover east of Lougheed Island had broken.

Many small areas of broken ice and open water had developed earlier than usual. The date on which the broken area near the southwest tip of Bathurst Island appears is generally a fairly reliable indicator of the type of ice season to follow. In 1973 the first signs of break-up in this area probably occurred at the end of June; in 1972 the condition appeared during the second week of July; in 1971 it was evident during the last week in June and in 1970 and 1971 it appeared in the third week in July. If the broken area appears around mid-July the following season will probably be a typical year. The earlier it develops the more favourable the ensuing summer ice conditions are likely to be. Other areas of open water became visible before their usual time thereby strengthening the likelihood of the trend suggested by the ice conditions near the southwest tip of Bathurst Island. Some of these other areas include the narrow straits between the islands to the northwest of Bathurst Island, Belcher Channel, Hendriksen Strait, Eureka Sound and to some extent northern Kennedy Channel. Other methods of assessing the rate the season is advancing are possible. One way is to compare the rate development of puddling and thaw holes with similar developments in previous years. In 1973 both of these types of features had developed much earlier than they usually do.

In some areas the ice conditions which develop may be readily explained while in others there is no obvious answer. For example, the open water areas in Belcher Channel first appear in mid-channel where the water is shallow. Similarly, a reef in the central southern part of Austin Channel causes the conditions which allow the development of the two open areas shown on Map 3-1973 East. The large areas of flooded ice observed in the central parts of Prince Gustaf Adolf Sea, Peary Channel and Sverdrup Channel resulted from the snow melting faster than it could form a drainage system to reach the ocean below. The reason the solid tongue of ice develops in the northwest part of Baffin Bay remains unknown.

Unobserved Areas

Satellite photographs combined with observations in adjacent areas provided the basis for reducing the conditions in Baffin Bay, eastern Lancaster Sound as well as Admiralty Inlet and the channels surrounding Bylot Island. It is likely that a small, ice-free area had developed in the northern part of Kane Basin immediately to the east of the junction with Kennedy Channel. Small open areas likely existed around the islands in the southeastern part of Kennedy Channel.

Comments

The season was advancing much faster than usual. The pattern of break-up in the unnamed sea to the north of Penny Strait differed considerably from the norm. Usually the northeastern parts are the first to move while the ice cover in the southwestern area does not fracture until later.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)

CONCENTRATION BY AGE AND FLOE SIZE

tenths of each age (C) / tenths of floes medium or larger (N) (> 200 m)

$$\frac{C_{my}\,C_{sy} * C_{fy}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy} \quad N_{fy}\,N_{gw}\,N_g\,N_n}$$

Example $\frac{2/}{1} * \frac{3410}{23}$ MM/3 AA/2 ∩/1 Sn/3 Pd/2 Th/0 F/0 Tmy/89 D/9

2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
* - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

MM/3 - 3/10's Ridging
AA/2 - 2/10's Rafting
∩/1 - 1/10 Hummocking
Sn/3 - 3/10's Snow covered
Pd/2 - 2/10's Puddling

Th/0 - No Thaw holes
F/0 - No Frozen puddles
Tmy/89 - 89cm thickness of Multi year ice
D/9 - 9 cm depth of Snow

SURFACE FEATURES

MM - Ridging
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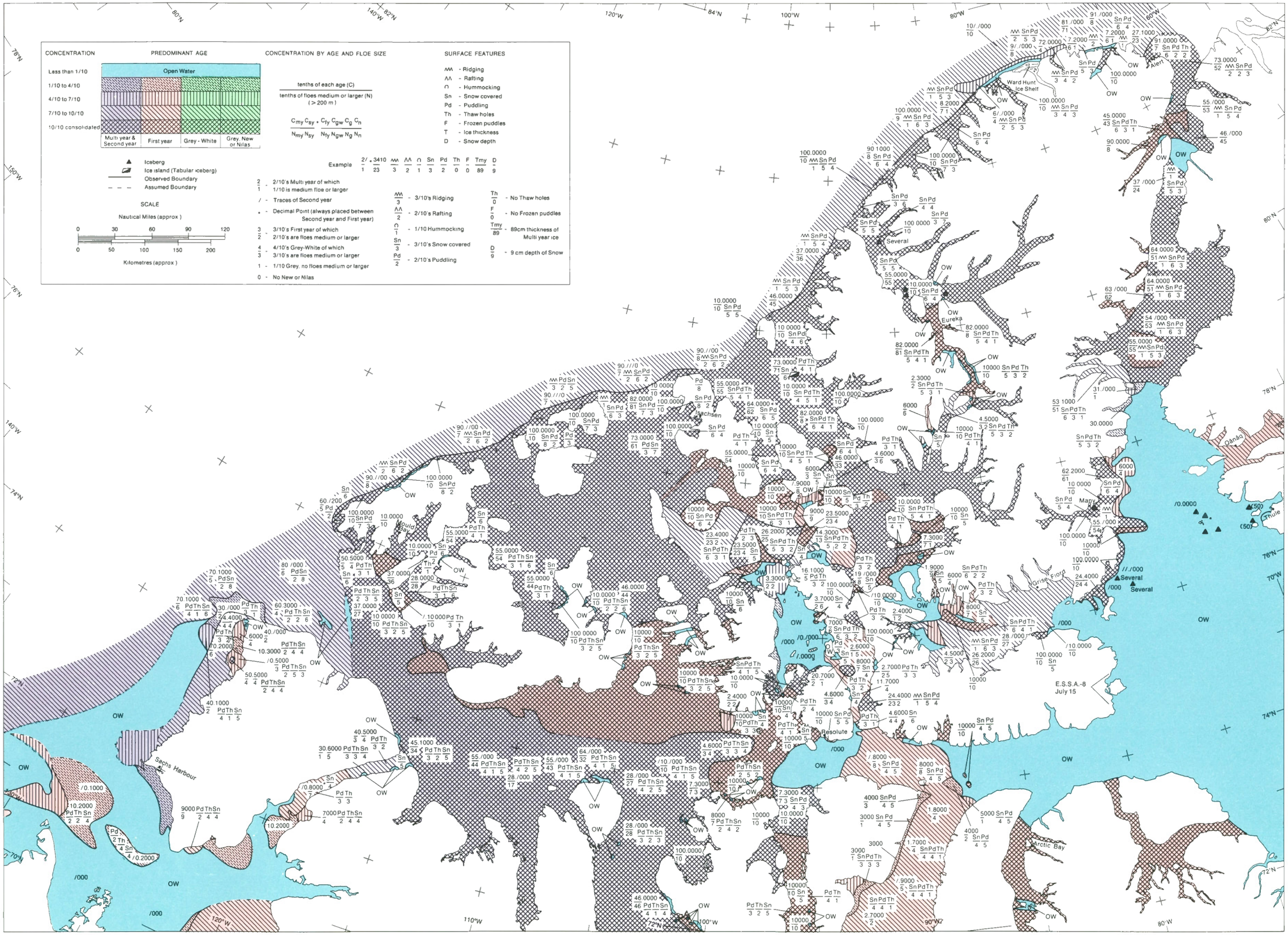
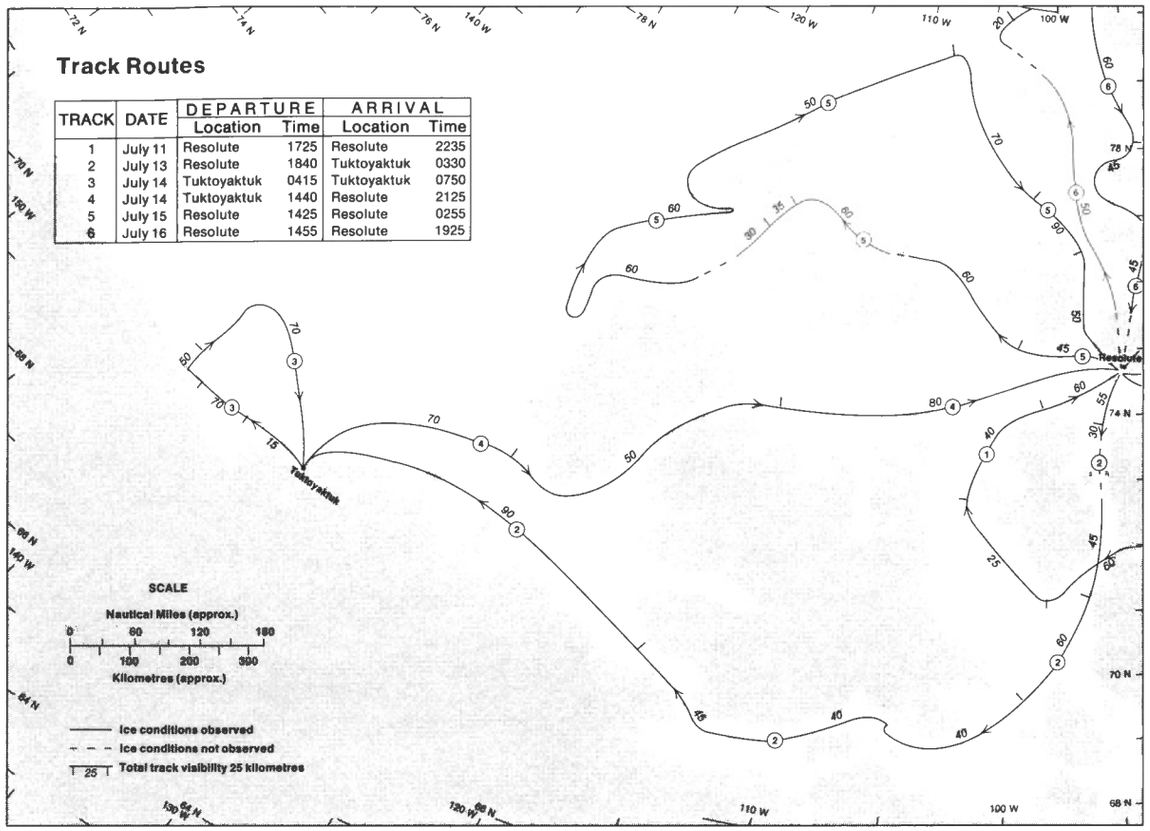
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth



MAP 3 - 1973 EAST

July 11-19, 1973



MAP 3-1973 West July 11-16

Flight Effectiveness

Visibility during the five tracks over the western part of the archipelago ranged from good through very good to excellent. Only a few brief interruptions to observations were caused by low clouds, rain and fog patches. Flight 3-1973 West was at least 80 per cent effective.

Ice Conditions

Many changes had taken place in the interval between the completion of Flight 2 and the end of 3. Break-up occurred in M'Clure Strait, Prince of Wales Strait, Amundsen Gulf and throughout the channels as far east as Cambridge Bay. Puddling, especially in the south part of the area, had reached its maximum and had rapidly declined as the percentage of the area of ice showing thaw holes increased. Most of the first-year ice in the Beaufort Sea had melted, but the total area of open water declined as the multi-year ice moved about 50 kilometres further south.

The degree of development of puddling, thaw holes, moving ice covers and areas of open water in and around M'Clintock Channel indicated that the season in this area was almost three weeks ahead of the normal type of year. In a usual season the ice cover on Victoria Strait does not begin to move until early in August. Similarly, the small area of open water noted in the southeastern part of Franklin Strait typically develops to the same extent in mid-August. A similar distribution of thaw holes may not develop at all in most years.

Further evidence for the rapid advance of the 1973 season was the appearance of shore leads and long, wide cracks which extended across the southern entrance to Franklin Strait and between the headlands guarding Ommanney Bay.

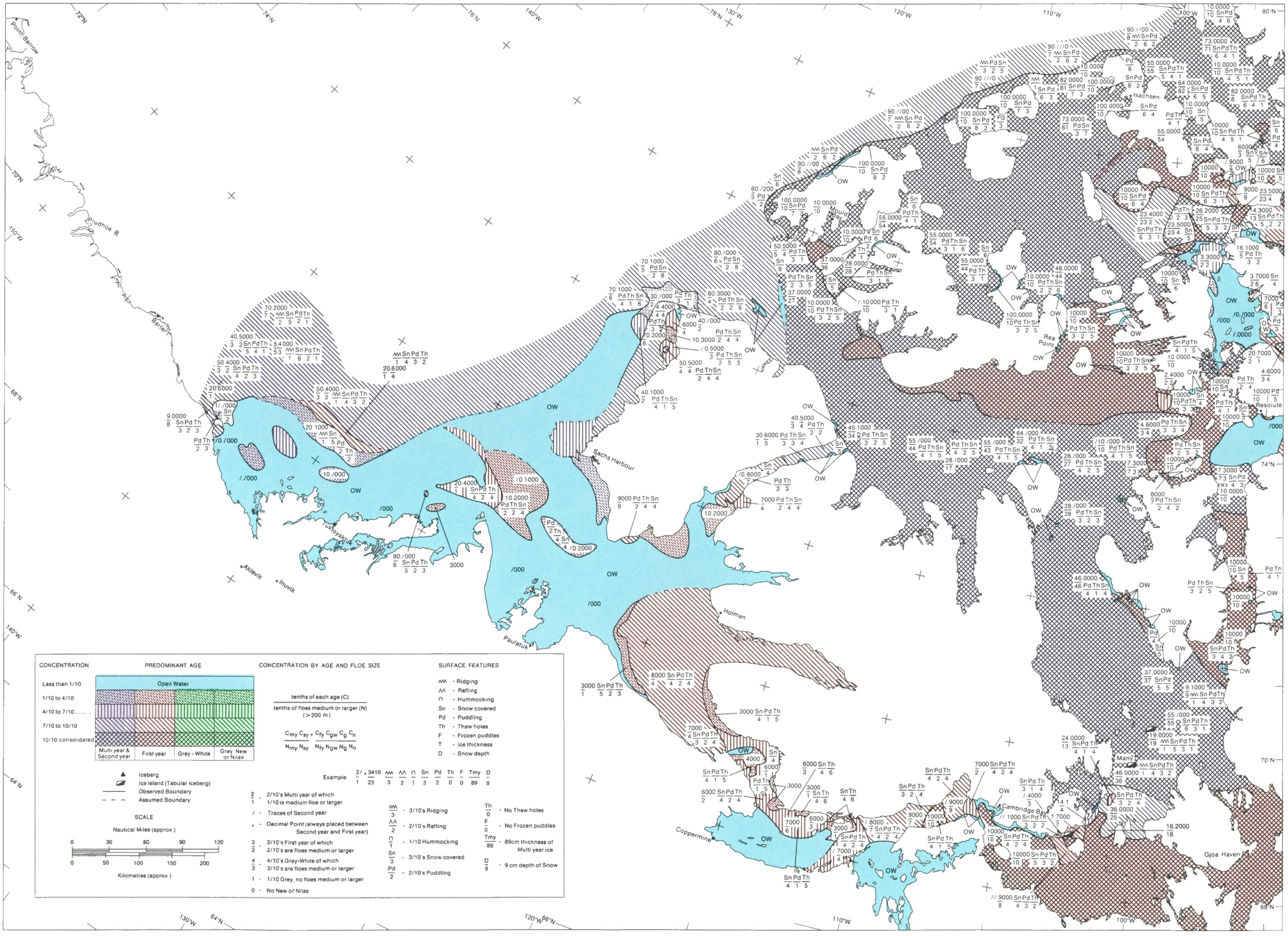
A very rapid deterioration of the ice cover of Peel Sound had taken place. The concentrations of thaw holes indicated that the ice in this sound would break up in the third week of July which precedes the typical date by at least four weeks. In some summer seasons such as the previous year, the ice cover on this sound remains solid and unmoving throughout the entire season.

Unobserved Areas

The assumed boundary between ice and open water in the central part of the Beaufort Sea was established from the previous survey and on the basis of the observer's reports which indicated the general trend of the ice edge. The situation in Rasmussen Basin was assumed on the basis of observations made in adjacent areas. Probably areas of open water had developed in the protected bays and the restricted channels which connect it with neighbouring bodies of water.

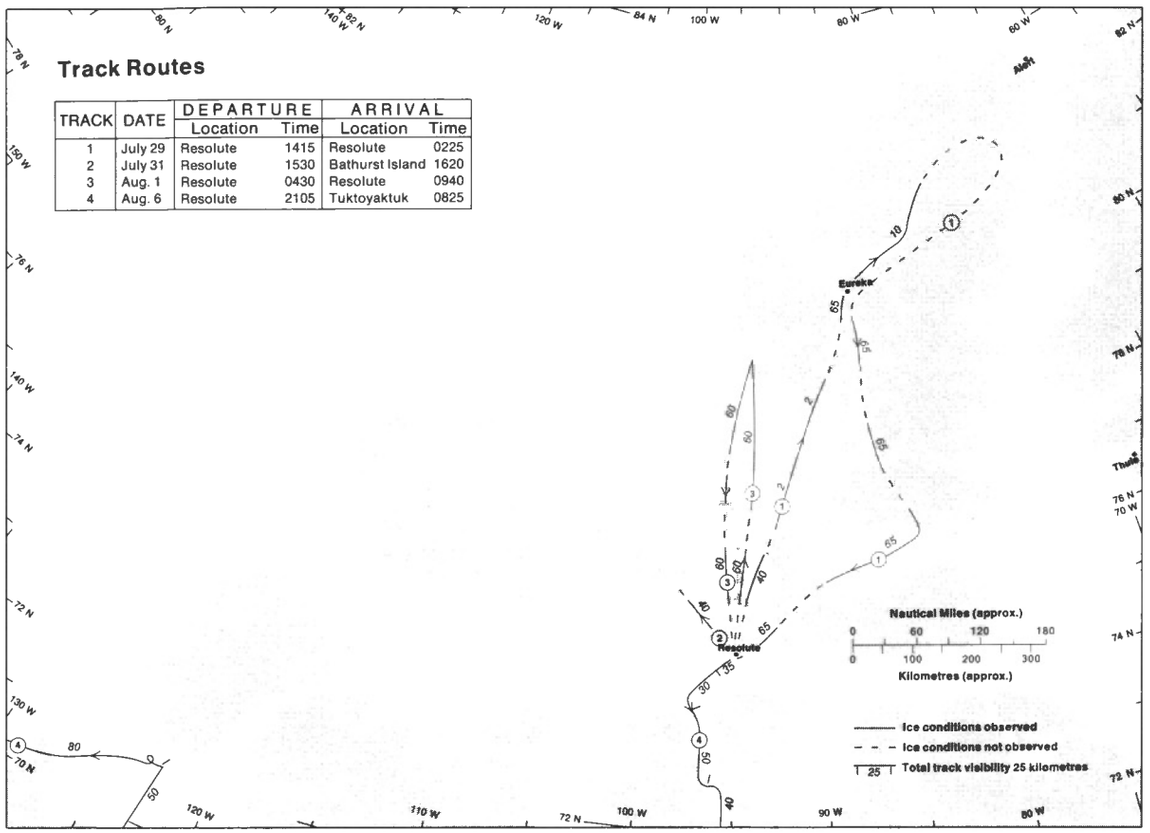
Comments

All indicators including the amount of puddling, thaw holes, progression of break-up and development of ice-free areas, showed that in all the areas the season was advancing up to four weeks ahead of normal. There are no reliable indicators to forecast what the ensuing season would be like in the Beaufort Sea, but by mid-July it was evident that very favourable ice conditions would develop in all remaining parts of the region.



MAP 3 - 1973 WEST

July 11-16, 1973



MAP 4-1973 East

July 29-August 6

Flight Effectiveness

The plans for Flight 4-1973 were completely disrupted and all of the scheduled series of tracks were cancelled due to other demands on the aircraft used for ice reconnaissance. While the aircraft was in the eastern part of the region the observer participated in as many of these logistic missions as possible. Limited amounts of information were also collected during other resupply flights conducted by the Polar Continental Shelf Project. Pilot reports, satellite photographs and data gathered during the routine ice reconnaissance surveys carried out by the Ministry of Transport added considerably to the scanty number of observations made during the three partial tracks that were completed. Considering the combined results of all sources of information, Flight 4-1973 East was judged to be between 35 and 45 per cent effective.

Ice Conditions

The main differences between the conditions shown on Maps 3 and 4 were the break-up in McDougall Sound, Norwegian Bay and the unnamed sea south of Ellef Ringnes Island. The ice throughout the length of Nares Strait had also started to move and the ice cover in the central part of Eureka Sound had broken and much of it had melted. The ice in the channels around Bylot Island had completely disappeared and only small areas of ice remained in Admiralty Inlet and Jones Sound. The rapid ablation in these areas would soon melt the remaining floes.

The patterns and distribution in the area between Lougheed Island and Belcher Channel were typical of conditions which usually develop in the first week in September during a better-than-average year. Similarly, in Norwegian Bay the break-up was approximately three weeks ahead of normal. In this area a slight reversal of the normal trend resulted when the ice cover in the northwestern part of Norwegian Bay broke up before the northeastern part.

Clearing in Eureka Sound was advancing a little more slowly than would normally be expected under the circumstances. Also, more ice remained in Wellington Channel than might have been anticipated with the early break-up in this area.

Unobserved Areas

Fortunately, enough information was available from the sources mentioned above and was used to establish the conditions in Baffin Bay and parts of its adjoining areas. The boundaries and ice conditions along the western fringe of the archipelago were assumed from information gathered during previous and subsequent flights.

Comments

Although the season was advancing between three and four weeks ahead of the typical rate, the usual patterns of break-up were followed. Despite the rapid development it was highly unusual that Middle Fiord, along the west coast of Axel Heiberg Island, became ice-free as early as it did.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

▲ Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\,C_{sy} \cdot C_{fy}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy} \quad N_{fy}\,N_{gw}\,N_g\,N_n}$$

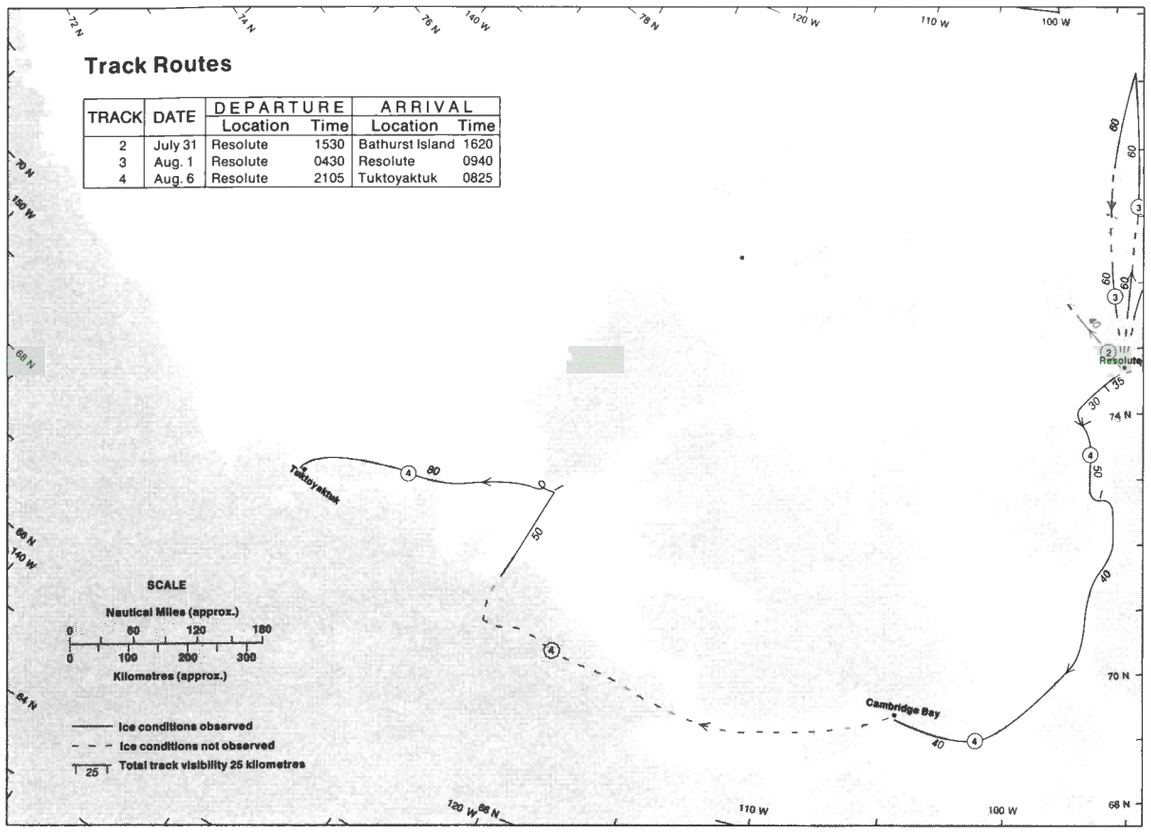
Example $\frac{2/\cdot 3410}{1\ 23}\ \frac{MM}{3}\ \frac{\Lambda\Lambda}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
· - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

SURFACE FEATURES

MM - Ridging
ΛΛ - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{MM}{3}$ - 3/10's Ridging
$\frac{\Lambda\Lambda}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling
$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow



MAP 4-1973 West

July 31-August 6

Flight Effectiveness

Concurrent demands on the aircraft permitted only one ice reconnaissance track to be completed in the western part of the archipelago. Although the routing and altitude during this survey were established by the requirements of another program, the ice observer collected a considerable amount of data. When this information was combined with other sources the map became much more meaningful and the flight effectiveness increased from 20 per cent to between 40 and 50 per cent.

Ice Conditions

Between the two flights considerable changes had taken place. The ice cover in all the channels had broken up and was in motion and all of the ice had cleared from the southern channels. The multi-year ice cover in the Beaufort Sea continued its southerly drift another 50 kilometres closer to the mainland.

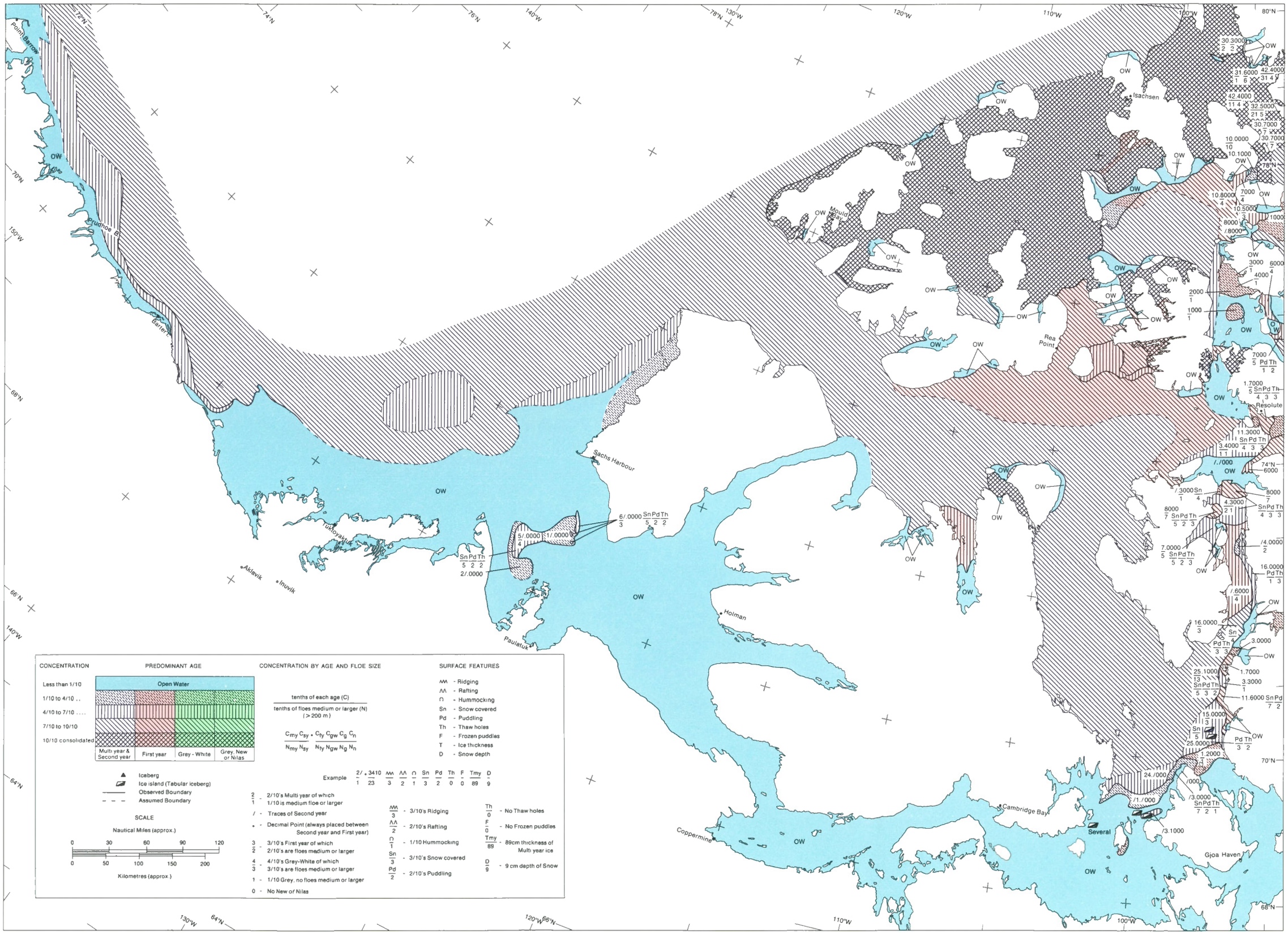
The rate at which the season was advancing throughout the area is not truly represented by the open water in the channels between Banks and Victoria Islands and the mainland. These areas became ice-free earlier than usual; they normally develop to this stage by mid-August. True indicators of the rate at which the season was progressing came from ice conditions noted in Peel Sound and M'Clintock Channel. In a normal year only portions of M'Clintock have broken up by the second week in September. Similarly, the ice cover in Peel Sound usually breaks up during the first week of September. The variations between favourable and unfavourable ice years in these areas are considerable. In some years the ice cover on both M'Clintock Channel and Peel Sound may remain solid and unbroken throughout the entire year.

Unobserved Areas

Information from Ministry of Transport ice reconnaissance surveys aided in determining the conditions shown north of Alaska. These surveys combined with satellite photographs were used to establish the conditions in M'Clure Strait and Viscount Melville Sound. The patterns, distributions and assumed boundaries shown in the Beaufort Sea were derived from satellite photos, the estimates made during track 4 and from the conditions observed in the area during Flights 3 and 5. The situation in M'Clintock Channel was deduced from the conditions observed in adjacent areas and from the results obtained from the next flight.

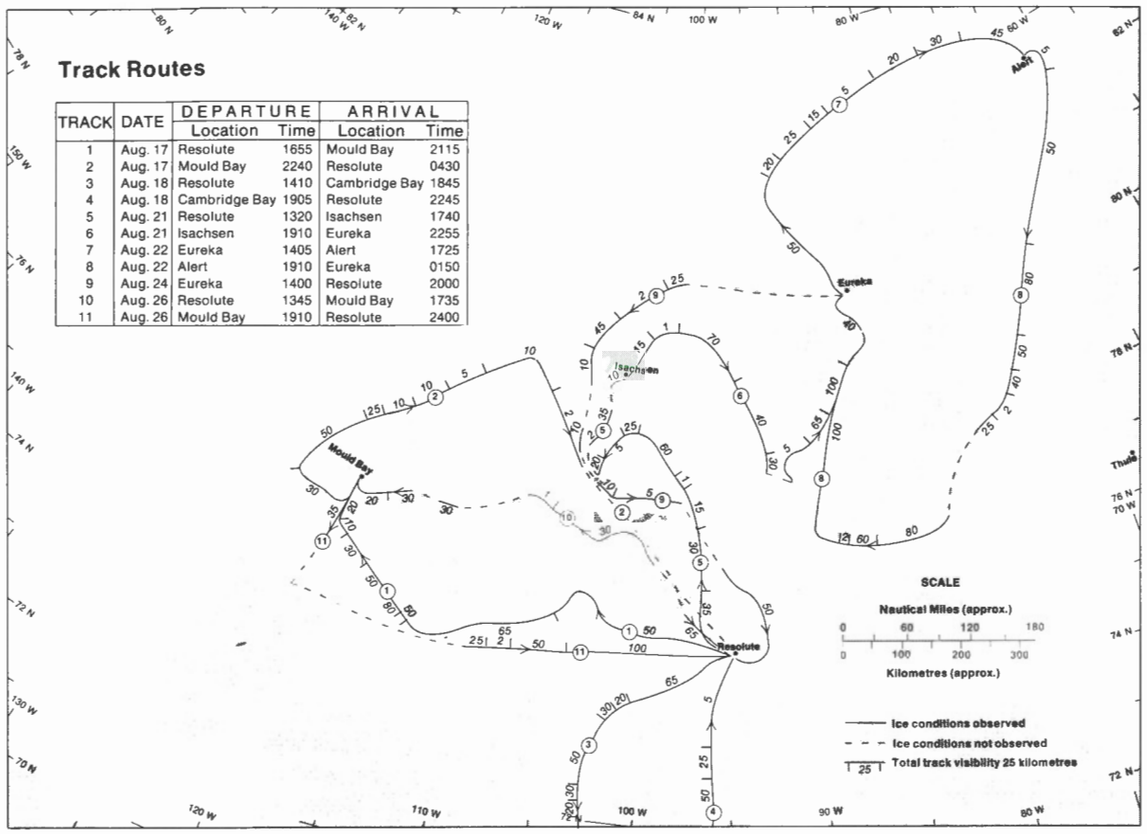
Comments

Even though the ice conditions ir other parts of the region were much mor favourable than those observed at simila times in other years the amount of open water in the Beaufort Sea was slightly less than normal for this time of year.



MAP 4 - 1973 WEST

July 31 - August 6. 1973



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 17	Resolute	1655	Mould Bay	2115
2	Aug. 17	Mould Bay	2240	Resolute	0430
3	Aug. 18	Resolute	1410	Cambridge Bay	1845
4	Aug. 18	Cambridge Bay	1905	Resolute	2245
5	Aug. 21	Resolute	1320	Isachsen	1740
6	Aug. 21	Isachsen	1910	Eureka	2255
7	Aug. 22	Eureka	1405	Alert	1725
8	Aug. 22	Alert	1910	Eureka	0150
9	Aug. 24	Eureka	1400	Resolute	2000
10	Aug. 26	Resolute	1345	Mould Bay	1735
11	Aug. 26	Mould Bay	1910	Resolute	2400

MAP 5-1973 East

August 17-26

Flight Effectiveness

Visibilities during some portion of each of the seven tracks conducted over the eastern part of the region were restricted or in some cases completely obscured by dense low cloud and fog. Occasionally, rain and/or snow showers reduced the observations even further. This flight was nearly 70 per cent effective.

Ice Conditions

The rapid clearing in Norwegian Bay, Belcher Channel and the eastern part of the unnamed sea along with the break-up in Hecla and Griper Bay, Hazen Strait and the major part of Prince Gustaf Adolf Sea were the main changes that took place between the two flights. Melting had also reduced concentrations and thicknesses in all remaining areas. Signs of the forthcoming winter season were found throughout the region either in the form of frozen puddles or as a fresh cover of snow.

The progression of break-up had followed its normal pattern and the ice edges across Nansen Sound, Massey Sound, and Hassel Sound were briefly arrested in typical locations. Usually the solid area in the southern part of Kristoffer Bay breaks before the northern part, and it is not normal to find a thin, solid band across the northern part of Prince Gustaf Adolf Sea. The multi-year ice in this latter area still appeared thick and massive compared with the thin, rotten types of ice which were melting in the southern areas.

Unobserved Areas

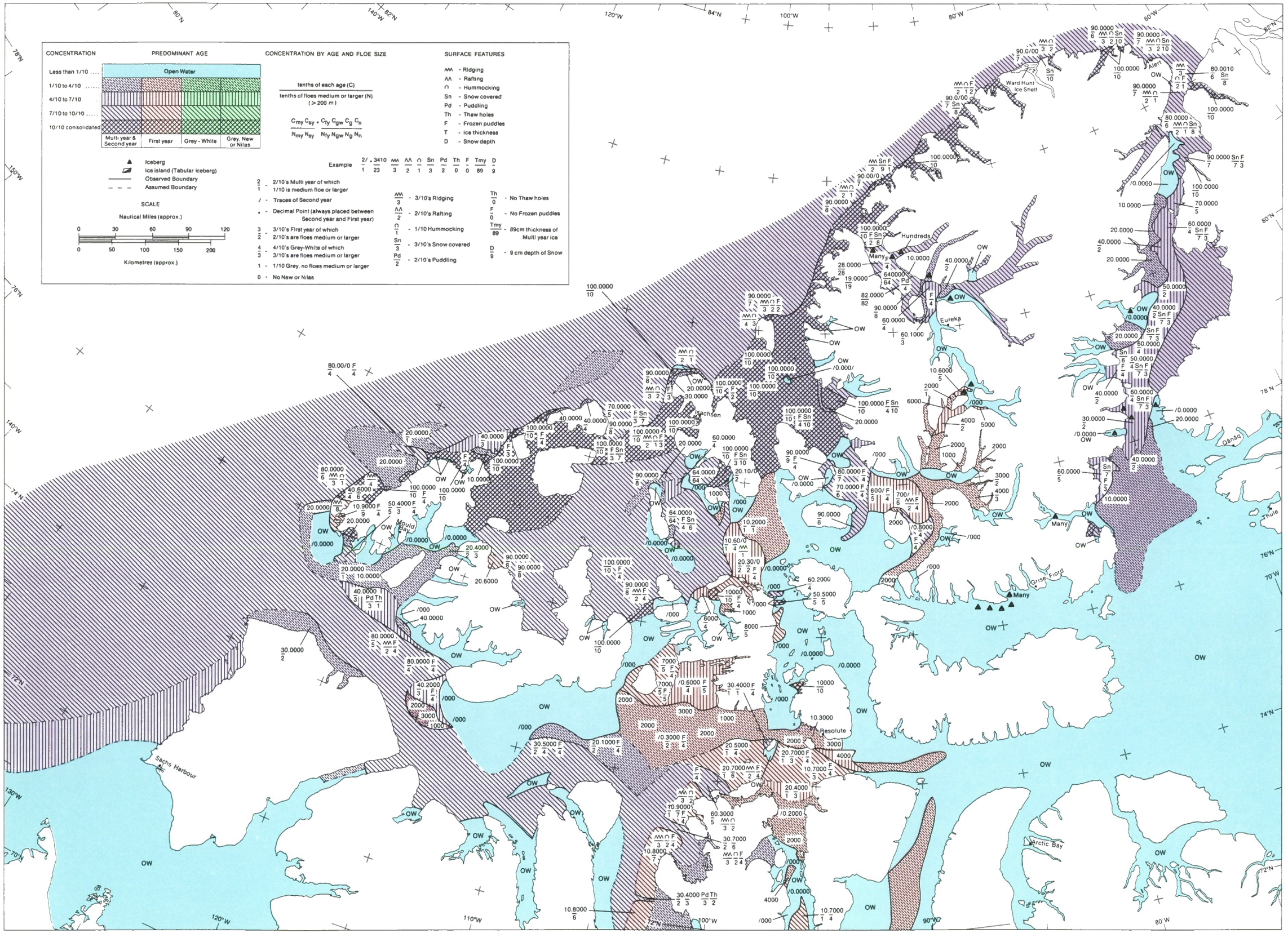
Satellite photographs combined with pilot reports and observations from ships were used to establish the conditions shown in Lancaster Sound, Prince Regent Inlet, Admiralty Inlet, the waters around Bylot Island as well as the central part of Baffin Bay. The results of a subsequent survey helped determine the boundaries along the northwestern part of Axel Heiberg Island. It was probable that a fairly large area of open water had developed in the channel separating Brock Island from Mackenzie King Island.

Comments

The solid plug across the northern part of Prince Gustaf Adolf Sea would not remain very long. Once break-up starts into this area the entire ice cover usually breaks up in a rapid succession of steps until it meets the moving ice cover in the Arctic Ocean. The timing of break-up in Ballantyne Strait follows a schedule similar to the one in Prince Gustaf Adolf Sea and soon all the ice in Ballantyne Strait would be set in motion. Break-up in the northern part of Nansen Sound had not started yet. Multi-year ice was drifting south through Nares Strait and entering Baffin Bay.

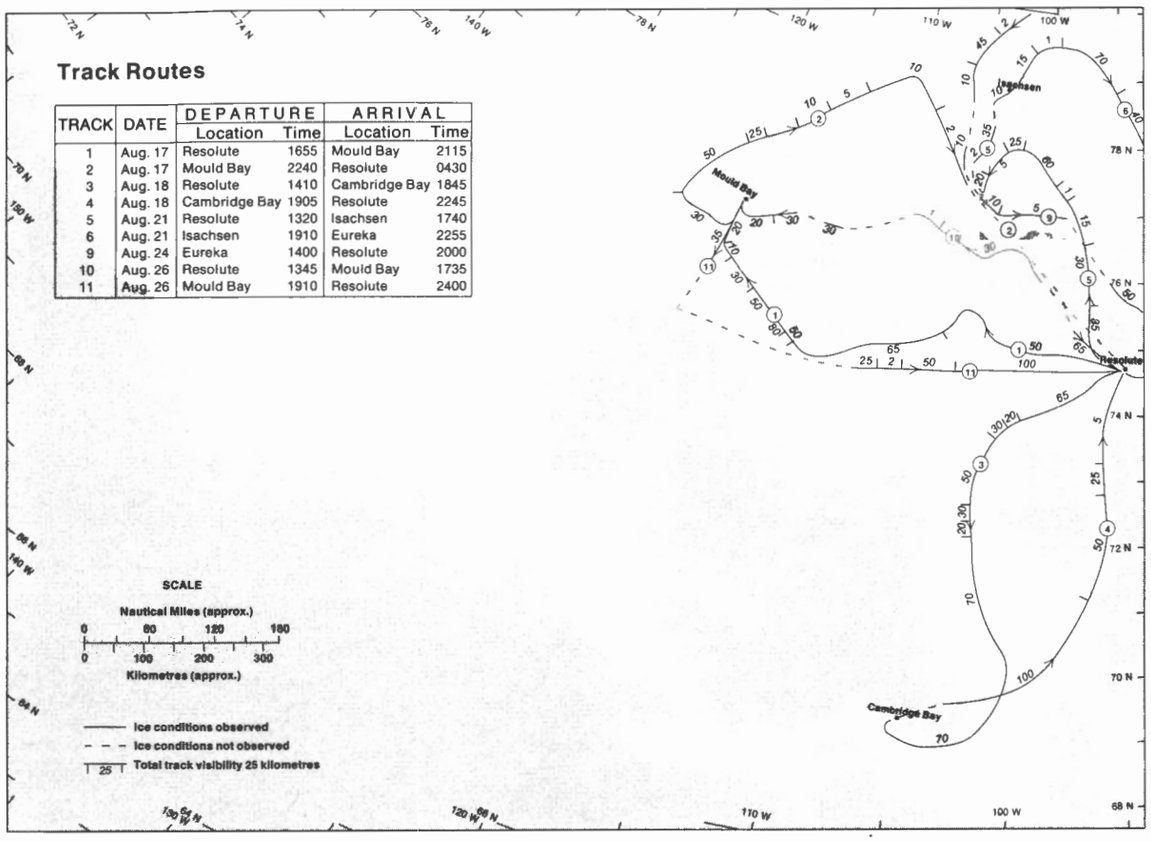
Movement of multi-year ice to the south through Byam Martin Channel would soon be possible because two large cracks running across the plug were observed by a pilot flying over the area on August 28.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 5 - 1973 EAST

August 17-26, 1973



TRACK	DATE	DEPARTURE		ARRIVAL	
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6	Aug. 21	Isachsen	1910	Eureka	2255
9	Aug. 24	Eureka	1400	Resolute	2000
10	Aug. 26	Resolute	1345	Mould Bay	1735
11	Aug. 26	Mould Bay	1910	Resolute	2400

MAP 5-1973 West

August 17-26

Flight Effectiveness

Attempts were made to complete four tracks over the ice in the western part of the archipelago. Generally low stratus clouds restricted the horizontal visibility during part of each track. Occasionally, fog and rain reduced the size of the area observed even further. In spite of these limitations the Flight was about 60 per cent effective.

Ice Conditions

Large areas of ice had melted and disappeared in the interval between Flights 4 and 5, especially in Viscount Melville Sound and M'Clintock Channel. Concentrations in other areas such as Peel Sound and Barrow Strait were considerably reduced. The first-year ice remaining in Barrow Strait and the eastern half of Viscount Melville Sound was very fragmented and these small floes exhibited an advanced state of decay and would soon disappear completely. A similar condition was noted for the ice remaining in Peel Sound and in M'Clintock Channel.

The distribution of frozen puddles throughout the northern part of this region indicated that the melting season would soon be complete. However, the puddles on the ice in the southern half remained unfrozen and ablation would still be the norm for about two weeks.

The amount of movement was increasing as the concentrations declined. The thicker ice which resisted ablation seemed to be concentrated in the southern part of west Barrow Strait. The amount of pressure ridging and the general compactness of the ice in this area indicated that a considerable amount of pressure was occasionally developed in this area. This situation is typical because the ice in that part of Barrow Strait in a band about 50 kilometres wide along the northern coast of Prince of Wales Island is noted for its rugged topography.

Unobserved Areas

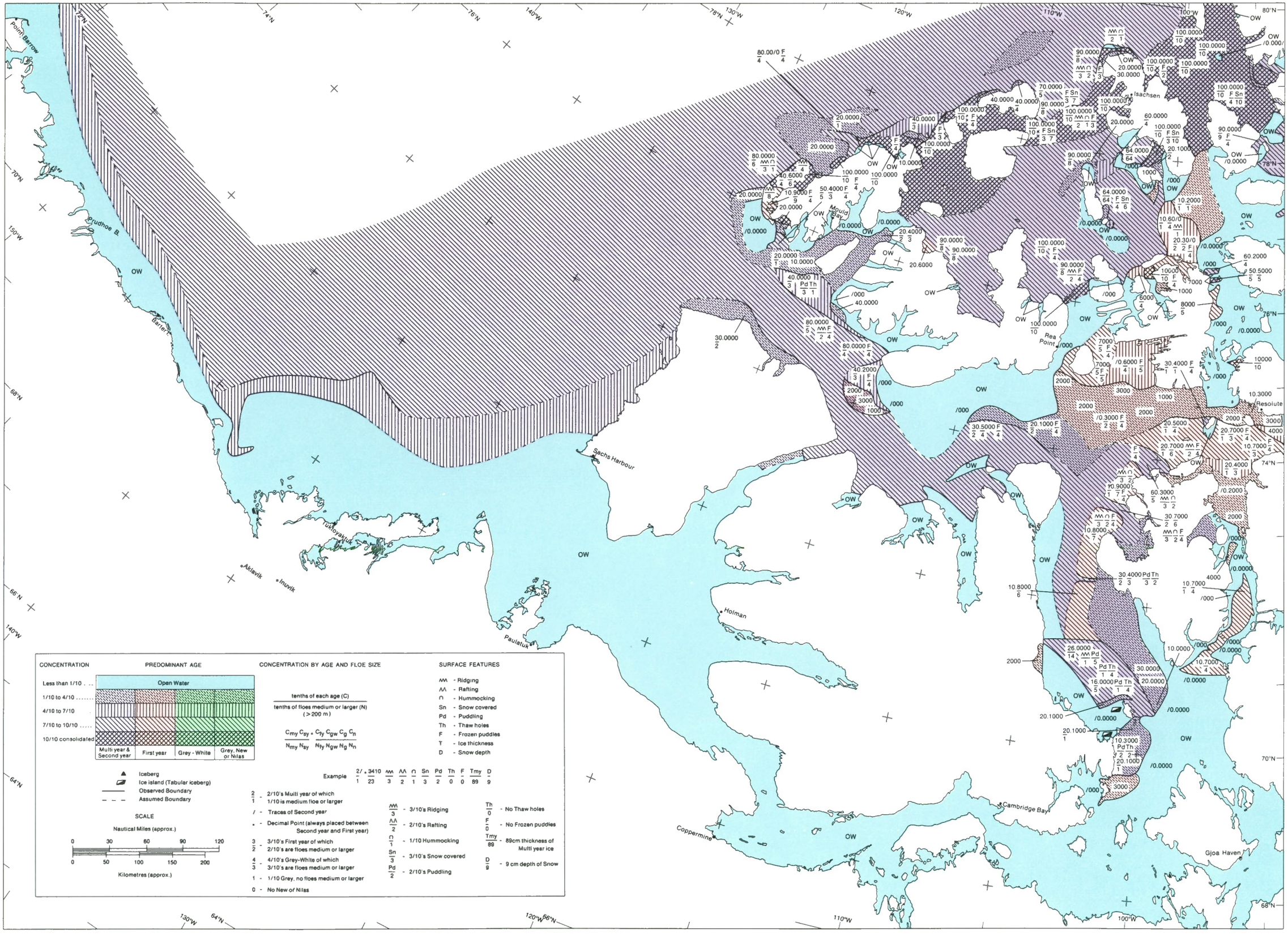
Ministry of Transport observations combined with satellite photographs and the results of subsequent surveys were used to deduce the ice conditions shown on Map 5-1973 West for the Beaufort Sea and the southern part of Viscount Melville Sound. Surveys over the southern channels separating the islands from the mainland were not required at this time of year because once the area becomes ice-free it will remain so until freezing temperatures return for the winter.

Comments

Thousands of fragments of ice islands in their final stages of decay and disintegration spread across the southern part of M'Clintock Channel between Gateshead Island and Victoria Island. The position of the two large pieces that remained is shown by the symbols on the map.

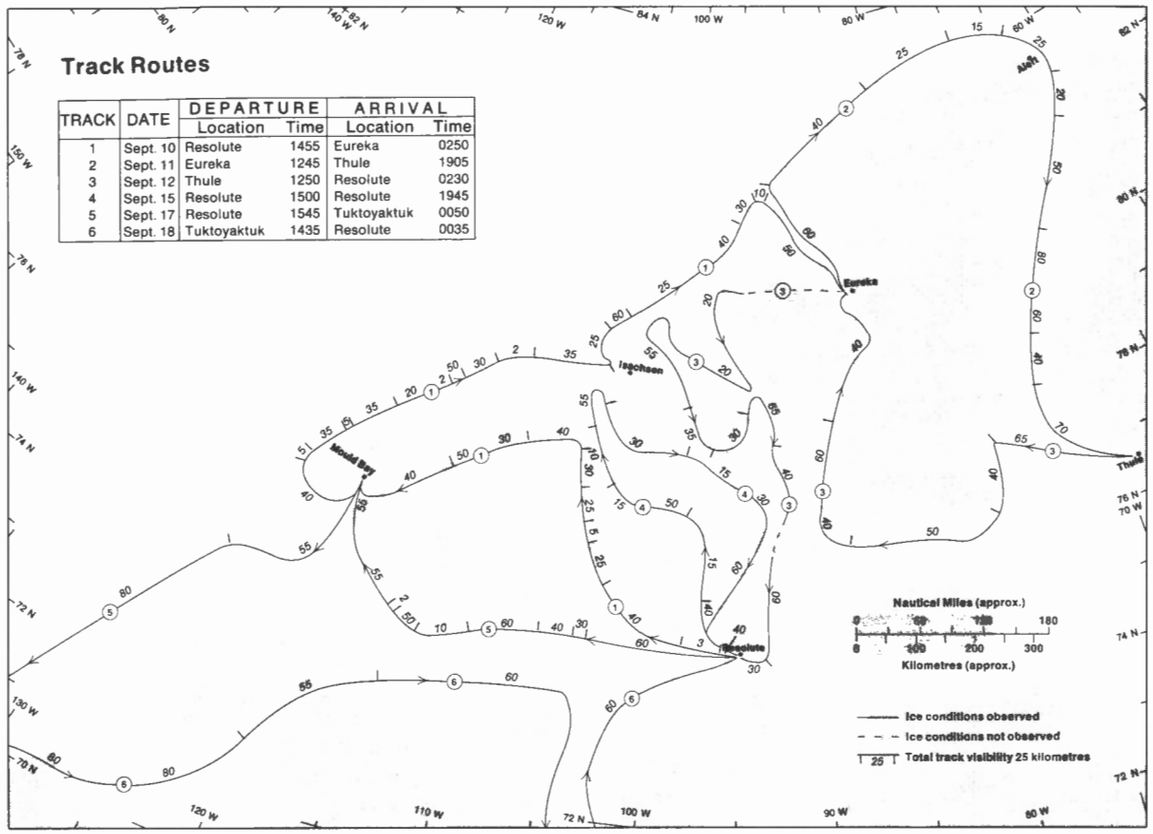
The amount of open water separating the ice from the land in the Beaufort Sea had not changed during the period between the two flights. This indicated that the rate of ablation was just keeping up with the southerly drift. The total area of open water was less than usual for the Beaufort Sea at this time of year. A southerly drift of multi-year ice was also taking place from M'Clintock Channel through Victoria Strait. This movement appeared to be limited to small amounts of ice which melted before they could enter Queen Maud Gulf.

In addition to its reputation for rough ice, the area in the southern part of Barrow Strait near Prince of Wales Island seldom becomes totally ice-free for more than a few days before more ice moves in. The concentrations shown on Map 5 are typical for this area for this time in any year.



MAP 5 - 1973 WEST

August 17-26, 1973



MAP 6-1973 East

September 10-18

Flight Effectiveness

Four extremely effective tracks were completed over the eastern part of the archipelago during Flight 6. The weather was very favourable and, although low cloud ceilings limited the observing altitude, the horizontal visibility was generally very good for this time of year. Flight effectiveness was better than 90 per cent.

Ice Conditions

During the interval between Flights 5 and 6 melting continued to reduce the concentrations of older ice. The ice barriers across the northern entrances of Ballantyne Strait and Prince Gustaf Adolf Sea broke up but no appreciable amounts of multi-year ice had moved into them from the Arctic Ocean. The barriers across Peary Channel, Sverdrup Channel and Nansen Sound remained in place. Small concentrations of the thin forms of new ice had started to form throughout the region and some fresh snow had appeared in the northern areas.

The expected massive southerly movement of multi-year ice through Byam Martin Channel, Penny Strait and Nares Strait which normally follows break-up in the neighbouring channels to the north had not materialized. Instead, it appeared as if the winds were gradually forcing the ice in these areas toward the north.

The amount of break-up, the degree of melting and the area of open water and new ice had reached levels far in excess of those usually expected. Although a thin layer of ice was developing on the ocean surface, the thicker and older ice floes continued to melt.

Unobserved Areas

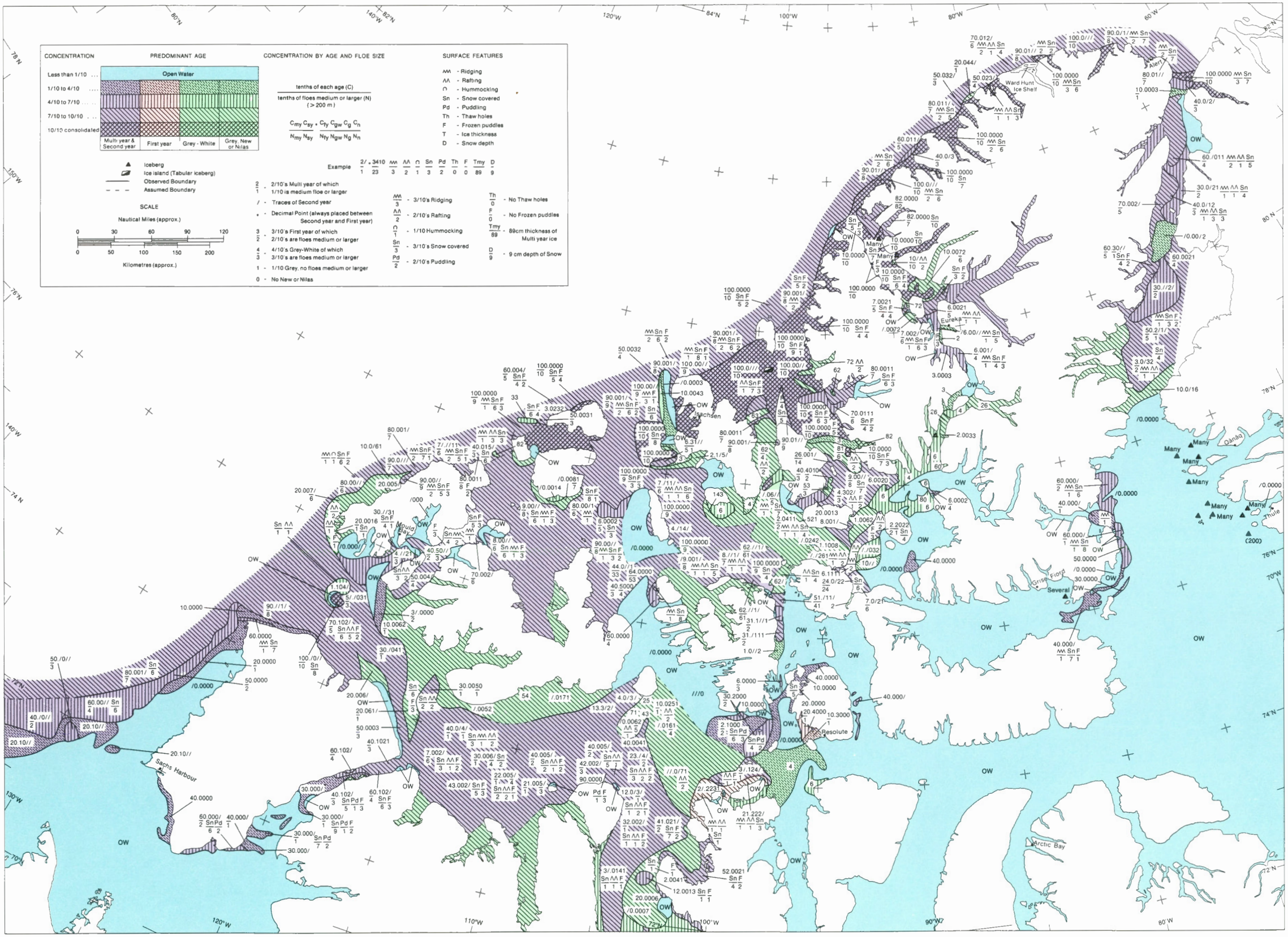
No observations were required to determine the conditions in central Baffin Bay, Lancaster Sound, Prince Regent Inlet, Admiralty Inlet or the waters surrounding Bylot Island. The lack of ice in these areas during the previous Flight, and the fact that no ice had moved into them along with above-freezing temperatures, meant that they were entirely free of sea ice. An iceberg count, particularly in Lancaster Sound, would be made during a later survey. Ice conditions in Peabody Bay probably resembled those in Kane Basin. Many icebergs likely were spread throughout the length of Peabody Bay.

Comments

The new forms of ice were very recent additions. Likely the greatest area of totally ice-free water existed around September 5 which was about the time the new ice types began to appear.

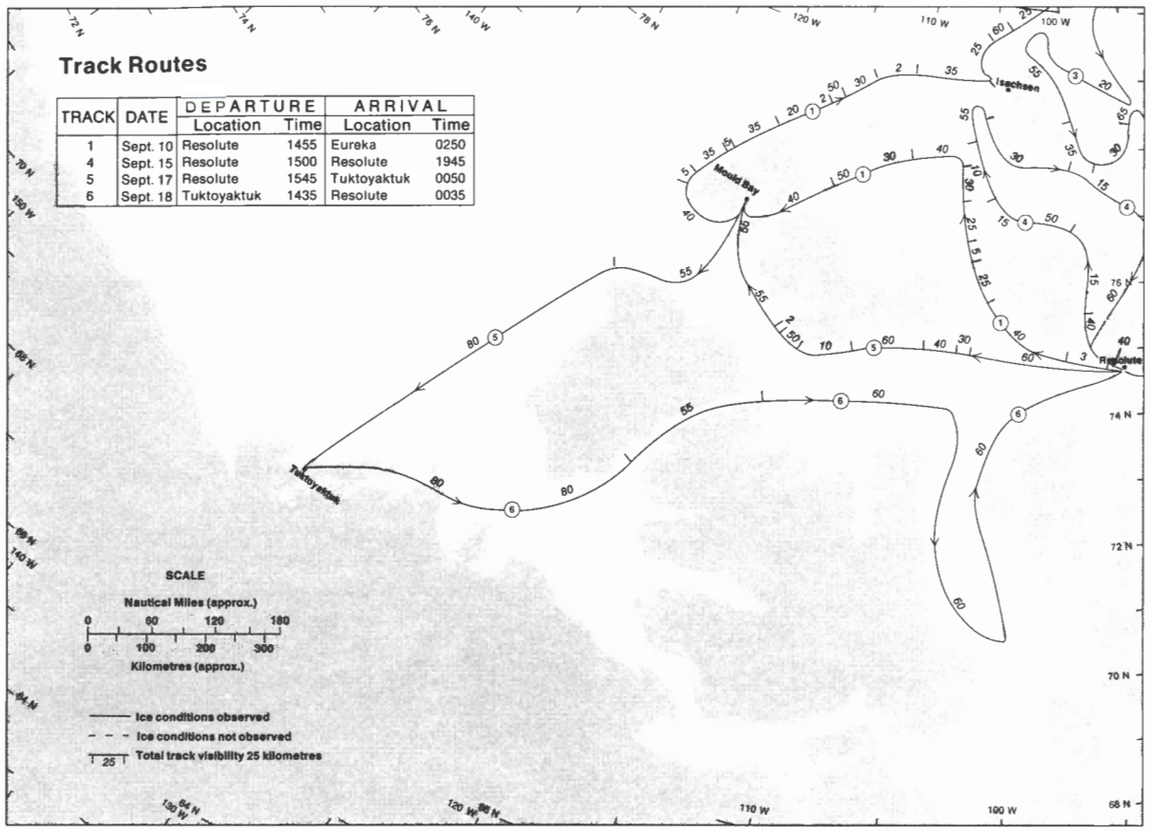
The ice barriers in Sverdrup Channel, Peary Channel, and Nansen Sound had cracks running through them but there were no signs of movement.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 6 - 1973 EAST

September 10-18, 1973



MAP 6-1973 West

September 10-18

Flight Effectiveness

Two long tracks were completed over the western part of the region. Almost all of the observations in each of these tracks were made from an altitude of 5,000 feet and the horizontal visibility was very good. The Flight was almost 100 per cent effective.

Ice Conditions

A number of changes from the conditions observed during the previous flight were noted. All first-year ice in M'Clintock Channel and the western part of Viscount Melville Sound had melted and the new forms of ice were beginning to develop over most areas. By comparing Map 5 with Map 6 it would appear from the purple colour indicating the predominance of multi-year ice that much more of this type of ice had moved into the central part of Viscount Melville Sound during the interval between the two Flights. Although some ice probably did move east through M'Clure Strait it is likely that part of the apparent expansion of the multi-year ice pattern was a result of a gradual spreading of this ice into a broader area. Thus areas previously six tenths covered during Flight 5 were now only four tenths ice while other areas which were ice-free now had a two to three tenths cover.

While the multi-year ice was spreading out over Viscount Melville Sound the opposite was happening in M'Clintock Channel where the total area covered was reduced as winds concentrated the ice in the western part of the channel along the coast of Victoria Island. The concentrations in the western half of M'Clure Strait remained about the same while the amount of multi-year ice in the eastern part was slightly reduced by a combination of melting and movement into Prince of Wales Strait and Viscount Melville Sound. The movement into the former area had already started in mid-August, but this southerly drift was well underway in mid-September. It is possible that some of the thickest multi-year floes in the northern part of Amundsen Gulf had survived the drift through Prince of Wales Strait. Most of the multi-year ice along the southern coast of Banks Island represented the last remains of ice which had moved into the area from the Beaufort Sea and had been concentrated in the northern part of Amundsen Gulf by southerly winds. These winds were also responsible for stopping the southerly advance of the ice in the Beaufort Sea. Between the two flights the change in the distance between the ice and the mainland was minimal except along the coast of Banks Island where an ice-free area 50 kilometres wide developed.

Unobserved Areas

Pilot reports indicated that Peel Sound was totally ice-free. These observations along with those made in the southern part of M'Clintock Channel both indicated that the open water continued throughout the southeastern part of the channel and through Victoria Strait. If these areas were ice-free the same state would prevail in the channels surrounding King William Island. As previously pointed out, there would be no ice in the channels joining Amundsen Gulf with Queen Maud Gulf until much later in the season.

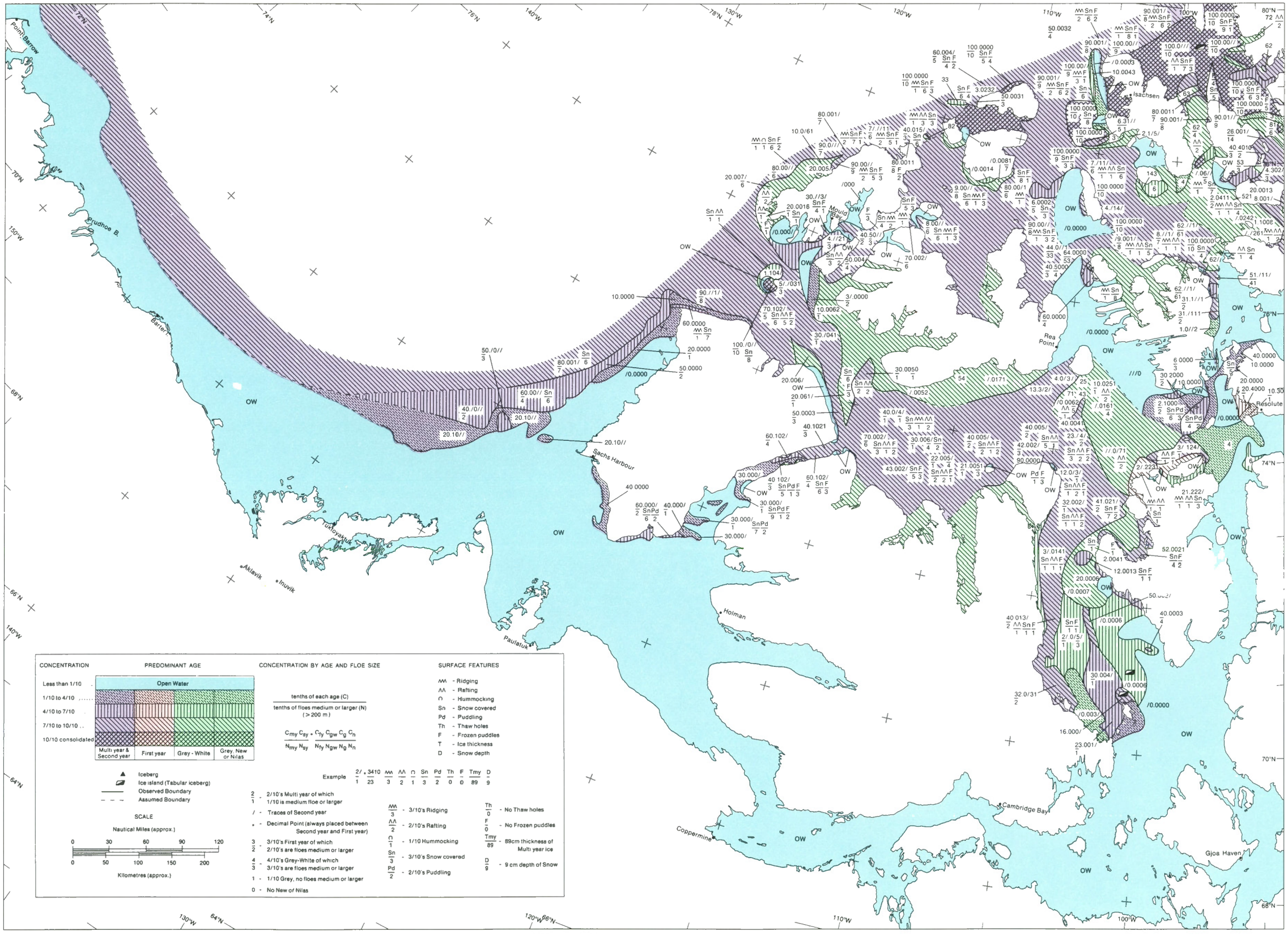
The assumed conditions shown along the Alaskan coast are based on reports from Ministry of Transport surveys and satellite photographs.

Comments

It seemed that the multi-year ice in the Beaufort Sea was starting to gradually retreat from its menacing position so close to the coast that it had maintained throughout July and August.

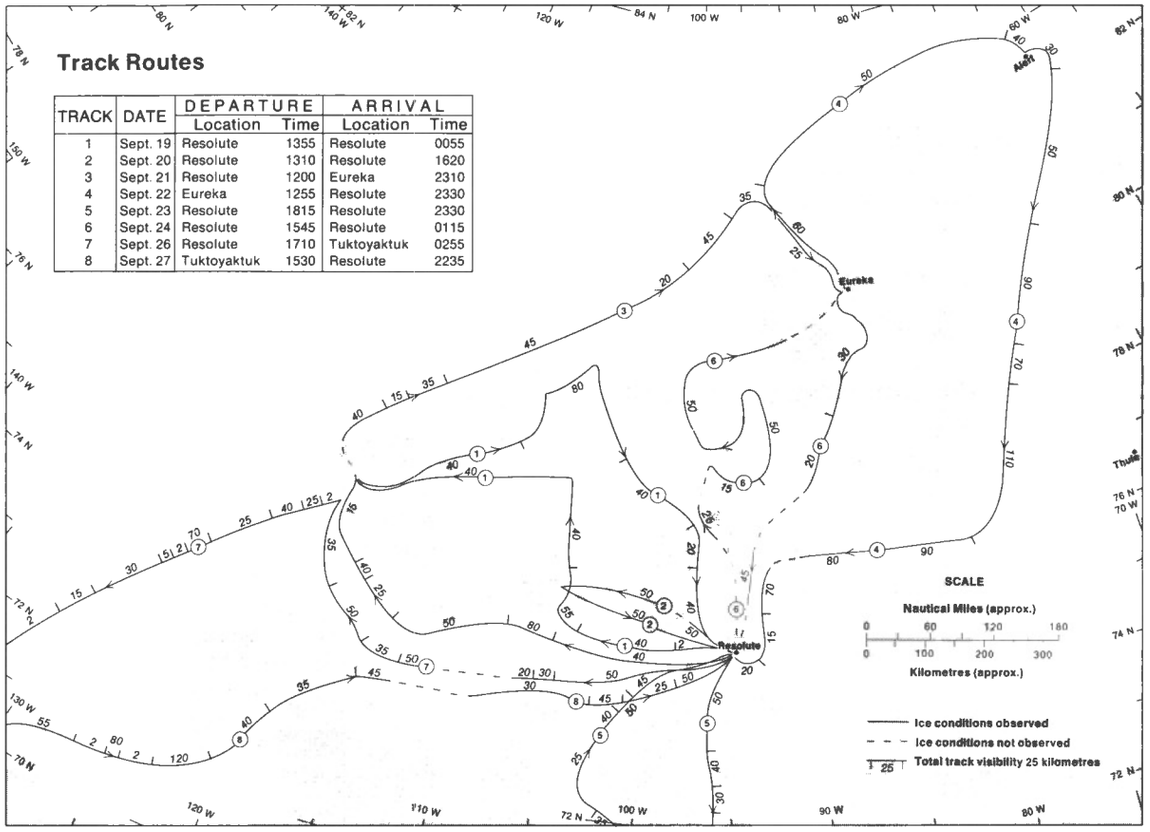
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 6 - 1973 WEST

September 10-18, 1973



MAP 7-1973 East

September 19-27

Flight Effectiveness

Four long tracks and one relatively short one were completed over the eastern part of the archipelago during Flight 7. Results ranged from fairly good to excellent as the observing altitudes varied from 100 feet to 5,000 feet. The Flight effectiveness exceeded 85 per cent.

Ice Conditions

Two main changes had taken place between Flights 6 and 7. One was the expansion of the younger ice types across all the previously ice-free areas in the northern channels. The other was associated with the southerly drift of multi-year ice. A great volume of ice moved south through Nares Strait and spread out along the northwestern part of Baffin Bay. The rate of drift of this ice may be approximated by making the following generalization. Assume that a distinct piece of ice was observed at the entrance to Smith Sound during track 2 on September 11. This piece would probably have reached the area near the northeastern tip of Devon Island by September 24. During the 14-day interval this ice floe would have moved about 350 kilometres or an average of about 25 kilometres per day. This rate corresponds with the drift of an ice island fragment which moved through the same area in September, 1963 at nearly 20 kilometres per day. The amount of ice which moved south through Byam Martin Channel was not as great as the drift into Baffin Bay. Using a similar set of assumptions it is possible that the ice which moved through Byam Martin Channel and into Viscount Melville Sound between September 10 and 19 was drifting at an average rate of about 20 kilometres per day. An ice island and its associated fragments moved through the same area in September, 1962 at an average rate of drift of about 18 kilometres per day. The quantities of ice which moved south through Penny Strait were small compared with those in Byam Martin Channel and Smith Sound. Probably some movement was taking place through Maclean Strait. A large mass of multi-year ice was observed in the eastern part of Prince Gustaf Adolf Sea on September 15. If it is assumed that the large solid area located near King Christian Island on September 19 was once a part of the original piece, it can be concluded that average rate of ice drift through this channel during the interval was about 20 kilometres per day.

The ice plugs across Peary Channel, Sverdrup Channel and Nansen Sound remained in position and new ice was beginning to heal the cracks which once crossed through them. The formation of new ice had started to reduce the degree of movement in other areas such as Prince Gustaf Adolf Sea and the northern part of Smith Bay.

Unobserved Areas

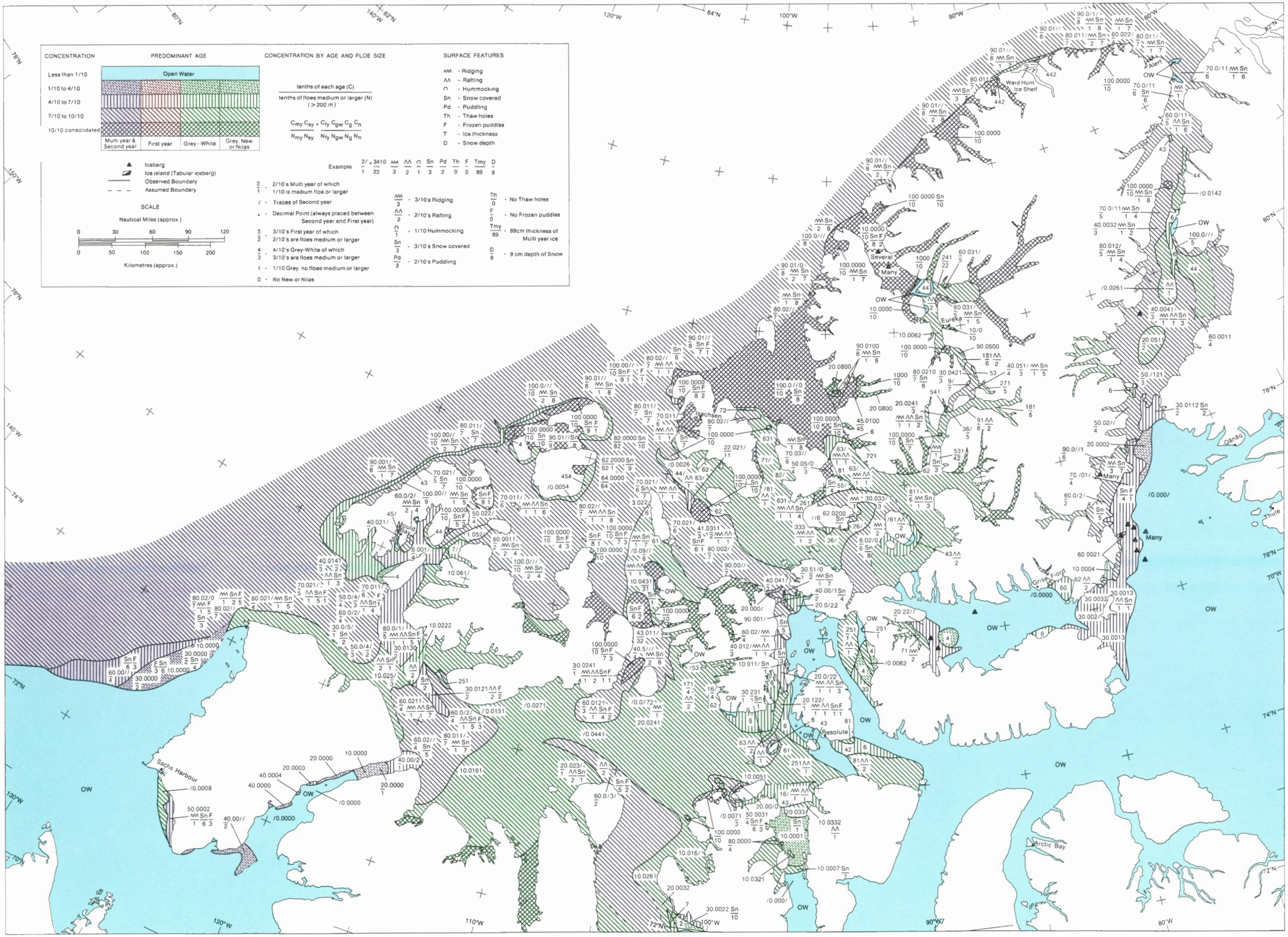
Traces of freezing were probably evident in the protected bays around Bylot Island and Admiralty Inlet, but the main parts of these channels along with Prince Regent Inlet, Lancaster Sound and the central part of Baffin Bay would remain ice-free. Probably large numbers of icebergs were present in the eastern part of Peabody Bay.

Comments

Strong winds from a northeasterly quadrant were mainly responsible for the movements in Nares Strait, Byam Martin Channel, Maclean Strait and Penny Strait. Conditions in 1973 were ideal for these rapid drifts.

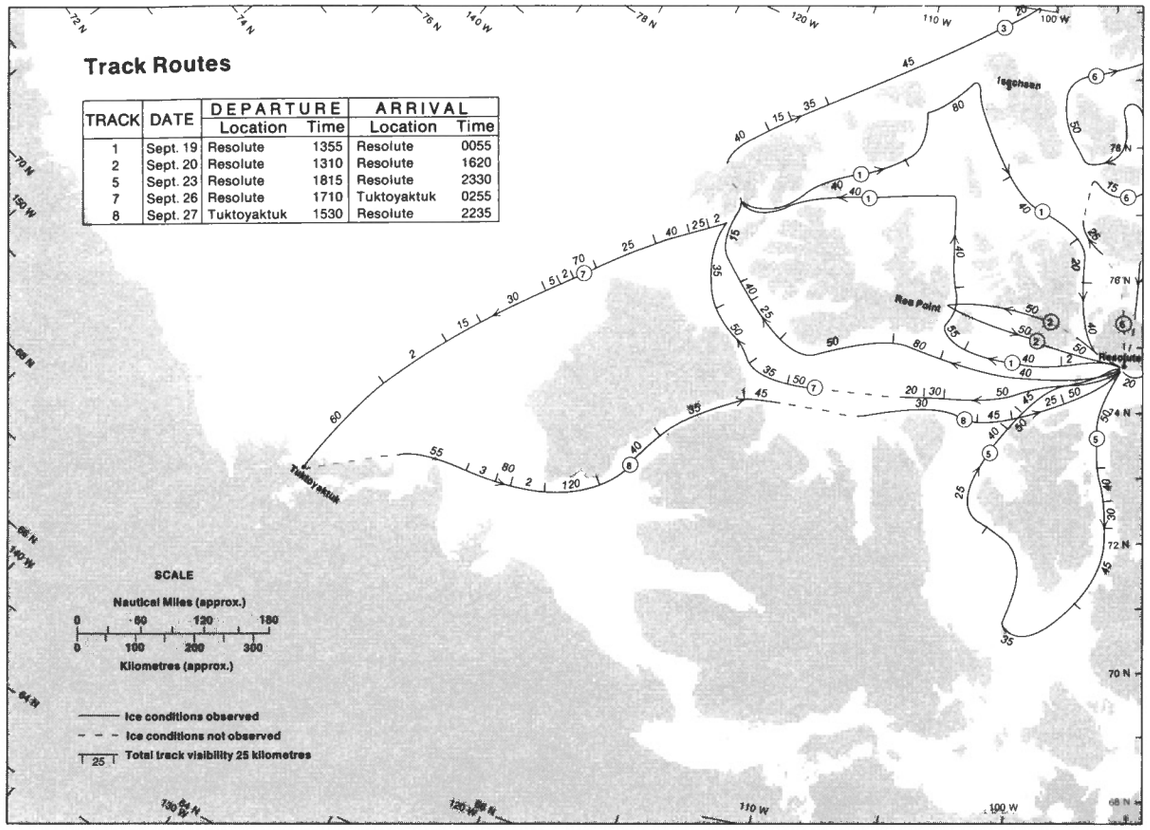
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 7 - 1973 EAST

September 19-27, 1973



MAP 7-1973 West

September 19-27

Flight Effectiveness

Extremely rapid changes and very variable weather conditions were encountered during each of the five tracks over the western part of the archipelago. For example, in a distance of about 100 kilometres the total track visibility varied in equal stages from 55 kilometres to 2, then up to 80 and back to 2, before jumping to 120 kilometres. In spite of these variations the Flight effectiveness was better than 85 per cent.

Ice Conditions

Apart from the gradual increase in thickness of the young ice types, there were two notable changes that took place between Flights 6 and 7. In the Beaufort Sea the ice had continued the northward retreat which started near the end of Flight 6. By the end of Flight 7 the boundary had moved another 100 kilometres further north leaving an area about 250 kilometres wide of open water between the edge of the pack ice and the mainland. In the Beaufort Sea this expanse was about normal while north of Alaska at least twice the usual amount of open water was present. The second change, really a series of differences, related to the redistribution of multi-year ice in M'Clintock Channel, Viscount Melville Sound and to some extent M'Clure Strait. The ice in the central part of M'Clintock Channel seemed to be held back while the remaining ice was concentrated in the southwestern part. The result was a wide east-west belt of new ice across the central part of the channel. In Viscount Melville Sound all the multi-year ice that once spread itself over the central part of the sound was concentrated in the western part, some moving on into the adjacent part of M'Clure Strait. While this westerly movement was taking place in Viscount Melville Sound a similar, but slower, drift occurred in M'Clure Strait. The multi-year ice in Viscount Melville Sound did not quite catch up with the ice in M'Clure Strait and they remained separated by a thin strip of the young ice types.

Compared with the previous survey only small quantities of multi-year ice were able to enter Prince of Wales Strait and the ice that previously filled the strait had a chance to melt and disappear.

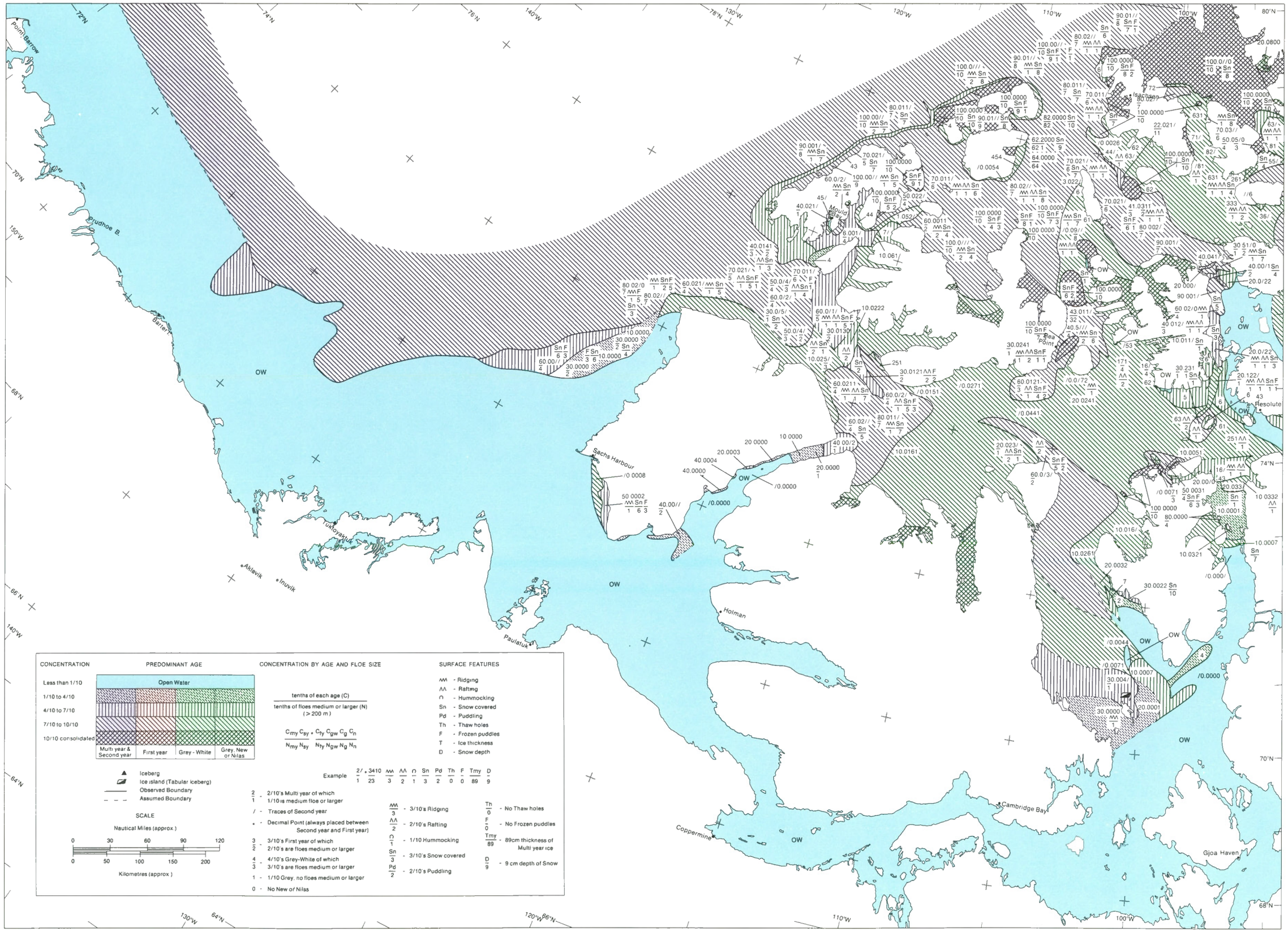
Unobserved Areas

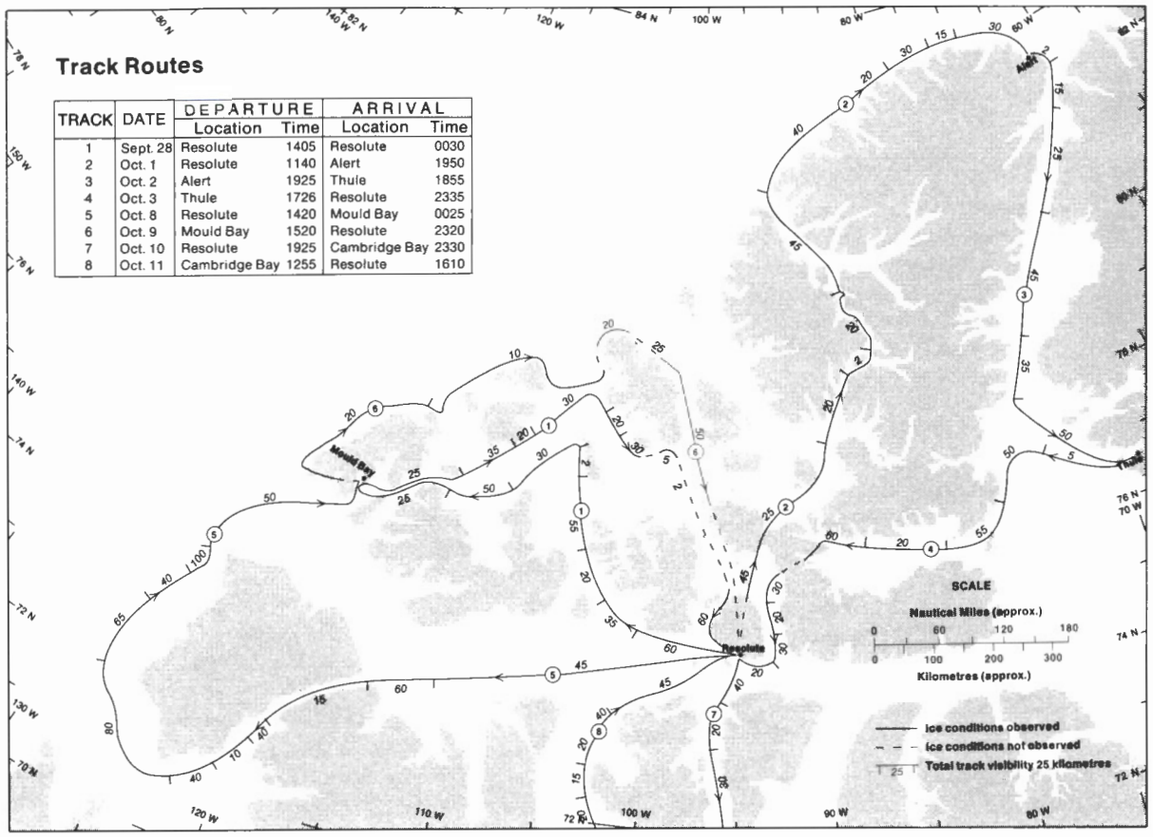
As in the previous two flights no effort was made to survey the channels between the mainland and Banks and Victoria Islands because the open water observed in the southern part of M'Clintock Channel and the eastern part of Amundsen Gulf indicated that no ice had entered the area. Thus, open water would continue to prevail from Amundsen Gulf through Victoria Strait. The conditions shown along the Alaskan coast were established on the basis of satellite photographs and information from Ministry of Transport ice surveys.

Comments

At first it might appear that large quantities of multi-year ice melted between Flights 6 and 7. However, although some ablation may have taken place, the overall amounts of multi-year ice were about the same. The apparent difference resulted from the effect of strong northeasterly winds which concentrated the multi-year ice that recently had spread across the main channels.

The weather during this flight was very good and a considerable amount of information was collected compared with surveys carried out at the same time in other years.


Point Barrow
Prudhoe B.
Barter I.
Sachs Harbour
Ukiavaktuk
Aklavik
Inuvik
Paulatuk
Holman
Cambridge Bay
Coppermine
Gjoa Haven
Resolute
Isachsen
Mould Bay
Sea Point
OW
72°N
74°N
76°N
78°N
80°N
70°N
68°N
66°N
64°N
140°W
130°W
120°W
110°W
100°W
150°W
CONCENTRATION
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
PREDOMINANT AGE
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice Island (Tabular Iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N) (> 200 m)
SURFACE FEATURES
Ridging
Rafting
Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Example
2/ • 3410 Sn F Th F Tmy D
2/10's Multi year of which 1/10 is medium floe or larger
Traces of Second year
Decimal Point (always placed between Second year and First year)
3/10's First year of which 2/10's are floes medium or larger
4/10's Grey-White of which 3/10's are floes medium or larger
1/10 Grey, no floes medium or larger
No New or Nilas
3/10's Ridging
2/10's Rafting
1/10 Hummocking
3/10's Snow covered
2/10's Puddling
No Thaw holes
No Frozen puddles
89cm thickness of Multi year ice
9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Sept. 28	Resolute	1405	Resolute	0030
2	Oct. 1	Resolute	1140	Alert	1950
3	Oct. 2	Alert	1925	Thule	1855
4	Oct. 3	Thule	1726	Resolute	2335
5	Oct. 8	Resolute	1420	Mould Bay	0025
6	Oct. 9	Mould Bay	1520	Resolute	2320
7	Oct. 10	Resolute	1925	Cambridge Bay	2330
8	Oct. 11	Cambridge Bay	1255	Resolute	1610

MAP 8-1973 East

September 28-October 11

Flight Effectiveness

Typical fall weather including generally low cloud ceilings occasionally combined with rain and fog reduced visibilities and made observations difficult during some parts of each of the five tracks completed over the eastern part of the archipelago during Flight 8. Strong northeasterly winds grounded the aircraft at Resolute for a few days between tracks 4 and 5. Overall, the Flight was considered to be nearly 70 per cent effective.

Ice Conditions

New ice had continued to increase in thickness throughout the region and spread across Jones Sound and Wellington Channel. A new snow cover was appearing in many areas and remained on the thicker forms of ice. The winds appeared to have moved large areas of multi-year ice through Belcher Channel and into the unnamed sea where this type of ice was concentrated to the east of Lougheed Island and in Desbarats Strait. A similar increase in concentration had developed in the area north of Byam Martin Channel.

The southerly drift of ice through Byam Martin Channel and Penny Strait had ceased and, although the ice continued to move south through Nares Strait into Baffin Bay, the rate compared with the previous weeks was considerably reduced.

A large part of the solid ice cover in the northern half of Peary Channel had broken up, but a solid cover across the southern half of this channel continued and stopped multi-year floes from drifting south into Hassel Sound. Many north-south leads and areas of new ice across Prince Gustaf Adolf Sea indicated that the ice would still move if winds from the proper quadrant developed. The plug of solid ice in Nansen Sound remained unbroken and the formation of new ice between the floes stopped movements in the central part of the sound. Similar freezing conditions and the subsequent development of young ice briefly reduced the amount of movement in the northern reaches of Byam Martin Channel.

Unobserved Areas

Observations during the tracks in adjacent areas combined with Ministry of Transport data for the southern part of Prince Regent Inlet indicated that open water was still the main characteristics in the channels east of Somerset Island. Likely some new ice had continued to develop in Admiralty Inlet as well as Navy Board Inlet and Pond Inlet.

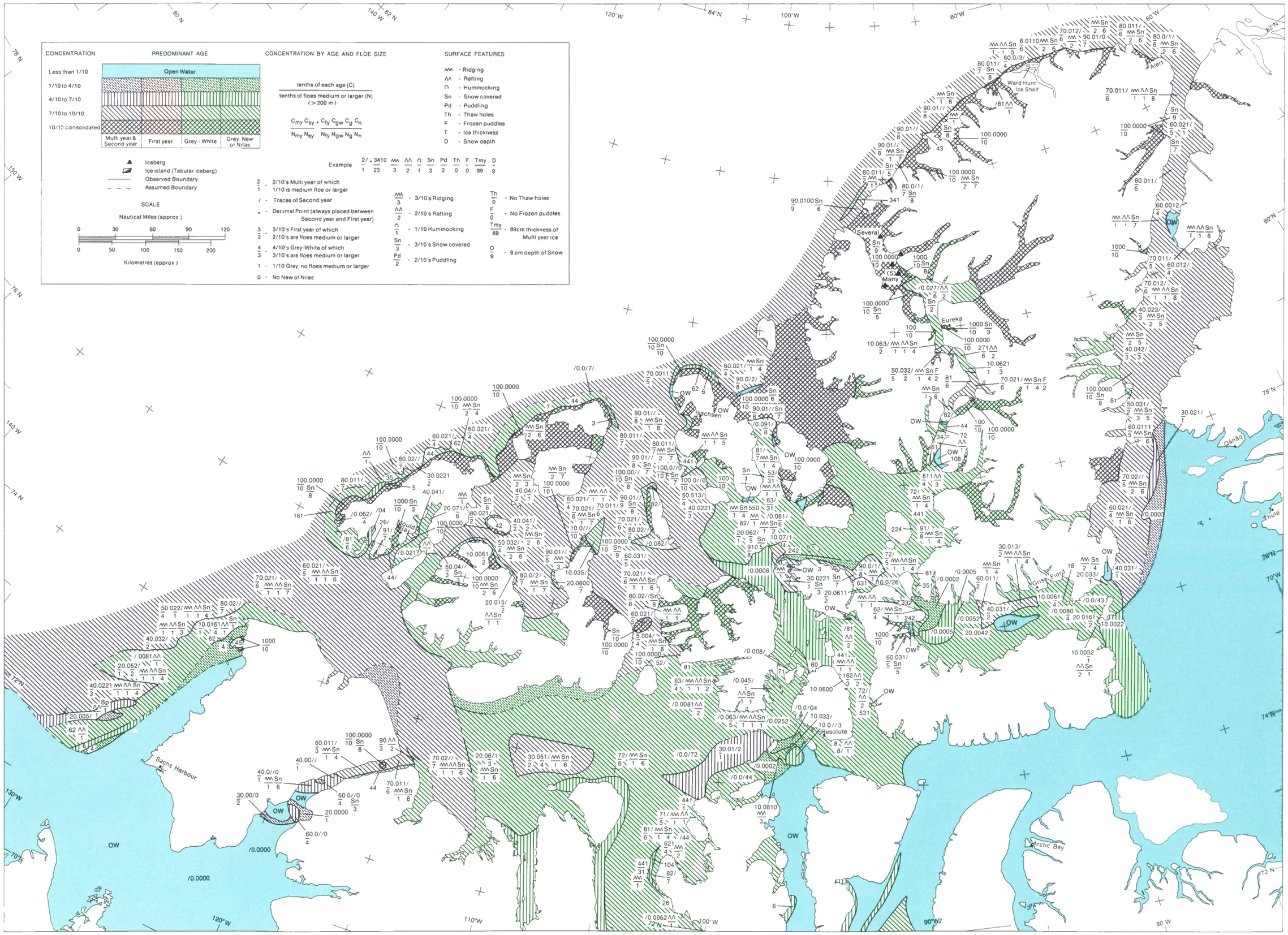
The conditions assumed to exist along the northern coast of Axel Heiberg Island, in Sverdrup Channel and Massey Sound were based on observations made in previous and subsequent surveys over these areas.

Comments

Ice conditions which had developed in Eureka Sound and Nares Strait were similar to those expected in a normal year and did not reflect the very favourable type of season that had developed throughout the remainder of the region.

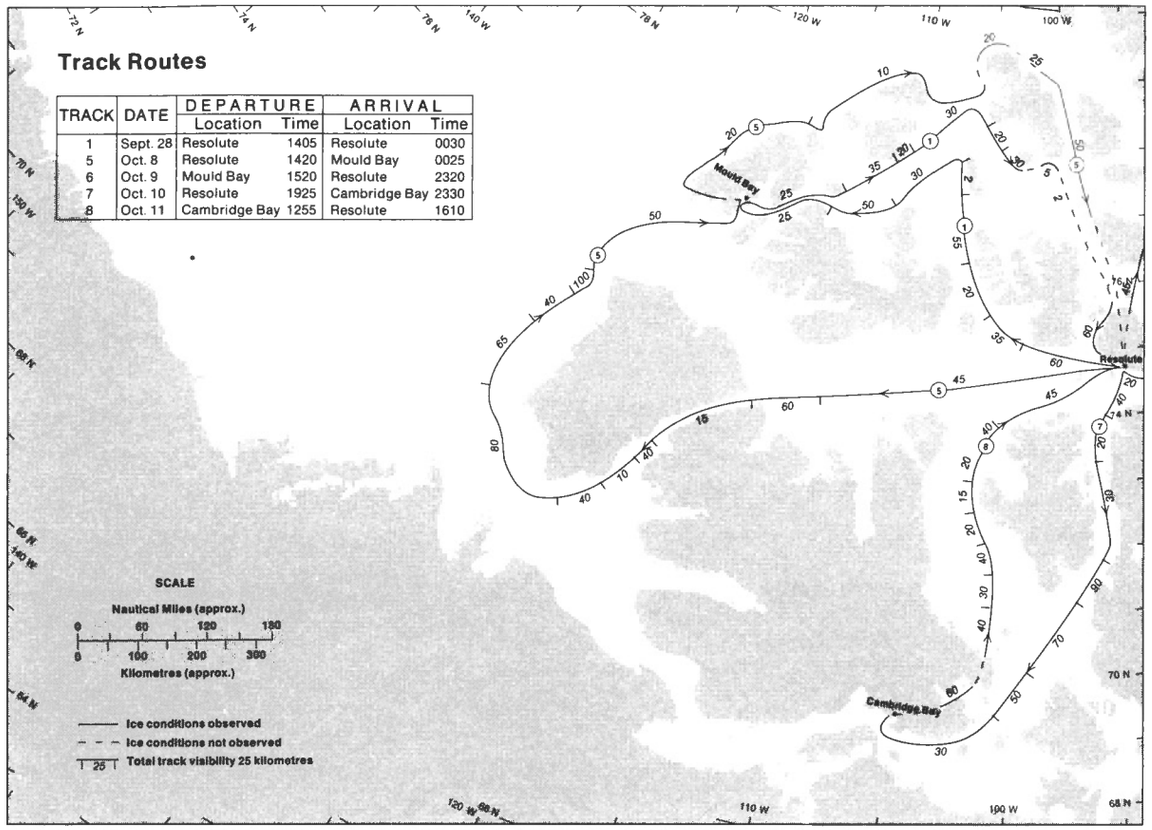
Numerous icebergs were seen in the open water area between Thule and the entrance to Smith Sound.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 8 - 1973 EAST

September 28 - October 11, 1973



MAP 8-1973 West

September 28-October 11

Flight Effectiveness

Better than average weather permitted large areas to be surveyed during tracks 5 and 7. The results of track 8 were slightly better than are normally expected at this time of year. Flight effectiveness approached 75 per cent.

Ice Conditions

Three main differences from the previous Flight were seen by the end of Flight 8. The first was the apparent movement of multi-year ice into M'Clure Strait and the western part of Viscount Melville Sound. The second variation came in Prince of Wales Strait where multi-year ice had once again choked the northern part and was drifting south toward Amundsen Gulf. The third was the disappearance of the multi-year ice from the northern part of M'Clintock Channel.

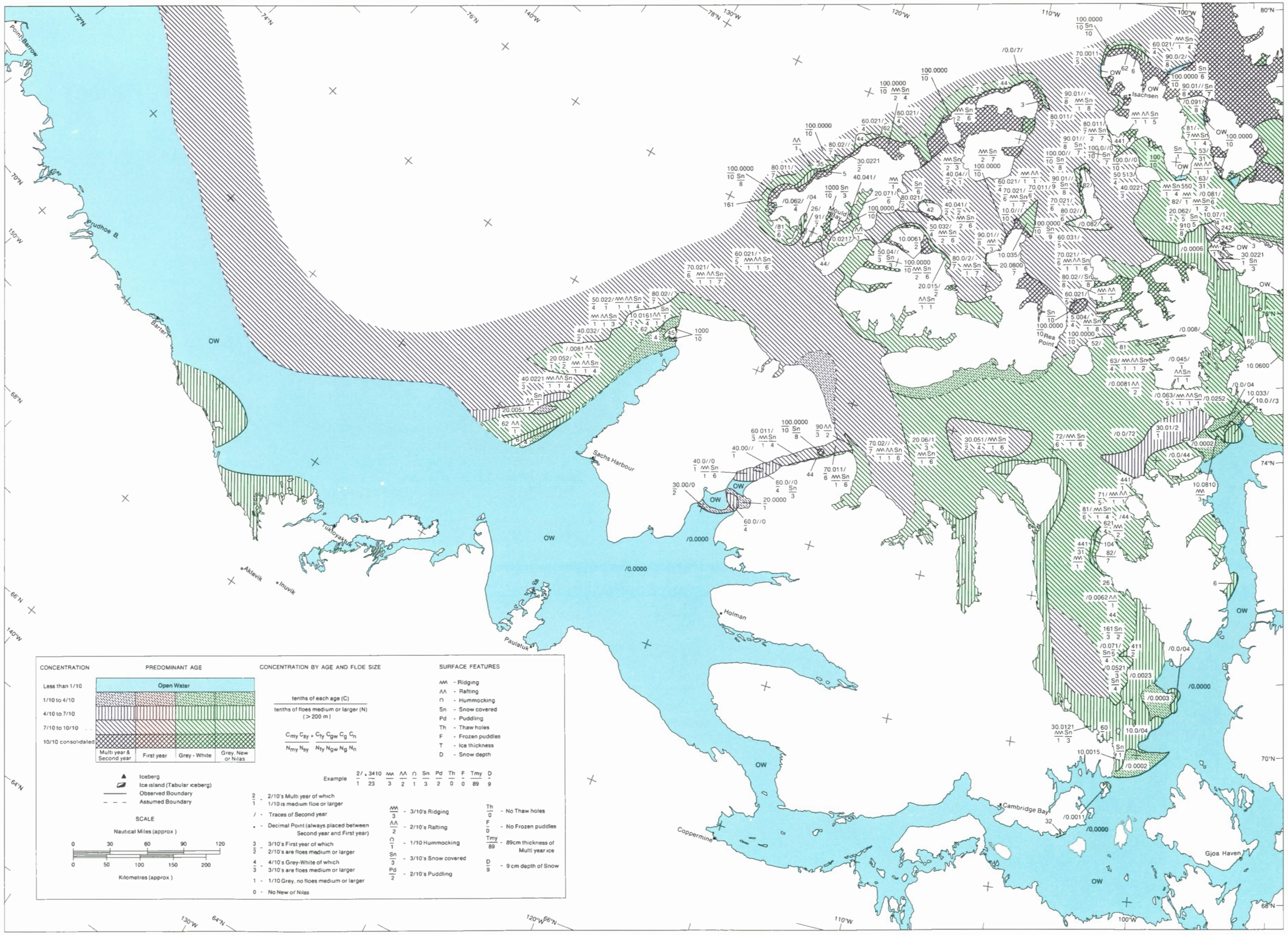
Between September 27 and October 8 the ice in Prince of Wales Strait moved about 125 kilometres or at an average rate of 10 kilometres per day. Movements through M'Clure Strait probably approached the same rate, but there are no reliable indicators to confirm this assumption. Generally strong northerly winds along with the very open conditions which offered no restrictions to ice drift were responsible for the considerable drifts which took place in these channels. The ice in the Beaufort Sea had moved about 50 kilometres further south from the position shown on Map 7-1973 West. A similar invasion along the northern coast of Alaska had slightly reduced the width of open water. However, the ice conditions along the Alaskan coast were very favourable compared with other years.

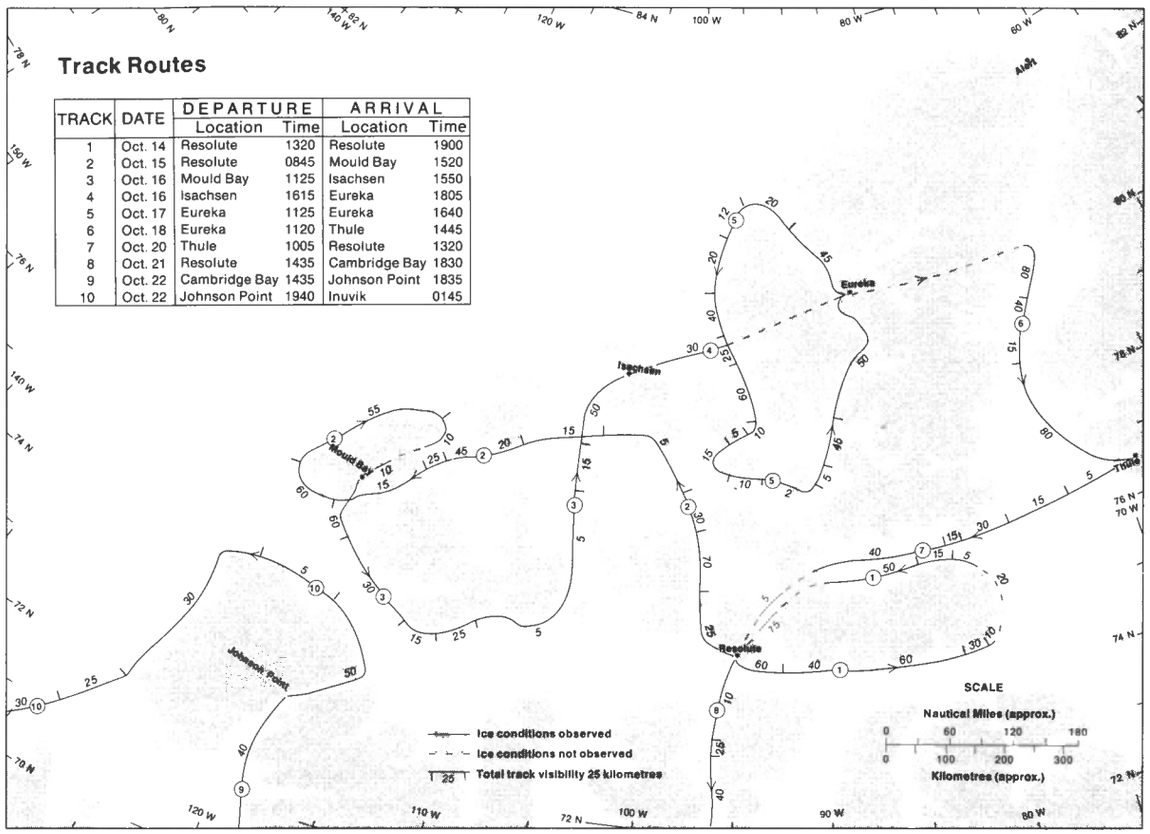
Unobserved Areas

The open water observed in Amundsen Gulf and Victoria Strait indicated that a similar condition existed throughout all the passages linking Amundsen Gulf with Rasmussen Basin. The assumed conditions shown for the central part of M'Clure Strait were derived from observations made at both ends of the strait and the information gained during Flights 7 and 8.

Comments

Very small amounts of first-year ice remained in the western part of the archipelago at the end of Flight 7. By the end of Flight 8 no signs of this type of ice were observed. This considerable amount of melting does not usually occur. Large quantities of multi-year ice had disappeared from the northern part of M'Clintock Channel during the interval between September 27 and October 11. Possibly some of this ice had melted while the remainder must have moved north. No satisfactory single explanation of why or where this ice disappeared to is immediately evident.


Point Barrow
Prudhoe B
Barter
OW
Sachs Harbour
Ukkoyaktuk
Aklavik
Inuvik
Holman
Paulatuk
Isachsen
Mould Bay
Rea Point
Cambridge Bay
Coppermine
Gjoa Haven
/0.0000
CONCENTRATION
PREDOMINANT AGE
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N) (> 200 m)
SURFACE FEATURES
Ridging
Rafting
Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Example
2 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3 - 3/10's First year of which 2/10's are floes medium or larger
4 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas
3/10's Ridging
2/10's Rafting
1/10 Hummocking
3/10's Snow covered
2/10's Puddling
No Thaw holes
No Frozen puddles
89cm thickness of Multi year ice
9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 14	Resolute	1320	Resolute	1900
2	Oct. 15	Resolute	0845	Mould Bay	1520
3	Oct. 16	Mould Bay	1125	Isachsen	1550
4	Oct. 16	Isachsen	1615	Eureka	1805
5	Oct. 17	Eureka	1125	Eureka	1640
6	Oct. 18	Eureka	1120	Thule	1445
7	Oct. 20	Thule	1005	Resolute	1320
8	Oct. 21	Resolute	1435	Cambridge Bay	1830
9	Oct. 22	Cambridge Bay	1435	Johnson Point	1835
10	Oct. 22	Johnson Point	1940	Inuvik	0145

MAP 9-1973 East

October 14-22

Flight Effectiveness

Low cloud ceilings hindered observations during some part of each of the seven tracks completed over the eastern part of the region. In the northern areas the low sun restricted visibility and resulted in the cancellation of the track around the northern part of Ellesmere Island. In spite of these factors the Flight effectiveness was about 60 per cent.

Ice Conditions

Young ice types continued to develop in the area and most of Lancaster Sound, Prince of Wales Strait and northern Baffin Bay had started to support a partial cover of mainly new ice. In other areas throughout the region the young ice forms continued to increase in thickness to the extent that thin first-year ice spread across parts of the northern channels. In the protected areas like Eureka Sound the young ice types were developing a solid ice cover. In other areas the formation of ice between the existing older floes was restricting movements. The effects of this restriction were evident in Byam Martin Channel and Nares Strait where only limited amounts of multi-year ice moved toward the south.

While a solid ice cover was forming in most areas, break-up came to the previously solid cover on Peary Channel and the area southeast of it. The ice in Nansen Sound, Sverdrup Channel and northern Massey Sound remained unbroken and immobile. Considerable movement was occurring in the southern channels and much of the ice had rafted.

The icebergs in Lancaster Sound appeared to be drifting west as usual along the southern coast of Devon Island. One of these ice masses had reached the southwestern tip of Devon Island.

Unobserved Areas

The ice cover in Wilkins Strait had likely developed many cracks across it, but the resulting movement would be limited. Now that freezing conditions had returned, the ice cover in this area would resume its usual solid state.

The assumed ice conditions shown along the northern fringe of the archipelago were determined from the observations made along Prince Patrick Island and Axel Heiberg Island as well as from the surveys conducted in Prince Gustaf Adolf Sea and Sverdrup Channel. Conditions observed during Flight 8 were also used to establish the likely regime along the northern part of Ellesmere Island.

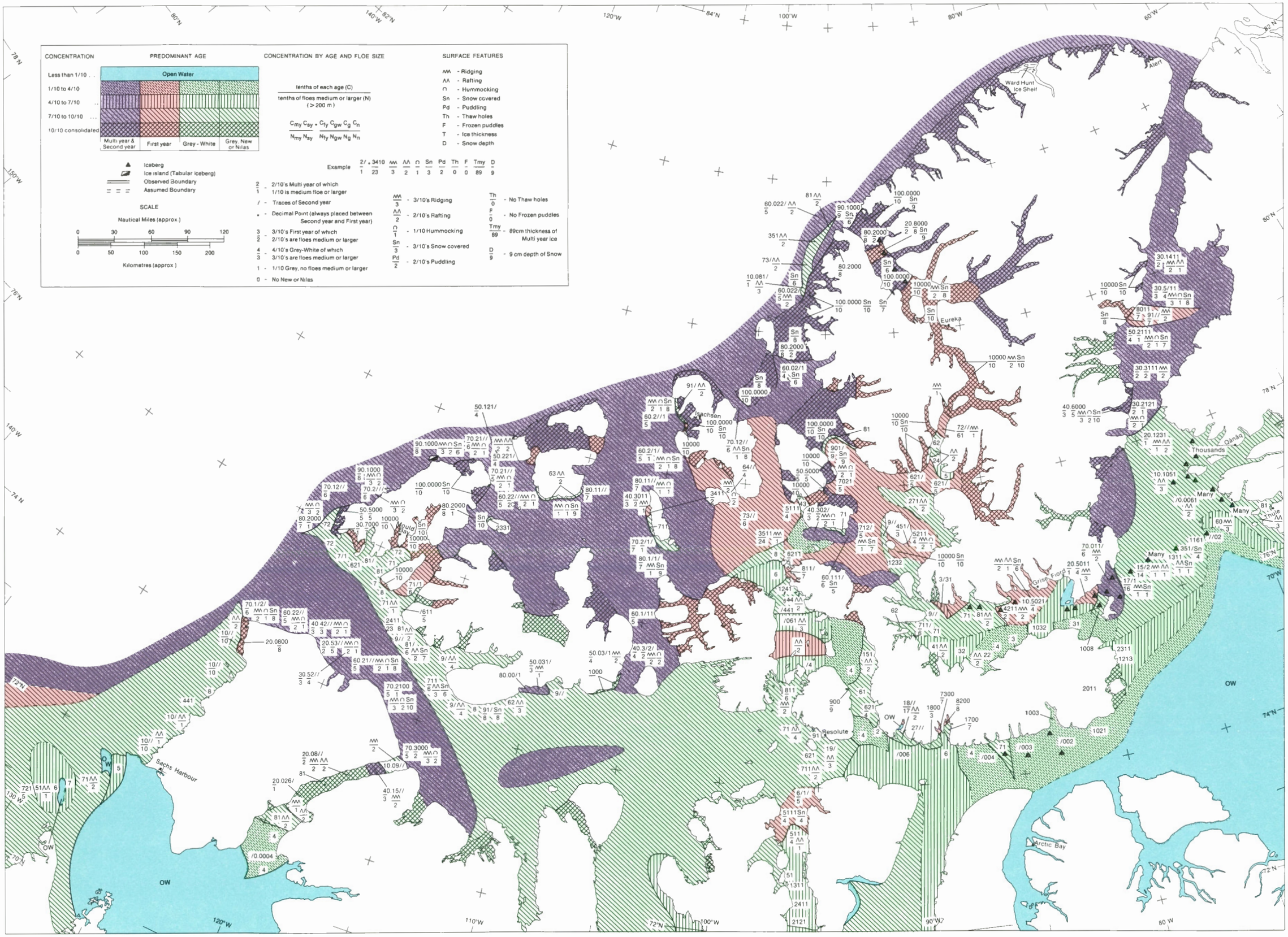
The curious lack of the new forms of ice in Admiralty Inlet, Navy Board Inlet and Pond Inlet were based on the interpretation of satellite photographs. It is probable that patches of new ice were rapidly developing in these inlets.

Comments

Although new ice was forming throughout the entire area and movements were slowing down, the final freeze-up in the large areas north of Parry Channel was probably at least four weeks away.

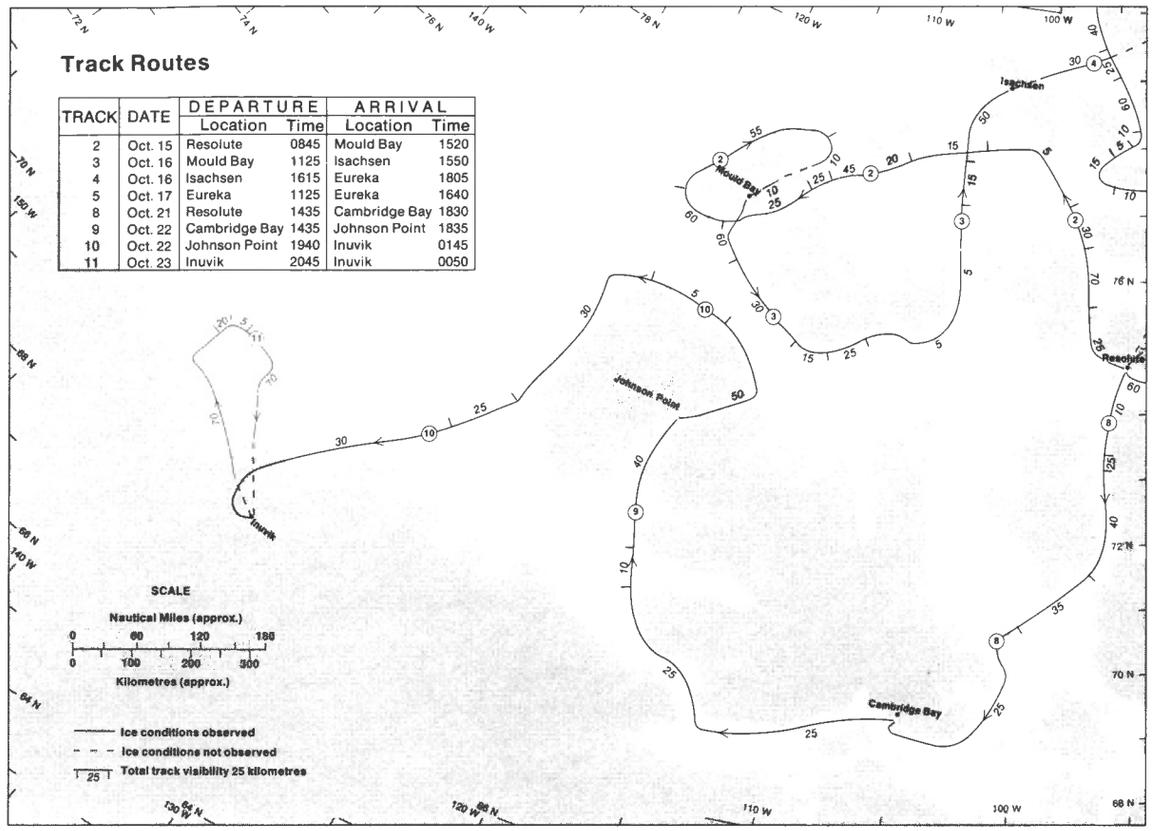
On June 13th an ice island measuring about four by six kilometres was located in the Arctic Ocean near Brock Island at 78° 08′N, 115° 05′W. The same island was observed on October 15 near Cape Andreason, at 77° 22′N, 119° 20′W. Between sightings the ice island averaged a net drift rate of slightly more than one kilometre per day which is slower than other drifts noted for this area.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 9 - 1973 EAST

October 14-22, 1973



MAP 9-1973 West

October 15-23

Flight Effectiveness

Low cloud ceilings, usually less than 700 feet, along with some snow showers and fog restricted observations and resulted in only fair visibilities during the five tracks carried out over the western part of the region during Flight 9. This weather was typical for the time of year. The Flight effectiveness was slightly better than 50 per cent.

Ice Conditions

Young forms of sea ice had developed in the open areas of the Beaufort Sea, Franklin Strait and Peel Sound. Concentrations of multi-year ice in Prince of Wales Strait were reduced and in this strait the predominant ice type changed from multi-year to the younger types as grey and grey-white ice developed. In some areas thin first-year ice was starting to appear as the younger forms increased in thickness. Only traces of ice had appeared in the channels separating the large islands from the mainland.

The southern limit of multi-year ice in the Beaufort Sea remained in the same area and little change had taken place in M'Clure Strait. Rafting was occurring in most areas where the young forms of ice were growing. The greatest amount of rafting was observed in the northeastern part of M'Clure Strait near the entrance to Liddon Gulf.

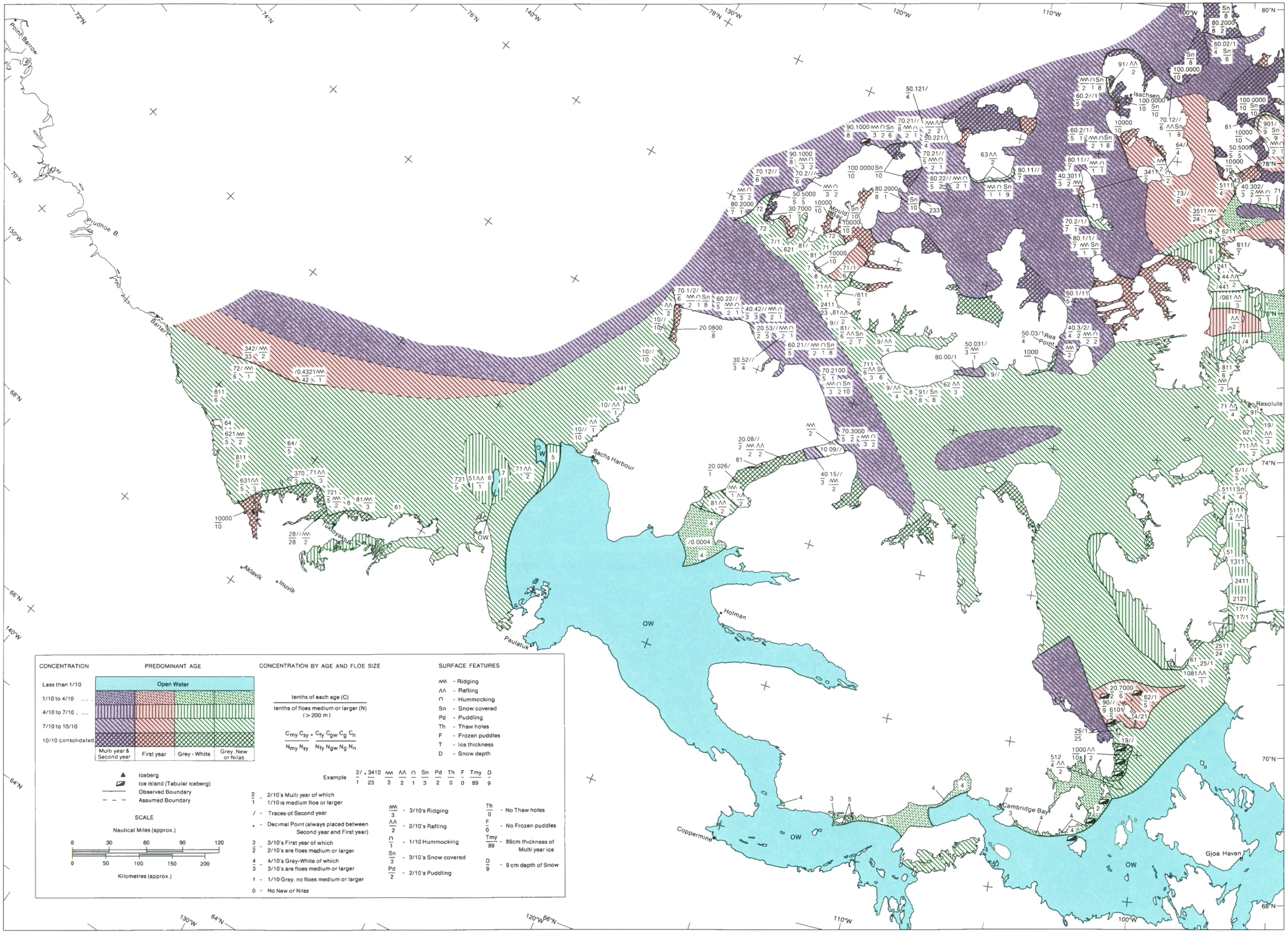
Unobserved Areas

Unfortunately, the central portions of Viscount Melville Sound and M'Clintock Channel were not observed during Flight 9-1973 West. The ice conditions assumed to exist in these areas were determined on the basis of information gathered during previous surveys, from satellite photographs and from the conditions observed during the first Flight of 1974. The boundaries between the multi-year ice and the younger forms in the eastern part of the Beaufort Sea were deduced from observations made during track 10 and from the ice conditions which prevailed during the previous flight.

Comments

Large movements were still possible in M'Clure Strait and Viscount Melville Sound. The movements in the latter area would likely continue on into December before the new ice types became strong enough to withstand the forces generated by the winds over this area. Similarly the very large amounts of new ice in M'Clintock Channel meant that the ice in this channel would not stop moving until December or even later. The final data for freeze-up along the length of the channels connecting the Beaufort Sea with Rasmussen Basin probably came in the latter part of November. Occasionally the ice in the western part of Amundsen Gulf continues to move throughout the winter months.

Freeze-up of the main channels of the Mackenzie River between the ocean and Inuvik was well underway. Generally the northern part was nine to ten tenths first-year ice while in the vicinity of Inuvik the concentrations declined slightly to seven to eight tenths first-year and new ice.



CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year | First year | Grey - White | Grey, New or Nilas

▲ Iceberg
Ice Island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N) (> 200 m)}}$$

$$\frac{C_{my}\ C_{sy}}{N_{my}\ N_{sy}} \bullet \frac{C_{fy}\ C_{gw}\ C_g\ C_n}{N_{fy}\ N_{gw}\ N_g\ N_n}$$

Example: $\frac{2}{1}/\bullet\frac{3}{2}\frac{4}{3}$ $\frac{\wedge\wedge}{3}$ $\frac{\wedge\wedge}{2}$ $\frac{\cap}{1}$ $\frac{Sn}{3}$ $\frac{Pd}{2}$ $\frac{Th}{0}$ $\frac{F}{0}$ $\frac{Tmy}{89}$ $\frac{D}{9}$

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

$\frac{\wedge\wedge}{3}$ - 3/10's Ridging
$\frac{\wedge\wedge}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10's Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

SURFACE FEATURES

∧∧ - Ridging
∧∧ - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

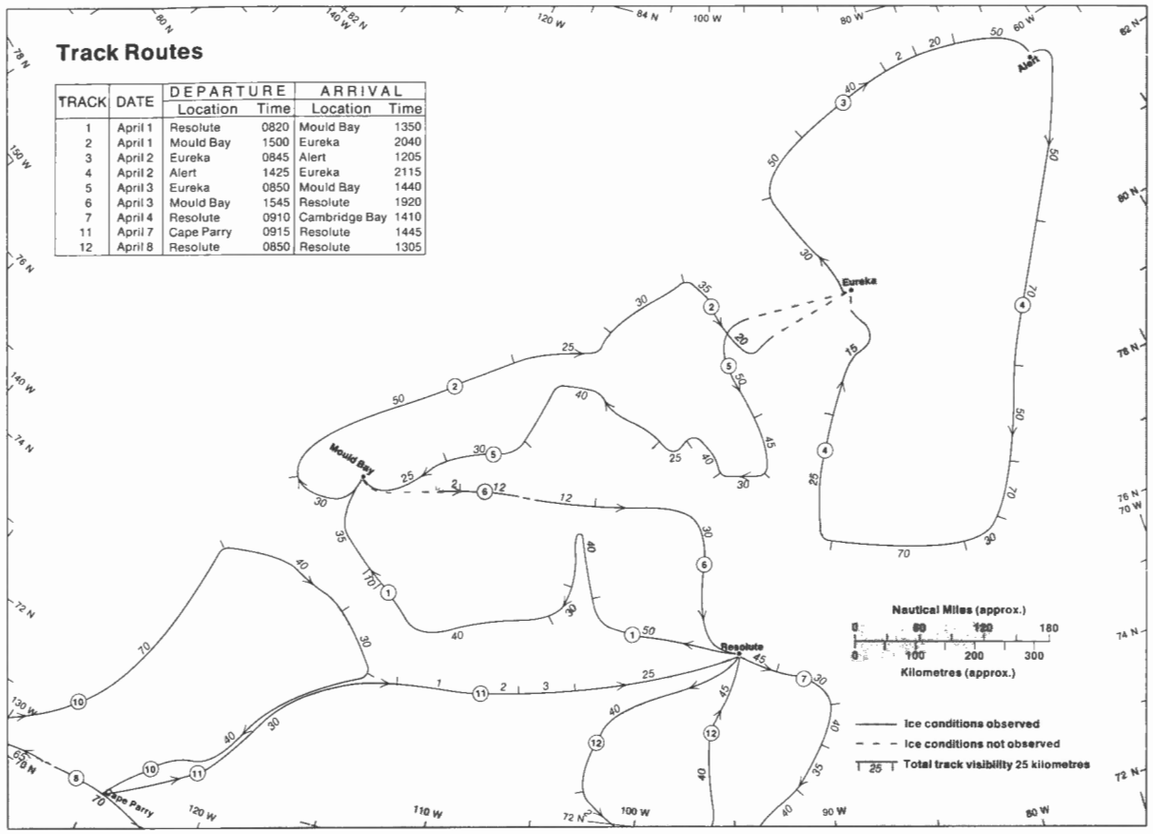
MAP 9 - 1973 WEST

October 15-23, 1973

SEASONAL SUMMARY: 1974

The ice conditions observed in the channels of the Canadian Arctic Archipelago during the summer of 1974 ranged from much below normal (little melting or break-up) in some areas to better than average in others. Overall, the ice conditions that developed were typical and no obvious departures from the usual patterns were noted. In the Beaufort Sea the situation was very unfavourable for shipping because the arctic pack ice remained close to the mainland throughout the summer. Similarly, the ice in Amundsen Gulf was more concentrated than usual. The ice in Parry Channel and all the areas north of it followed the usual sequence of ablation, break-up, movement and freeze-up. A solid ice cover prevailed across the northern channels throughout the season and no multi-year ice from the Arctic Ocean was able to enter the channels of the archipelago. The most favourable conditions developed in M'Clintock Channel and Peel Sound. In these areas melting, break-up and clearing preceded the usual time by two to three weeks.

Generally favourable flying weather throughout the season resulted in good coverage. An ice island, referred to as P-1, was located in the Beaufort Sea about 150 kilometres north of the mainland. The westerly drift of this mass of ice, about 50 feet thick when first sighted, was followed during the season. This ice island was first observed and marked by the Polar Continental Shelf Project in 1967 just after it had broken off from the Ward Hunt Ice Shelf which extends along a portion of the northern coast of Ellesmere Island.



MAP 1-1974 East April 1-4

Flight Effectiveness

Generally skies were cloud-free during the seven tracks over the eastern part of the archipelago, but ice crystal haze, snow cover coupled with a low sun angle, and some areas of low cloud and fog resulted in reduced visibilities. The Flight was nearly 80 per cent effective.

Ice Conditions

No major invasions of multi-year ice took place before the final freeze-up during the preceding fall. As a result, many areas such as Norwegian Bay supported a cover of mainly first-year ice. Although no multi-year ice entered the archipelago, some redistribution of the multi-year ice already in the channels took place between the end of October and the time of freeze-up. This late fall movement was very evident in the unnamed sea south of Ellef Ringnes Island where multi-year floes moved east toward Cornwall Island. In Nares Strait a massive late fall clearing took place. The southern half of this channel supported at least a three tenths cover of multi-year ice at the end of October. Southerly drifts between then and the time of final freeze-up had moved almost all of this older ice out of the strait. As a result an almost total cover of first-year ice had developed in Kane Basin and Kennedy Channel.

With one exception the patterns observed during Flight 1 reflected those usually expected in the spring. A solid ice cover spread across most of the channels. The boundaries between moving and solid ice in Smith Sound, eastern Jones Sound, western Jones Sound and the two small open areas on either side of Dundas Island occupied their usual positions. The exception to this was in Barrow Strait. In most years the boundary separating the solid ice in Barrow Strait from the moving ice in Lancaster Sound extends across the channel from the northeastern tip of Somerset Island to Devon Island. Occasionally, as in 1969, the ice in the eastern part of Barrow Strait remains in motion throughout the winter. This situation prevailed once again in 1974. The boundary between the solid and moving ice in Barrow Strait appeared in the position it usually occupies when similar conditions develop, that is, in an arc curving west from Resolute around to Somerset Island.

The amount of ridging observed throughout most parts of the archipelago seldom exceeded two tenths of the ice surface. As usual the highest concentration of ridging, four tenths, had developed in western Barrow Strait followed by Queens Channel, Penny Strait, the southwestern quarter of the unnamed sea and Hecla and Griper Bay. The small amounts of ridging in the remaining areas indicated that fall freeze-up took place with a minimum of movement.

The ice in the Arctic Ocean close to the northern fringe of the archipelago showed no signs of movement during the surveys carried out on April 1 and 2, but it would not be long until the ice continued its clockwise drift.

Unobserved Areas

Satellite photographs were used to establish the conditions in Lancaster Sound and the central portion of Baffin Bay. The situation along the north coast of Axel Heiberg Island was determined on the basis of observed conditions in adjacent areas.

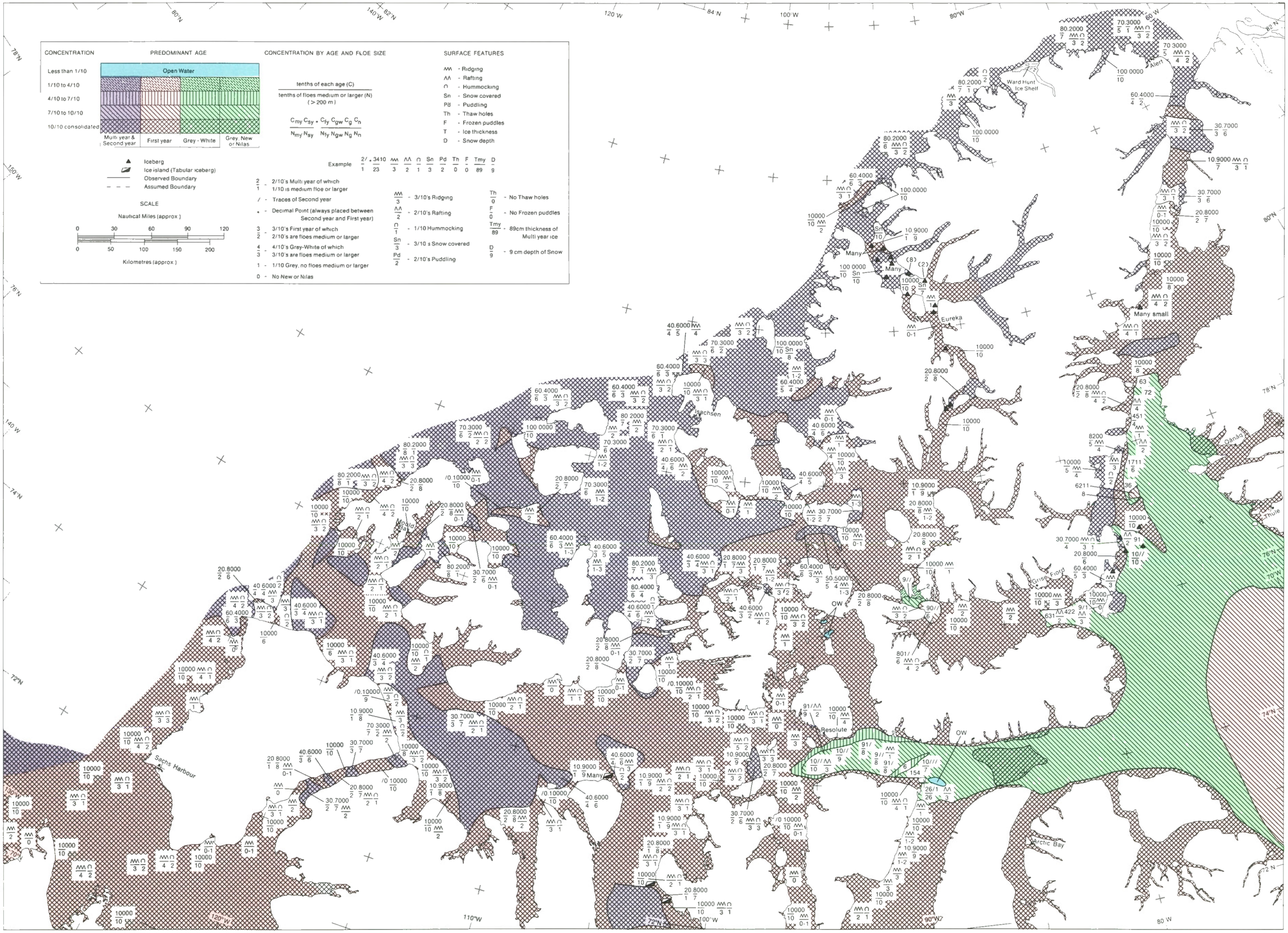
Comments

The early break-up in Barrow Strait did not signify anything more than the fact that the winter ice cover in this area is generally weak and can readily be cracked or broken by appropriate winds.

Several small icebergs were strung out along the southern coasts of Cornwall Island and Ellef Ringnes Island and a few ice island fragments were observed near the northeast tip of Cameron Island.

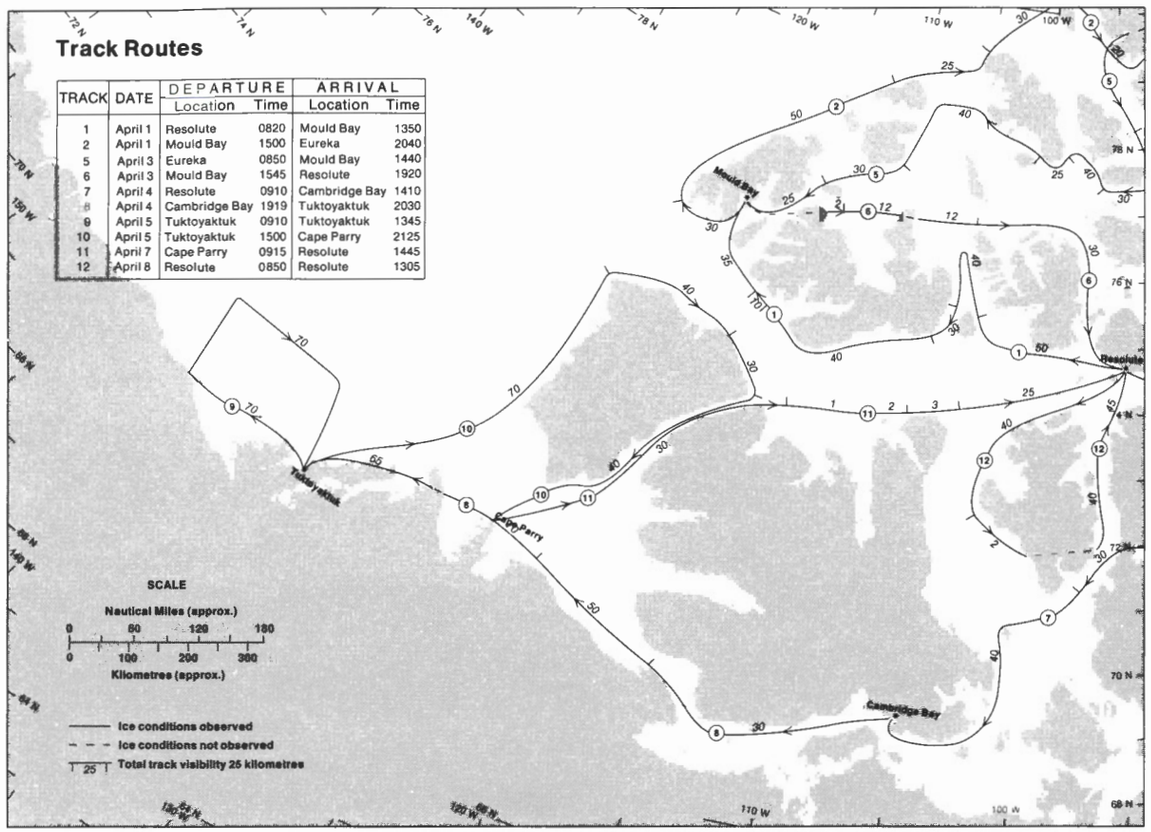
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 1 - 1974 EAST

April 1 - 4, 1974



MAP 1-1974 West April 4-8

Flight Effectiveness

Visibilities during the seven tracks in the western part of the archipelago varied from poor to excellent, low cloud and ice crystal haze being the main limiting factors. The Flight was almost 80 per cent effective.

Ice Conditions

As a result of the extensive melting and disappearance of ice in Viscount Melville Sound and M'Clintock Channel during the previous summer, the area of first-year ice present in these channels in 1974 was much greater than normal. The amount of first-year ice in M'Clure Strait was also greater than usual, not for the same reason but because movements after mid-October had allowed much of the multi-year ice in the central part of M'Clure Strait to drift into the western part of Viscount Melville Sound. The universal presence of first-year ice throughout the southern channels from Amundsen Gulf to Dease Strait is a typical spring situation. However, the complete first-year cover in Queen Maud Gulf and Victoria Strait was unusual.

The solid ice cover across the western entrance to M'Clure Strait and throughout the observed portions of the Beaufort Sea was a temporary situation. When the winds started the ice moving again the normal shear zone would appear across M'Clure Strait, along the coast of Banks Island and would generally parallel the mainland coast about 20 kilometres offshore. Vestiges of an earlier shear zone, separating the moving ice in the Beaufort Sea from the landfast ice along shore, were observed in these areas.

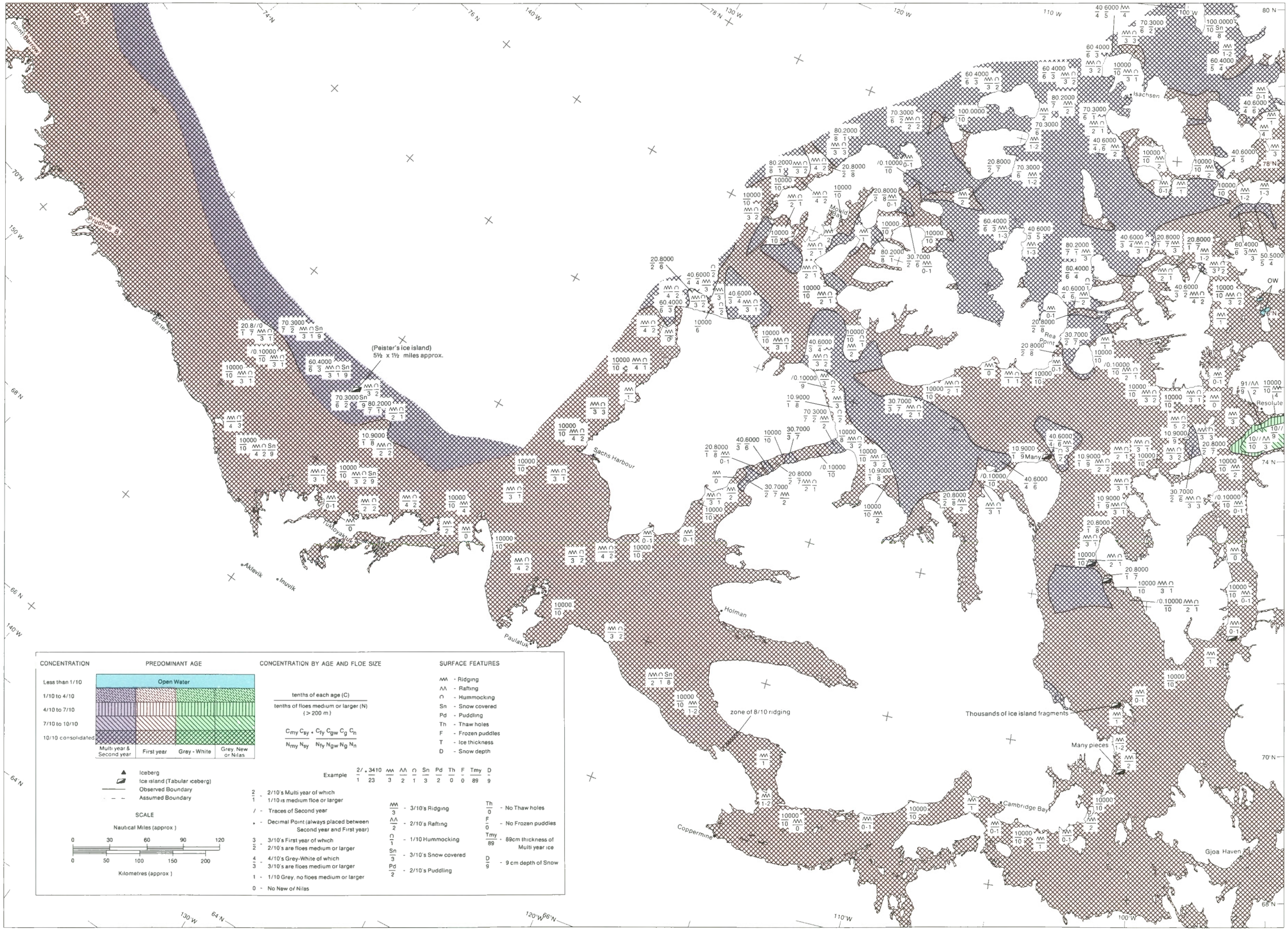
In some areas the freeze-up during the fall of 1973 was very quiet. This lack of movement was indicated by the limited amount of ridging in the eastern part of Amundsen Gulf, throughout the southern channels into Queen Maud Gulf and north through Victoria Strait, southern M'Clintock Channel, Franklin Strait and Peel Sound. Generally, ridging in these areas did not exceed two tenths of the ice surface. Ridging in the eastern half of Viscount Melville Sound was more extensive than in the previously mentioned areas. The greatest amounts of roughness, four tenths or more, had developed in western Barrow Strait, along the west coast of Banks Island and in Amundsen Gulf between Sachs Harbour and Cape Parry. Similar amounts of ridging had formed in the vicinity of Herschel Island.

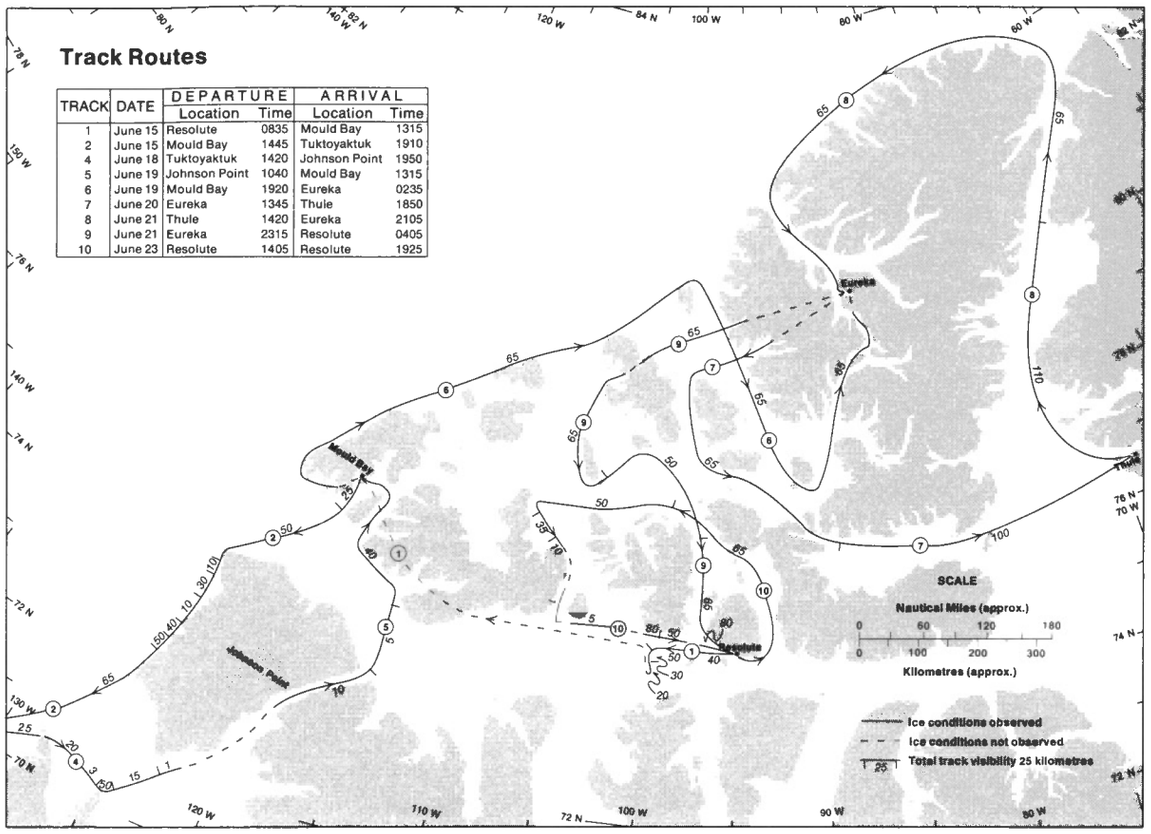
Unobserved Areas

Later surveys in the northern parts of M'Clure Strait and Viscount Melville Sound were used to establish their conditions shown on Map 1-1974 West.

Comments

The Bathurst Polynya had not developed but the small open areas in the central part of Bellot Strait occupied their usual position. Thousands of small ice island fragments were frozen into the ice cover between Gateshead Island and Victoria Island and throughout the western part of Victoria Strait. A few fragments were sighted in the southwestern part of Franklin Strait and near the northwestern tip of Stefansson Island. One large ice island, designated as P-1, was sighted in the Beaufort Sea at 71° 17'N, 135° 40'W. Its dimensions were approximately two and one half by nine kilometres.


Point Barrow
Prudhoe B.
Barter I.
Tuktoyaktuk
Aklavik
Inuvik
Sachs Harbour
Holman
Paulatuk
Isachsen
Mould Bay
Rea Point
Resolute
Many
OW
(Peister's ice island)
5½ x 1½ miles approx.
zone of 8/10 ridging
Thousands of ice island fragments
Many pieces
Coppermine
Cambridge Bay
Gjoa Haven
CONCENTRATION
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
PREDOMINANT AGE
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N)
(> 200 m)
Cmy Csy • Cfy Cgw Cg Cn
Nmy Nsy Nfy Ngw Ng Nn
Example 2/•3410 3 2 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9
2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/10's First year of which 2/10's are floes medium or larger
4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New of Nilas
3 - 3/10's Ridging
2 - 2/10's Rafting
1 - 1/10 Hummocking
Sn 3 - 3/10's Snow covered
Pd 2 - 2/10's Puddling
SURFACE FEATURES
- Ridging
- Rafting
- Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Th 0 - No Thaw holes
F 0 - No Frozen puddles
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	June 15	Resolute	0835	Mould Bay	1315
2	June 15	Mould Bay	1445	Tuktoyaktuk	1910
4	June 18	Tuktoyaktuk	1420	Johnson Point	1950
5	June 19	Johnson Point	1040	Mould Bay	1315
6	June 19	Mould Bay	1920	Eureka	0235
7	June 20	Eureka	1345	Thule	1850
8	June 21	Thule	1420	Eureka	2105
9	June 21	Eureka	2315	Resolute	0405
10	June 23	Resolute	1405	Resolute	1925

MAP 2-1974 East June 19-23

Flight Effectiveness

Cloudless skies and unlimited visibilities provided excellent observing conditions during four of the tracks over the eastern part of the archipelago. A concentrated fog bank around Byam Martin Island during track ten was the only weather factor limiting observations in Flight 2-1974 East. The Flight was almost 90 per cent effective.

Ice Conditions

The main changes that took place between Flights 1 and 2 occurred in Lancaster Sound and Baffin Bay. All of the younger forms of ice that previously spread across the former area had disappeared. Probably, melting was the main cause although some of the ice in the eastern part of the sound may have drifted into Baffin Bay. All boundaries between solid ice and open water in both Lancaster Sound and the eastern half of Barrow Strait had remained almost stationary during the nine-week interval which separated Flight 2 from its predecessor. This long period of static ice boundaries in these areas is common, especially when early spring break-up and clearing takes place in eastern Barrow Strait. Two seemingly contradicting changes were noticed in the northern portion of Baffin Bay between Flights 1 and 2. The area covered by first-year ice increased as the new ice types grew in thickness. While this ice was forming, the young ice types which previously occupied the northwestern part of the bay had disappeared. Likely, this ice moved out into the bay instead of melting in situ. The ice-water boundary across Smith Sound remained in the same position as did the solid ice tongue which extended into the bay from Cape Combermere.

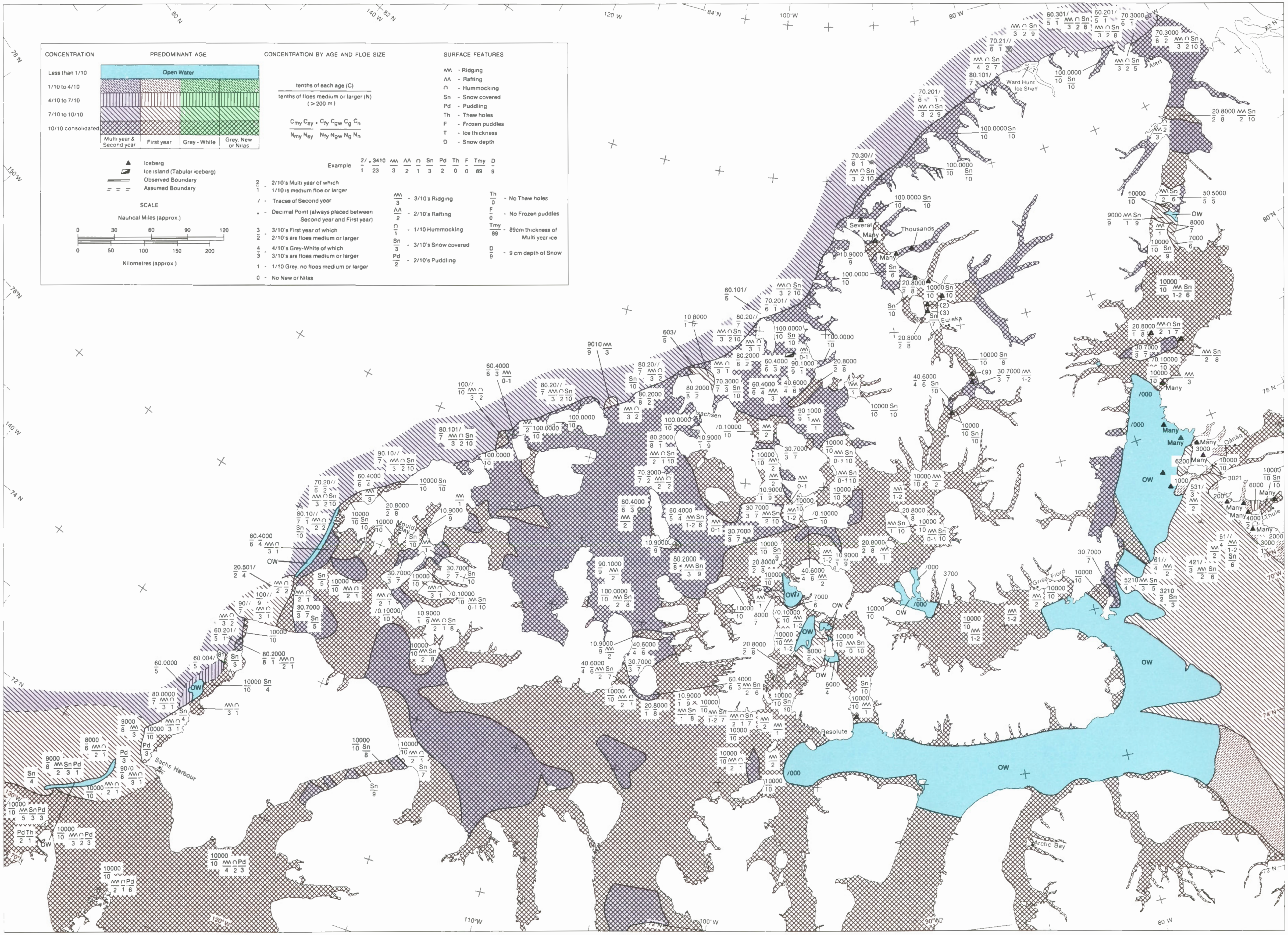
Other expected variations had taken place as the open areas in northeastern Queens Channel and Penny Strait developed. One small area of open water appeared in the southern part of Crozier Channel. In the southern part of Kennedy Channel the ice had broken and some clearing had taken place around the islands in the southeastern part of the channel. Apart from these normal signs that the summer was approaching, an almost total snow cover still existed in most of the area. No puddles had started to appear, even in the southernmost channels while in the northern areas the new ice types were still forming. Very small areas of open water in Belcher Channel, to the south of Table Island, had appeared in their usual location, but there were no signs of open water in the central eastern part of the channel.

Unobserved Areas

Satellite photographs along with the data observed in adjacent areas were used to determine the ice conditions shown for central Baffin Bay, Lancaster Sound and Prince Regent Inlet. A similar combination of sources served to fill in the area along the north coast of Axel Heiberg Island.

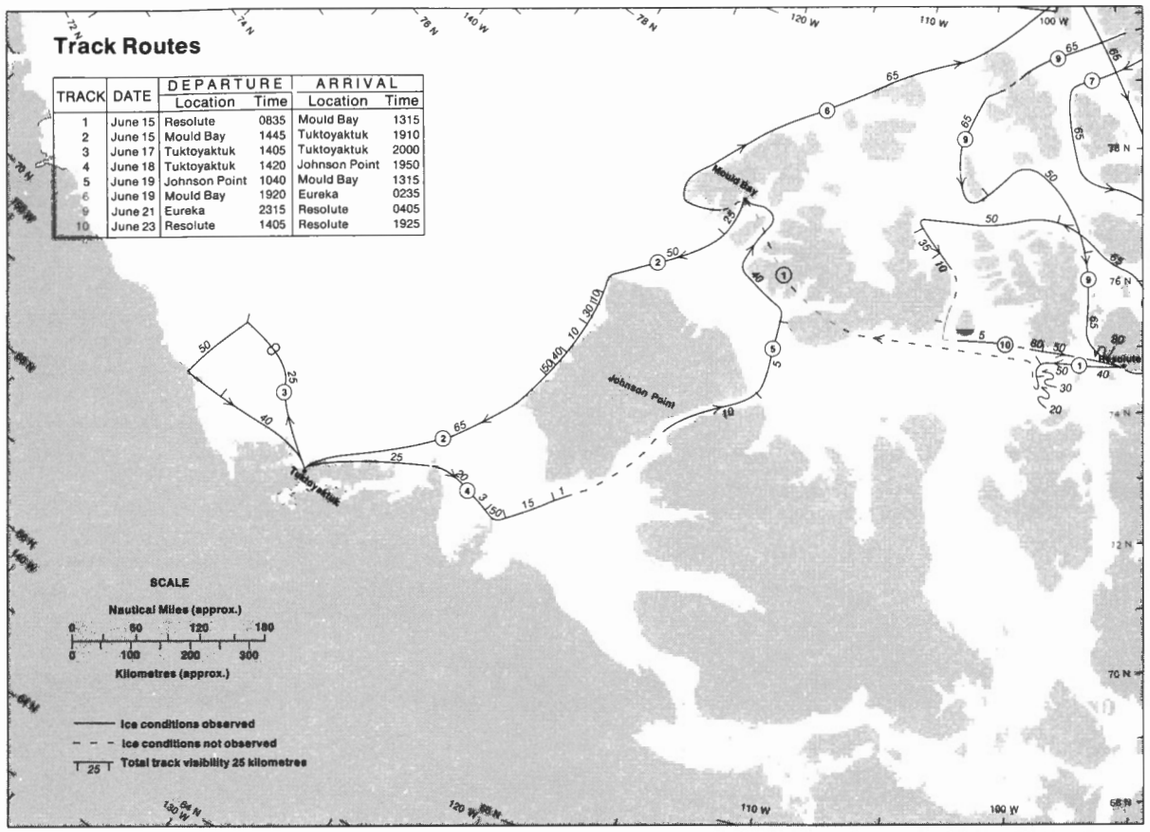
Comments

Generally the season seemed to be advancing at a normal rate. No puddles were observed and signs of the initial snow melt were appearing in the southern channels. One iceberg was sighted frozen into the ice in Wellington Channel near the southeast tip of Cornwallis Island. The iceberg could have reached this area through Queens Channel or Lancaster Sound, probably the latter.



MAP 2 - 1974 EAST

June 19 - 23, 1974



MAP 2-1974 West June 15-19

Flight Effectiveness

An almost uniform cover of low dense clouds accompanied by areas of rain and freezing rain reduced visibilities considerably during the five tracks carried out over the western part of the archipelago during Flight 2-1974 West. The reduced visibilities combined with the lack of surveys in most of the areas including Viscount Melville Sound, M'Clintock Channel, and the channels between Victoria Island and the mainland resulted in a Flight effectiveness which ranged between 30 and 40 per cent.

Ice Conditions

The main changes between the ends of Flights 1 and 2 had developed in the Beaufort Sea. Once the ice in the central part of the sea began to move again after the temporary halt noted in early April, the shear zone between the solid land-fast ice along the shore lines and the moving ice was established once again. By mid-June the shear zone across M'Clure Strait and along the west coast of Banks Island took up its usual position. In the southern part of the Beaufort Sea this zone appeared to be further from the coast than is normal for this time of year.

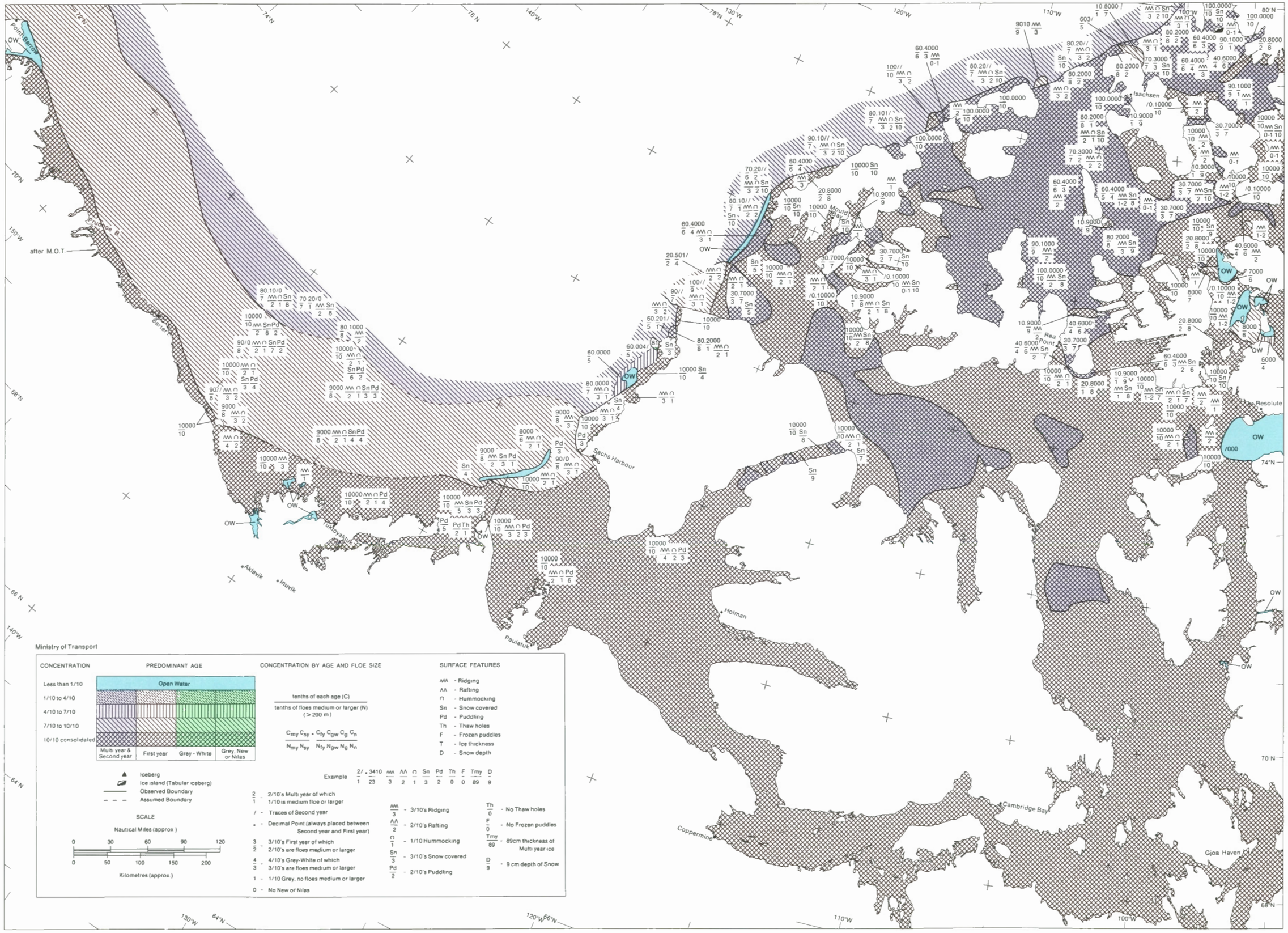
Signs of the advancing melt season were limited. Generally the snow had started to melt and puddles were developing only in the Beaufort Sea south of 72°N. A total snow cover spread across all the channels to the north of this parallel of latitude. Traces of new ice along the coast of Banks Island and in M'Clure Strait were noted. No signs of the Bathurst Polynya had appeared and Amundsen Gulf remained solid although the appearance of some thaw holes and two east-west cracks across the central part of the gulf indicated that break-up in this area was imminent.

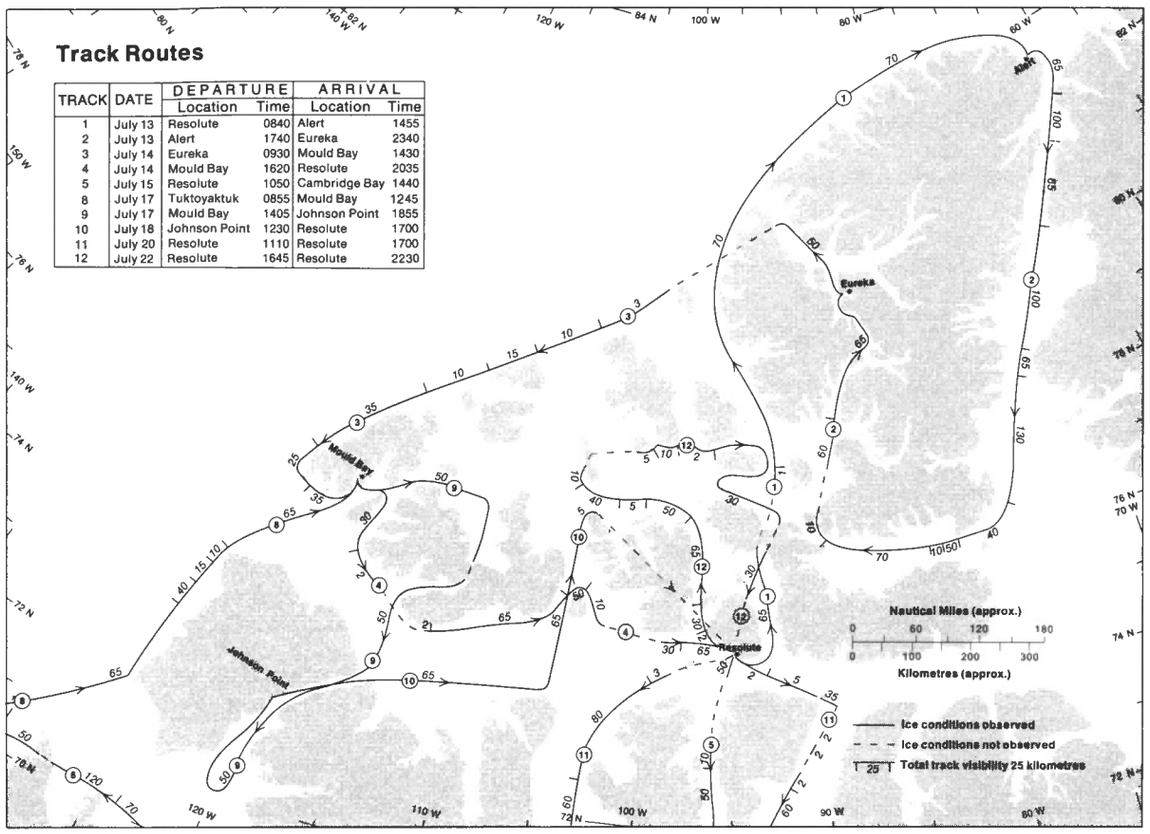
Unobserved Areas

Satellite photographs showed that the southern channels from Amundsen Gulf to Rasmussen Basin were still unbroken by the third week in June. Puddling of three tenths or more would be common throughout the area. Solid conditions would continue to prevail throughout all the remaining channels including Victoria Strait, Peel Sound, M'Clintock Channel, Viscount Melville Sound and M'Clure Strait. A ten tenth snow cover persisted in all of these areas and there were no signs of melting.

Comments

Typically, the Bathurst Polynya develops in mid-winter and it is unusual that it did not appear before mid-June. The lack of open water in the southern part of the Beaufort Sea at this time of year indicated that the southerly and easterly winds which cause the open areas to develop along with the Bathurst Polynya were weak or non-existent.


Point Barrow
OW
after M.O.T
Barter I.
Tuktoyaktuk
Aklavik
Inuvik
Sachs Harbour
Mould Bay
Isachsen
Resolute
Rea Point
Holman
Paulatuk
Coppermine
Cambridge Bay
Gjoa Haven
72°N
74°N
76°N
78°N
70°N
68°N
66°N
64°N
140°W
150°W
130°W
120°W
110°W
100°W
Ministry of Transport
CONCENTRATION
PREDOMINANT AGE
Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice Island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N) (> 200 m)
2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas
Example 2/1 • 3410 MA 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9
MA 3 - 3/10's Ridging
AA 2 - 2/10's Rafting
∩ 1 - 1/10 Hummocking
Sn 3 - 3/10's Snow covered
Pd 2 - 2/10's Puddling
SURFACE FEATURES
MA - Ridging
AA - Rafting
∩ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth
Th 0 - No Thaw holes
F 0 - No Frozen puddles
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	July 13	Resolute	0840	Alert	1455
2	July 13	Alert	1740	Eureka	2340
3	July 14	Eureka	0930	Mould Bay	1430
4	July 14	Mould Bay	1620	Resolute	2035
5	July 15	Resolute	1050	Cambridge Bay	1440
8	July 17	Tuktoyaktuk	0855	Mould Bay	1245
9	July 17	Mould Bay	1405	Johnson Point	1855
10	July 18	Johnson Point	1230	Resolute	1700
11	July 20	Resolute	1110	Resolute	1700
12	July 22	Resolute	1645	Resolute	2230

MAP 3-1974 East July 13-22

Flight Effectiveness

In spite of the low cloud, fog and rain which restricted observations during tracks three, eleven and twelve, cloudless skies throughout tracks one, two and nine resulted in unlimited visibilities. The Flight effectiveness ranged from 80 to 90 per cent.

Ice Conditions

The obvious changes occurred in Baffin Bay where the first-year ice had disappeared leaving open water and in Prince Regent Inlet where the ice cover had broken and concentrations were reduced to less than nine tenths. The open water areas in the eastern and western ends of Jones Sound had expanded. A similar growth had taken place in Penny Strait and Queens Channel. Ice-free areas were also developing in their usual locations in Belcher Channel and Hendriksen Strait. The break-up in Kennedy Channel continued to advance toward ends of the channel. Throughout the area all ice edges had developed in their usual place and taken on their normal shape. The ice edges across Barrow Strait and Smith Sound remained stationary.

Except for the areas noted above a solid ice cover prevailed across all interior channels of the archipelago. A very rapid reduction of the snow cover had taken place during the early weeks in July and by the third week puddling seldom decreased below three tenths of the surface in all areas including the fringes of the Arctic Ocean adjacent to the coast of northern Ellesmere Island. In some areas such has Fitzwilliam Strait and Hecla and Griper Bay the puddling reached a maximum of five to six tenths of the area. In other areas like Prince Regent Inlet and Eureka Sound puddling had already reached its maximum and had declined to three tenths. In both of these areas thaw holes had started to appear.

Unobserved Areas

Satellite photographs provided enough cloud-free coverage to establish ice conditions in Lancaster Sound, Admiralty Inlet, Navy Board Inlet, Pond Inlet and the central part of Baffin Bay. Conditions shown on Map 3-1974 East for Hazen Strait, Prince Gustaf Adolf Sea and Maclean Strait were deduced from data collected during previous and subsequent surveys over these areas.

Comments

About seven cm of new snow fell in the channels around Cornwallis Island on July 22nd. This increase is indicated by the high proportions, up to seven tenths, observed in McDougall Sound. This would soon melt and once again the ice surface would be bare.

SEA-ICE ATLAS OF ARCTIC CANADA

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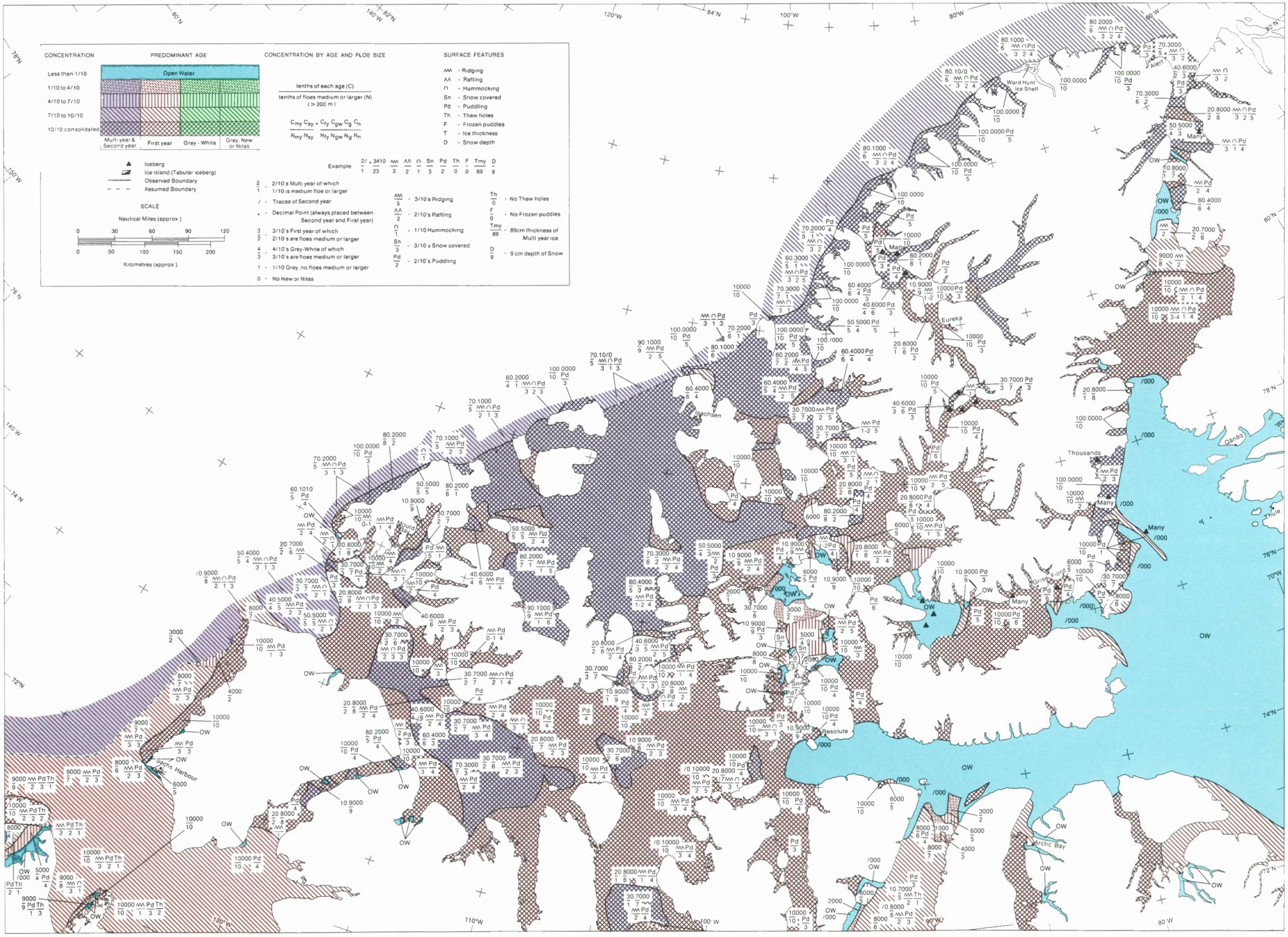
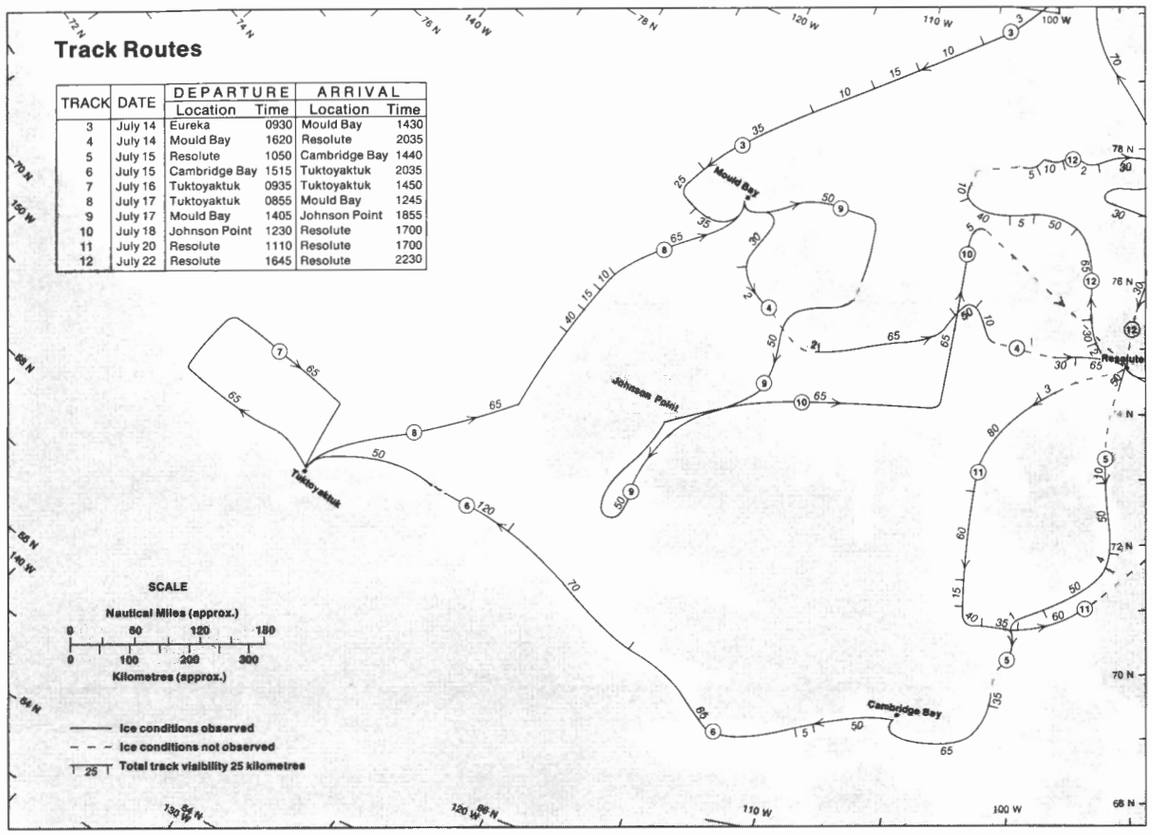


MAP 3 - 1974 EAST

July 13 - 22, 1974



MAP 3-1974 West July 13-22

Flight Effectiveness

Four of the eight tracks over the western part of the archipelago were completed under clear skies with no restrictions on visibilities. Some areas of low cloud, fog and rain temporarily interrupted observations during the other four surveys. The Flight was 90 per cent effective.

Ice Conditions

During the interval between the ends of Flights 2 and 3 rapid ablation had taken place throughout the entire area. Break-up and melting reduced the ice cover in the southern channels. The multi-year ice in the Beaufort Sea moved about 50 kilometres closer to the mainland coast and puddling had developed in all areas. In the southern part of the Beaufort Sea and through the channels as far east as Rasmussen Basin the amount of puddling had reached its maximum and had declined to three tenths. Thaw holes had developed throughout this area with maximums of four tenths occurring in the southern part of the Beaufort Sea. Puddling in M'Clure Strait, Viscount Melville Sound and M'Clintock Channel was increasing toward a maximum of five tenths but no thaw holes had developed yet.

Many cracks were appearing. In the eastern part of Amundsen Gulf and in Liddon Gulf they ran from north to south. In Peel Sound they extended from east to west. Although these areas would not break up until thaw holes appeared, the presence of these tiny areas of open water in Victoria Strait and in the solid fringe along the Tuktoyaktuk Peninsula indicated imminent break-up.

The boundaries separating the solid ice from the moving ice in the Beaufort Sea along Banks Island and across M'Clure Strait appeared in their usual position. The fringe of solid ice in the southern part of the Beaufort Sea north of Tuktoyaktuk was wider than usual but it would soon break up.

Unobserved Areas

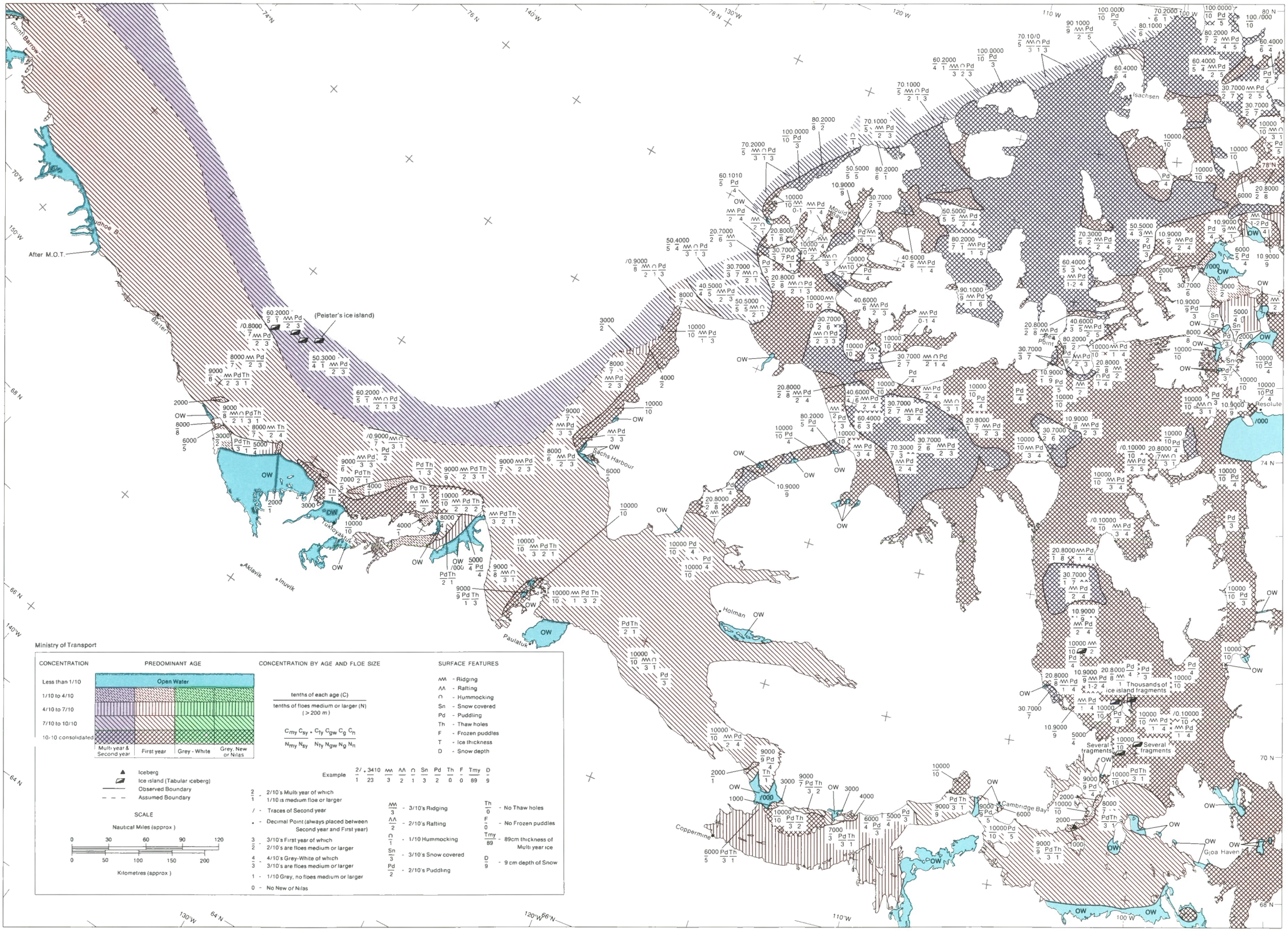
Satellite photographs were used to establish the conditions in the channels around King William Island. Probably many cracks crisscrossed Rasmussen Basin.

Comments

No southerly winds strong enough to move the ice out of the Beaufort Sea had appeared. The area remained congested because the multi-year ice was drifting south to replace the first-year ice as fast as it was melting.

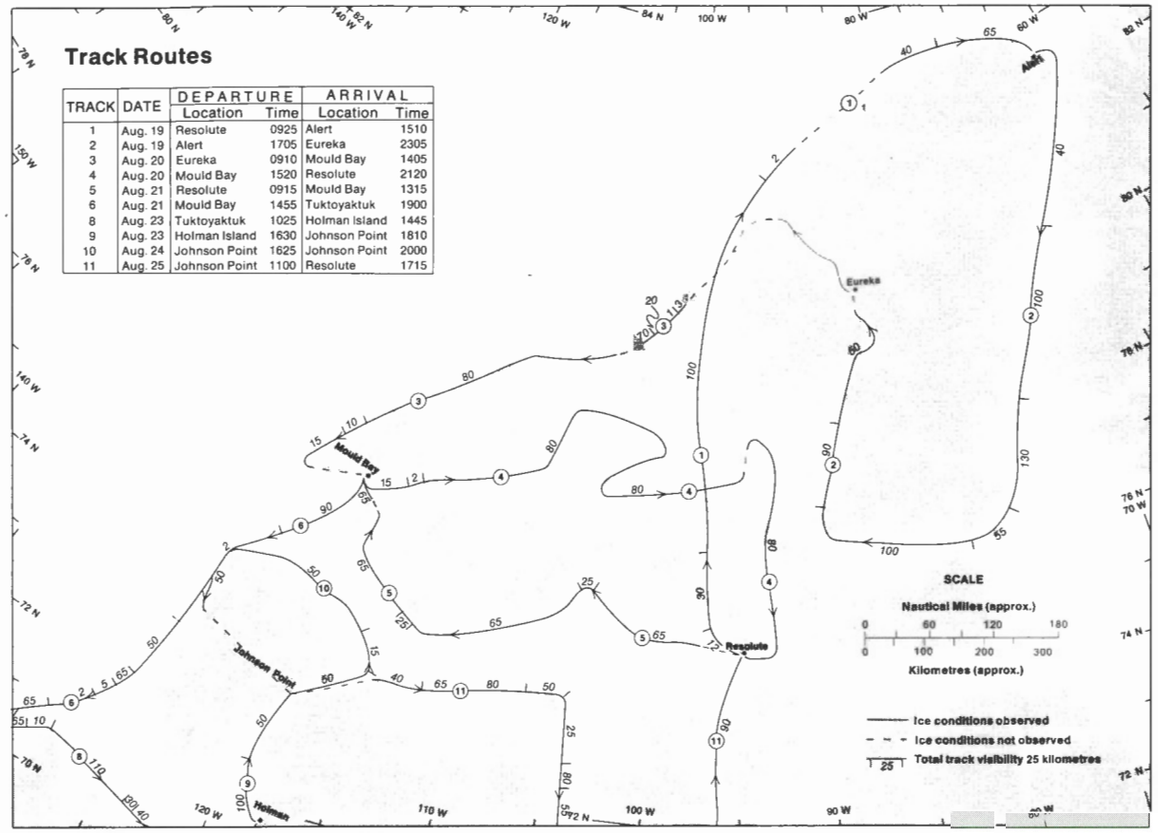
A number of ice islands and ice island fragments were spread out in the southern part of the Beaufort Sea about 200 kilometres north of Herschel Island. The following were located on July 16 during track seven; one piece about 1.6 by .3 kilometres at 71° 08'N, 140°W, a little fragment at 71° 15'N, 140°W, a piece about 1.6 by .3 km at 71° 25'N, 139° 50'W, a piece about 6 by 1.5 kilometres at 71° 24'N, 139° 45'W, a small fragment at 71° 25'N, 138° 50'W and another at 71° 20'N, 138° 10'W. The largest was P-1 measuring about 7 by 3.2 kilometres, located at 71° 20'N, 138° 10'W. P-1, named after the observer, K. Peister, had drifted west a net distance of 95 kilometres since Peister located it on April 5, 1975 at 71° 17'N, 135° 40'W. Ninety-seven days had elapsed between the two sightings indicating that mean net drift was about one kilometre per day. This was a very slow rate compared with other, larger masses of ice, which have drifted through the area.

Subsequent to the sighting on July 16 a party landed on P-1 and noted a pile of empty 45 gallon gas drums. The author, who previously had marked many other ice island fragments, had the drums placed on P-1 on May 20, 1967 at 83° 02'N, 79° 50'W. At that time it was referred to as WH-6 because it had broken away from the Ward Hunt Ice Shelf in the early months of 1967. It was first sighted about 10 to 30 metres from the ice shelf by a U.S. Navy Oceanographic Office, "Birds Eye" flight on April 3, 1967. P-1 was not sighted in the interval between May 20, 1967 and April 5, 1974.



MAP 3 - 1974 WEST

July 13 - 22, 1974



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Aug. 19	Resolute	0925	Alert	1510
2	Aug. 19	Alert	1705	Eureka	2305
3	Aug. 20	Eureka	0910	Mould Bay	1405
4	Aug. 20	Mould Bay	1520	Resolute	2120
5	Aug. 21	Resolute	0915	Mould Bay	1315
6	Aug. 21	Mould Bay	1455	Tuktoyaktuk	1900
8	Aug. 23	Tuktoyaktuk	1025	Holman Island	1445
9	Aug. 23	Holman Island	1630	Johnson Point	1810
10	Aug. 24	Johnson Point	1625	Johnson Point	2000
11	Aug. 25	Johnson Point	1100	Resolute	1715

MAP 4-1974 East

August 19-25

Flight Effectiveness

Despite localized areas of low stratus clouds and fog, the visibilities during the four tracks over the eastern part of the archipelago were very good. Flight effectiveness ranged from 80 to 90 per cent.

Ice Conditions

Considerable change in the ice conditions had taken place in the eastern part of the region between the third week in July and the third week in August. Generally the normal patterns of break-up and clearing had developed and the timing in most areas was normal. The exceptions to this occurred in Jones Sound and Nares Strait. During the interval between the two flights these channels broke up in their usual way but the amount of ablation and the resulting amount of open water that appeared was greater than is usually expected in a season like 1974. Ice conditions in one other area, McDougall Sound, differed slightly from the expected situation because the ice in this channel broke up more than two weeks ahead of the expected date.

Signs of the fall freeze-up had already appeared throughout the region as frozen puddles had developed in many areas. This along with a fresh snow cover in the central areas was contradicted to some extent by the unusually large numbers of puddles which continued to exist in the restricted areas north of Axel Heiberg Island and in Sverdrup Channel. Freezing temperatures would soon spread over these areas.

Unobserved Areas

Satellite photographs provided enough information to determine ice conditions in Lancaster Sound and the adjacent channels to the south as well as the central part of Baffin Bay. Conditions shown on Map 4-1974 East for a portion of the area along the north coast of Ellesmere Island and to the north of Byam Martin Channel were based on observations made in adjacent areas.

Comments

The season was advancing at the normal rate. This was evident by the amount of unbroken ice in the central and northern channels. Another indicator was the relatively small amount of clearing which had developed in the southern half of Norwegian Bay, in Belcher Channel, Hendriksen Strait and the length of Eureka Sound.

SEA-ICE ATLAS OF ARCTIC CANADA

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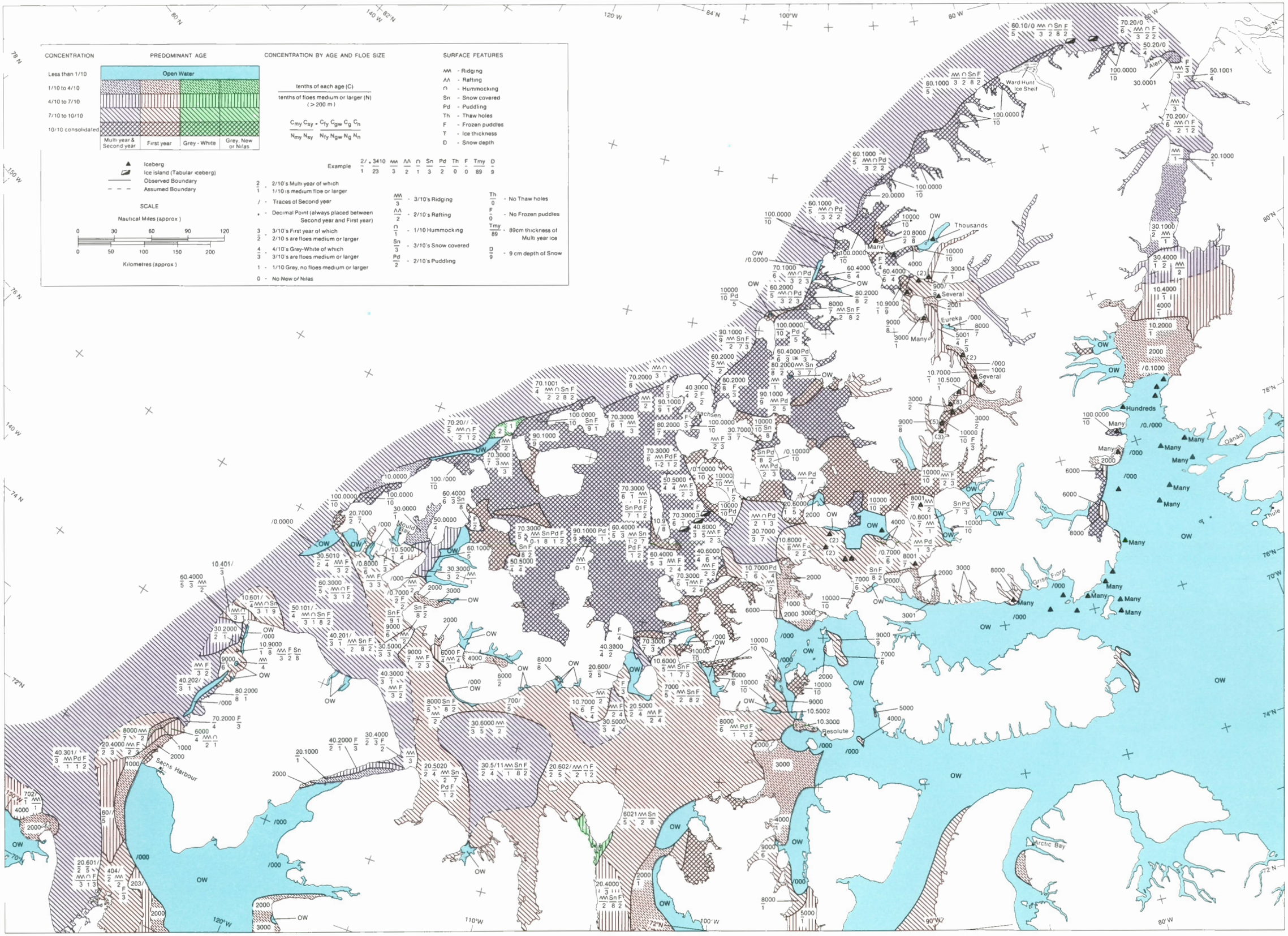
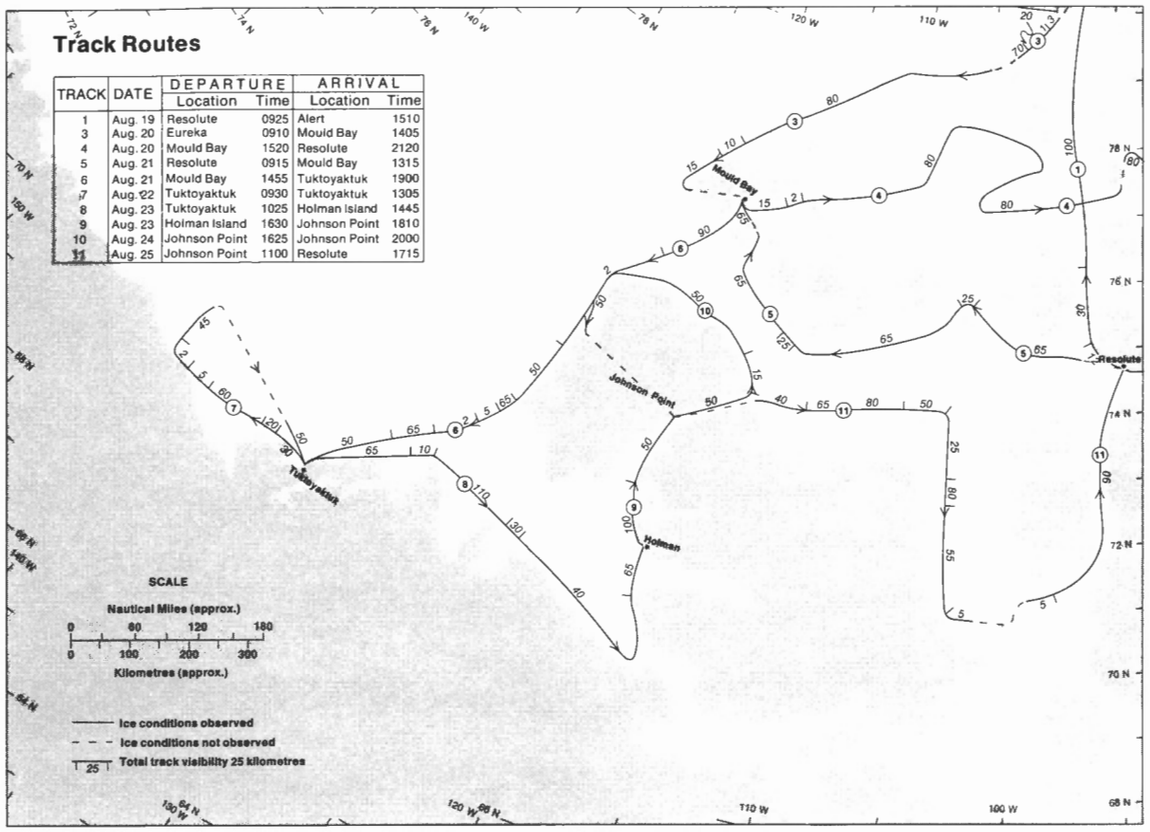


MAP 4 - 1974 EAST

August 19 - 25, 1974



MAP 4-1974 West

August 19-25

Flight Effectiveness

Fog and low cloud ceilings limited visibilities during some portion of each of the seven tracks carried out over the western part of the region during Flight 4. In spite of periodic reductions caused by the weather, Flight effectiveness was 75 per cent.

Ice Conditions

During the four-week interval separating the end of Flight 3 and the end of Flight 4, ice conditions in every area changed. The degree of change varied considerably depending on the area. In M'Clintock Channel and Peel Sound, the ice cover had broken up as much as three weeks earlier than usual and by the third week in August much of the original ice cover had melted. Typically, these channels exhibit the ice conditions shown on Map 4-1974 West in the middle of September. The break-up in Viscount Melville Sound and M'Clure Strait was not followed by the same degree of melting that took place in M'Clintock Channel and Peel Sound, but the movements which were observed in the two areas forming the western half of Parry Channel were considerable. Multi-year ice moved into the western part of M'Clure Strait and forced the existing ice to move east into the southern part of Viscount Melville Sound. The movements in Viscount Melville Sound had rearranged the area of multi-year ice which previously covered the western part of the sound.

While the channels between Coronation Gulf and Rasmussen Basin had become ice-free, the amount of ice that melted in Dolphin and Union Strait and Amundsen Gulf was less than usual for this time of year. Indeed, ice conditions throughout the Beaufort Sea were much more concentrated than they usually are at this season. The tongue of multi-year ice which forced its way through Amundsen Gulf and into Franklin Bay was not entirely unexpected considering the conditions in the remainder of the area.

Unobserved Areas

Ice conditions shown for Coronation Gulf, Dease Strait, Queen Maud Gulf, Victoria Strait and Rasmussen Basin were determined from satellite photographs. Conditions observed in the southern part of M'Clintock Channel and in Franklin Strait provided the key to establish the ice types in the adjacent channels to the south.

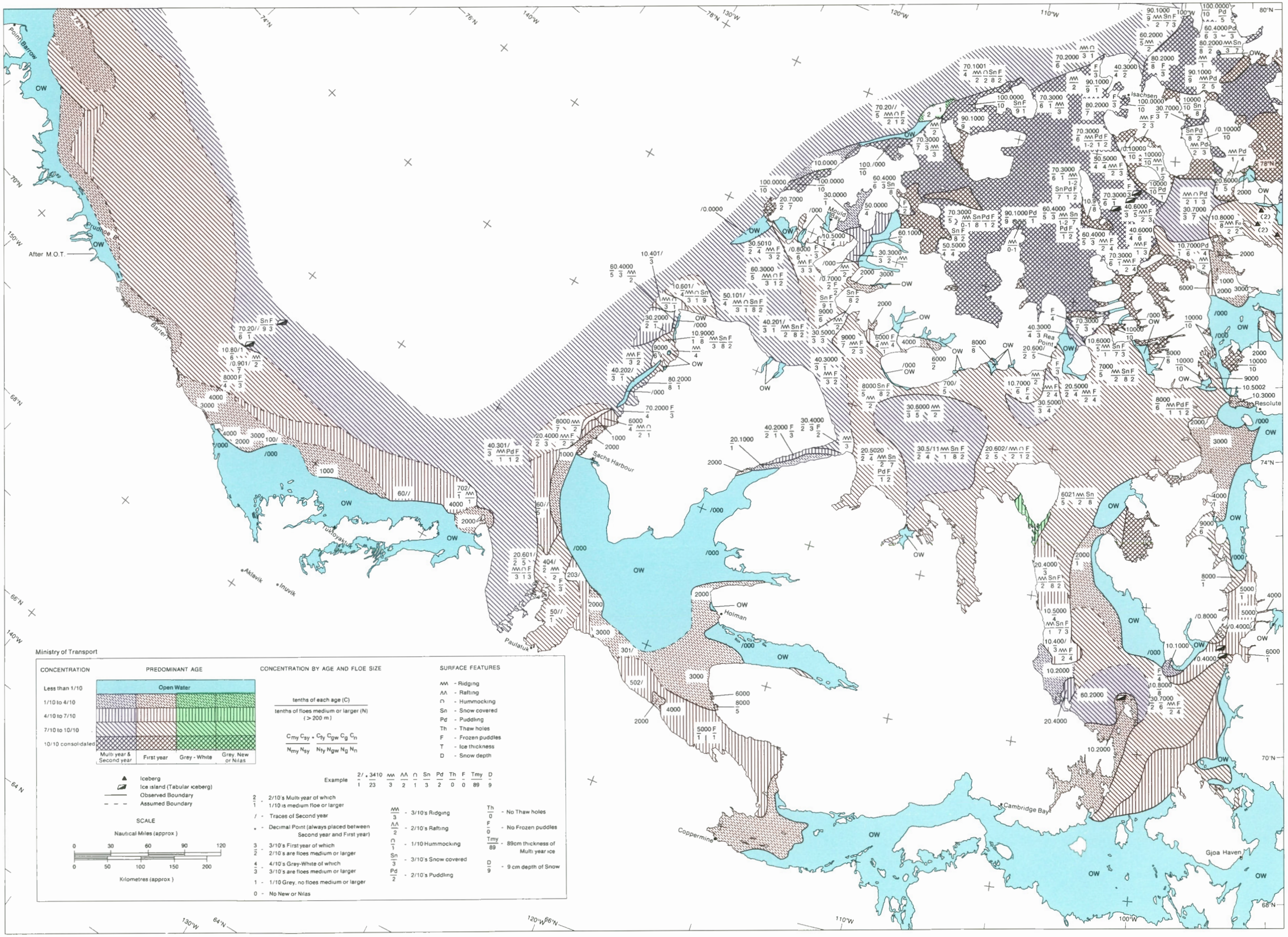
Comments

New snow, frozen puddles and the appearance of traces of new ice heralded the advance of the winter season throughout most of the region. This fact did not add any hope for relief from the terrible shipping conditions which continued to exist in the southern part of the Beaufort Sea. The unfavourable conditions in this area continued because once again winds from the south had failed to materialize in sufficient strength to move the ice away from the coast. Although the first-year ice in the Beaufort Sea had continued to melt, multi-year ice from the north moved in to replace it as fast as it disappeared. By the end of Flight 4 the multi-year ice had moved another 50 kilometres further south and now menaced the coast from a position only 75 kilometres from shore.

The ice island, P-1, was not seen. Two other ice islands were located about 150 kilometres north of Herschel Island. The larger measuring 2.4 by 1 kilometre, was sighted at 70° 39'N, 140°W and the smaller, about 1.6 by .8 kilometres, was located at 71°N, 139° 35'W.

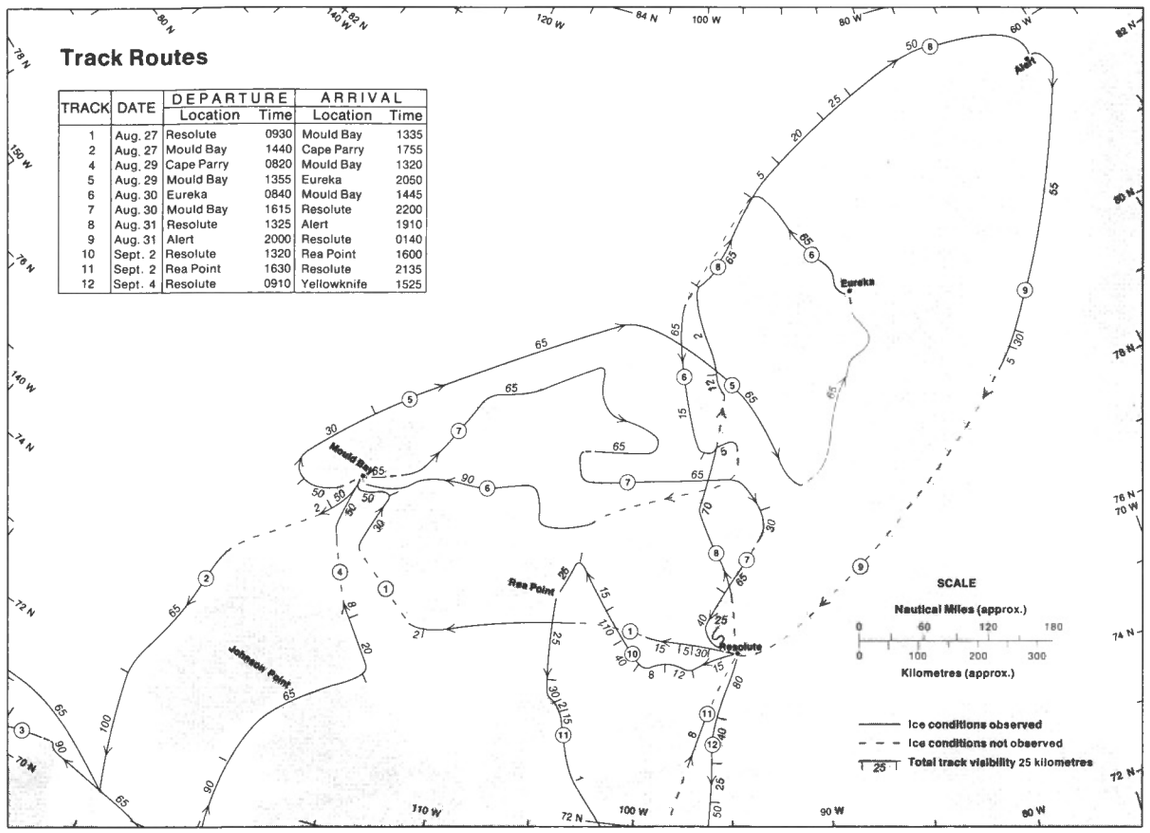
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 4 - 1974 WEST

August 19 - 25, 1974



MAP 5-1974 East

August 27-September 4

Flight Effectiveness

Seasonal weather including low cloud ceilings and fog restricted visibilities during portions of each of the five tracks carried out over the eastern part of the archipelago. The Flight was nearly 80 per cent effective.

Ice Conditions

No appreciable interval of time separated Flight 4 from Flight 5. These Flights are planned this way because in normal years the greatest changes take place during the interval from mid-August through mid-September. The trends of break-up previously established in Norwegian Bay gradually continued until by the end of Flight 5 the ice in the northeastern quarter of the bay had broken up. The classic pattern of break-up took place throughout Norwegian Bay in 1974. Similarly, the characteristic sequence was developing as break-up gradually extended to the west across the unnamed sea toward Lougheed Island. Besides following its typical pattern, the break-up in these two areas advanced within the time frame for a normal year. The boundaries separating the solid ice from the moving ice in all other parts of the area, including Byam Martin Channel, Hassel Sound, and Nansen Sound, remained in the same position. A temporary halt in the progression of break-up is usually expected in these areas during any type of ice year.

Throughout the entire area the puddles remained frozen, fresh snow up to ten tenths in some areas but generally about eight tenths had fallen, and many of the small open areas in the northern channels were supporting increasing quantities of the younger forms of ice.

While the broken ice in the central areas was slowly drifting toward the south, a similar flow was taking place through Nares Strait. On August 19th, concentrations in Kennedy Channel were less than four tenths. Twelve days later, on August 31st, the northern half of the channel supported similar concentrations of multi-year ice and some of this ice had moved into the southern part of the channel. This ice had moved about 100 kilometres in 13 days or about seven kilometres per day.

Unobserved Areas

Satellite photographs were used to establish the conditions throughout Baffin Bay, Jones Sound as well as Lancaster Sound and its adjacent channels extending to the south. Probably, traces of new types of ice were beginning to appear in all of these areas.

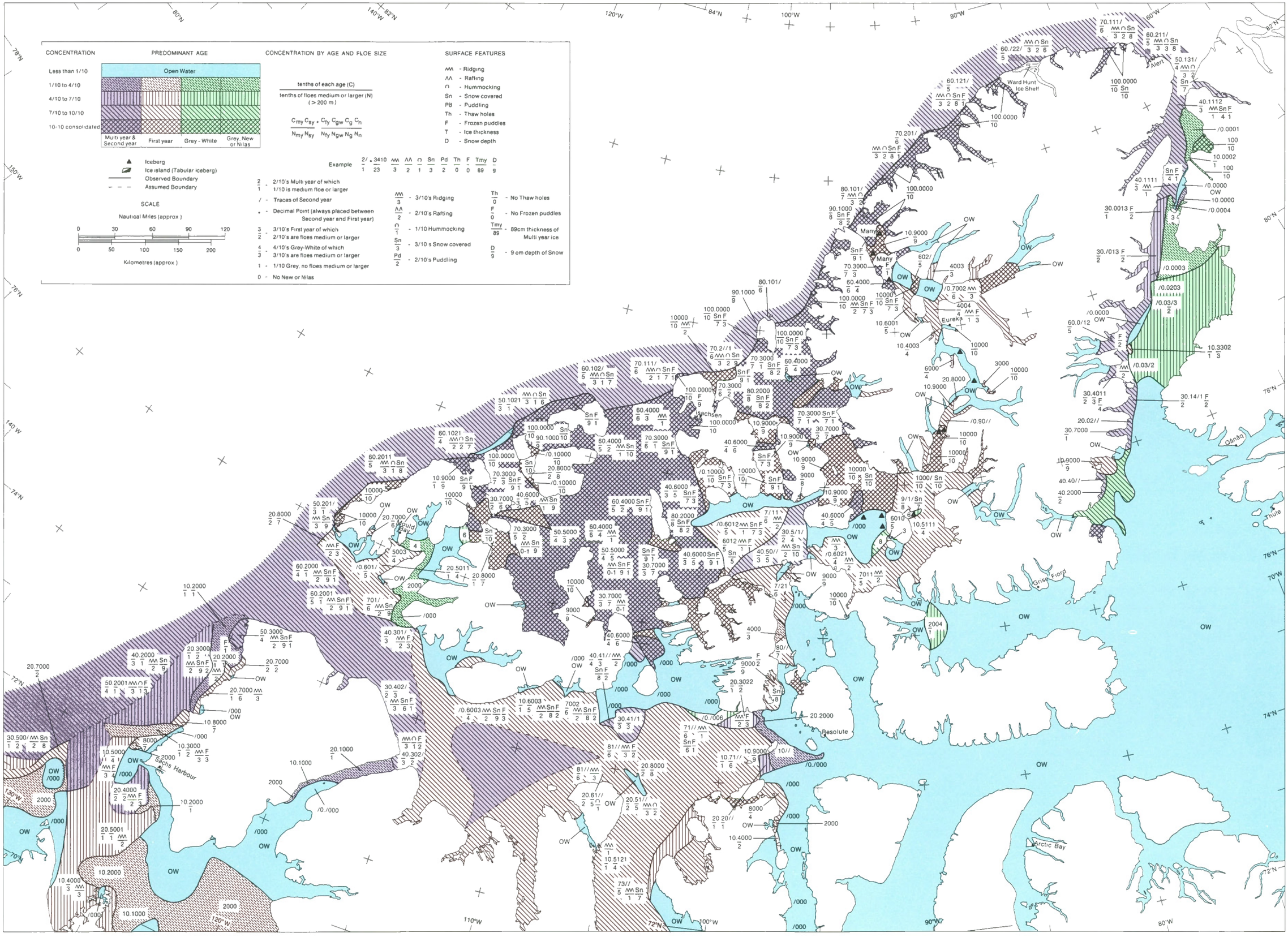
Comments

The ice conditions throughout the eastern part of the archipelago observed during this Flight were typical of those expected in a normal season.

On August 29th, two ships escorted by the icebreaker, "JOHN A. MACDONALD", were observed as they ploughed their way through the solid ice cover in the southern part of Eureka Sound.

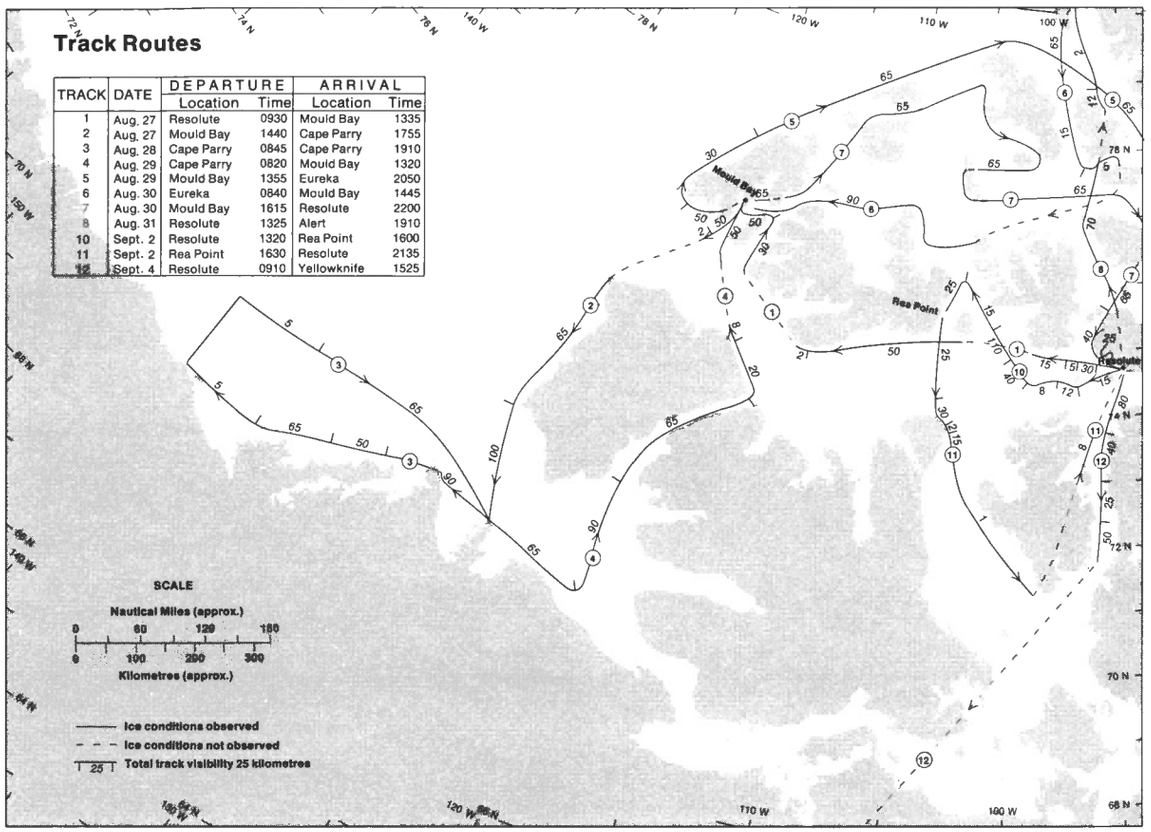
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 5 - 1974 EAST

August 27 - September 4, 1974



MAP 5-1974 West

August 27-September 4

Flight Effectiveness

Typical early fall weather conditions were encountered during each of the seven tracks over the western part of the archipelago. A number of types of weather effectively reduced visibilities; from most persistent to the least these were low stratus clouds, fog, rain and freezing drizzle. The Flight effectiveness approached 60 per cent.

Ice Conditions

Apart from considerable clearing in the southern part of M'Clintock Channel and the development of the open water area around Byam Martin Island, ice conditions throughout the area at the end of Flight 5 were very similar to those at the end of the previous Flight. Frozen puddles along with new snow continued to exist in all areas except the southern Beaufort Sea and along the passages between the mainland and Victoria Island. The new forms of ice were appearing in all areas where small patches of open water had developed. Similar conditions were just starting to develop in Peel Sound.

The area south of Byam Martin Island was observed on August 21st and again on August 27th. During this seven-day interval an expanse of open water about 65 kilometres wide came into existence as the ice drifted to the south at a rate of nearly ten kilometres per day. A similar rate prevailed as ice in the southern part of M'Clintock Channel moved south into the western part of Victoria Strait.

Unobserved Areas

Ice conditions shown in the channels separating Victoria Island from the mainland, around King William Island and in the southern portions of M'Clintock Channel were deduced from satellite photographs.

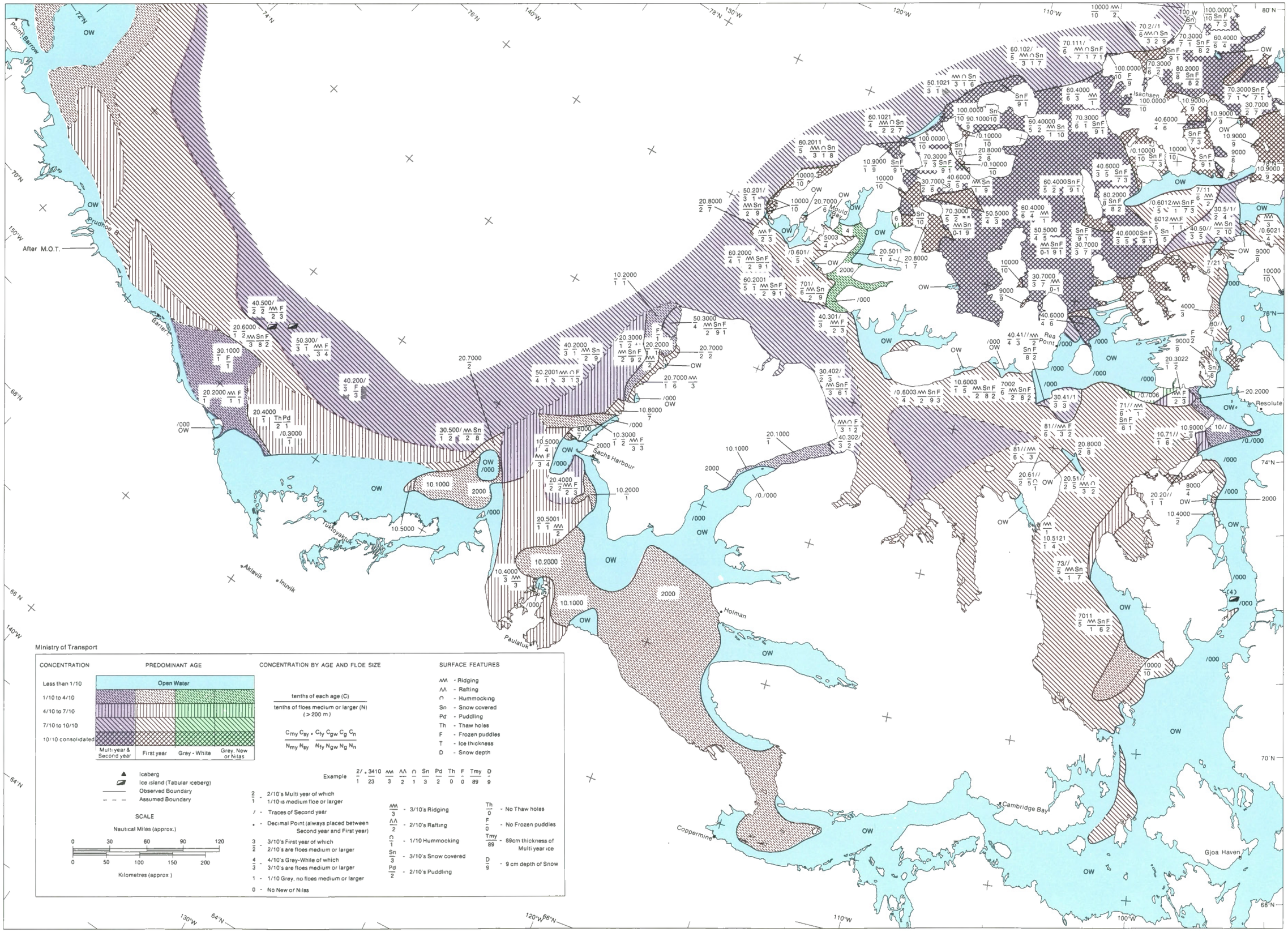
Comments

In spite of the slight increase in the width of the open water area north of Tuktoyaktuk Peninsula and a small reduction in concentrations near Amundsen Gulf, ice conditions in the southern part of the Beaufort Sea continued to thwart shipping in the area. No noticeable change in the position of the southern limit of the multi-year ice had taken place.

A number of ice islands and fragments of ice islands were located. Many fragments were strung out along the coast of Boothia Peninsula. Some of the pieces in Franklin Strait had moved north into the southwestern extremity of Peel Sound. In the Beaufort Sea a number of ice islands were located about 160 kilometres north of Herschel Island. One of the larger ones was spotted at 70° 57'N, 140°W and the largest, P-1, was relocated at 71° 10'N, 139° 10'W. Both of these and their accompanying fragments were sighted on August 28th during track 3. The area of P-1 was reduced as another portion of it had recently broken off and rested about 500 metres from the main island. During the 44-day interval between the last sighting of P-1 on July 16 and the August 28 position, the mass of ice had moved a net distance of 40 kilometres in a westerly direction. The average net daily rate of about one kilometre per day and the direction of travel during this part of the drift were almost the same as those noted from April 5 to July 16. As in the previous interval the rate of drift appeared to be slower than the rates normally expected in this area at the same time of year. P-1 was not located again during Polar Continental Shelf Project ice reconnaissance surveys, but there are reports that it was located near Wrangle Island during the winter of 1974-75.

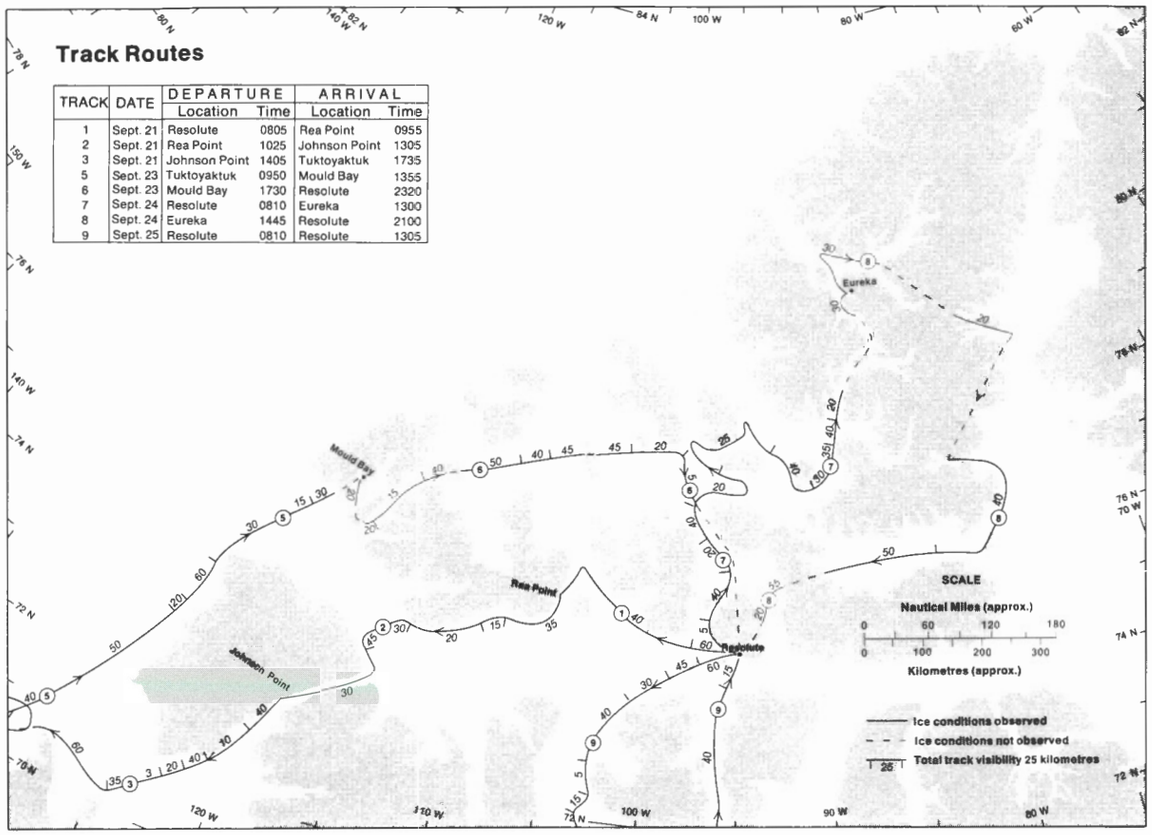
SEA-ICE ATLAS OF ARCTIC CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES
POLAR CONTINENTAL SHELF PROJECT



MAP 5 - 1974 WEST

August 27 - September 4, 1974



MAP 6-1974 East

September 21-25

Flight Effectiveness

Only three tracks were carried out over the eastern part of the archipelago during Flight 6. Generally low cloud, ice fog and poor light reduced visibilities during one third of each of these tracks. Fortunately, these tracks were carried out over the main areas where changes might have taken place and, although large parts of the area were not observed, the Flight was about 60 per cent effective.

Ice Conditions

Almost three weeks had elapsed between the end of Flight 5 and the start of Flight 6. During this period no major or unanticipated changes had taken place. Break-up was completed in the northwestern part of Norwegian Bay and the ice edge across the southern part of Massey Sound was in the position it usually occupies at this time in typical years like 1974. Similarly, the ice edges separating the moving ice from the solid ice across Maclean Strait, Nansen Sound and Byam Martin Channel were located in their normal positions at the expected time. The boundary across Byam Martin Channel had recently formed as indicated by the large unbroken floes of multi-year ice just starting to move out of the area.

The northern channels had remained unbroken and no ice was allowed to enter the archipelago. Generally, movements in the broken areas of the interior channels were very limited. However, multi-year ice had continued to move south through Nares Strait and into Baffin Bay in a series of periodic pulses through Smith Sound. By August 31st multi-year and the other forms of ice in concentrations of seven tenths or more had invaded the northern half of Kennedy Channel. Similar types and concentrations were noted on September 24th near the southern extremity of Kane Basin. During the 25-day interval, the ice in Nares Strait appeared to move about 350 kilometres further south. This means a net drift of about 14 kilometres per day which was twice as fast as the rate through Kennedy Channel and about half as fast as the rate described for the northern part of Baffin Bay during the latter part of September, 1973.

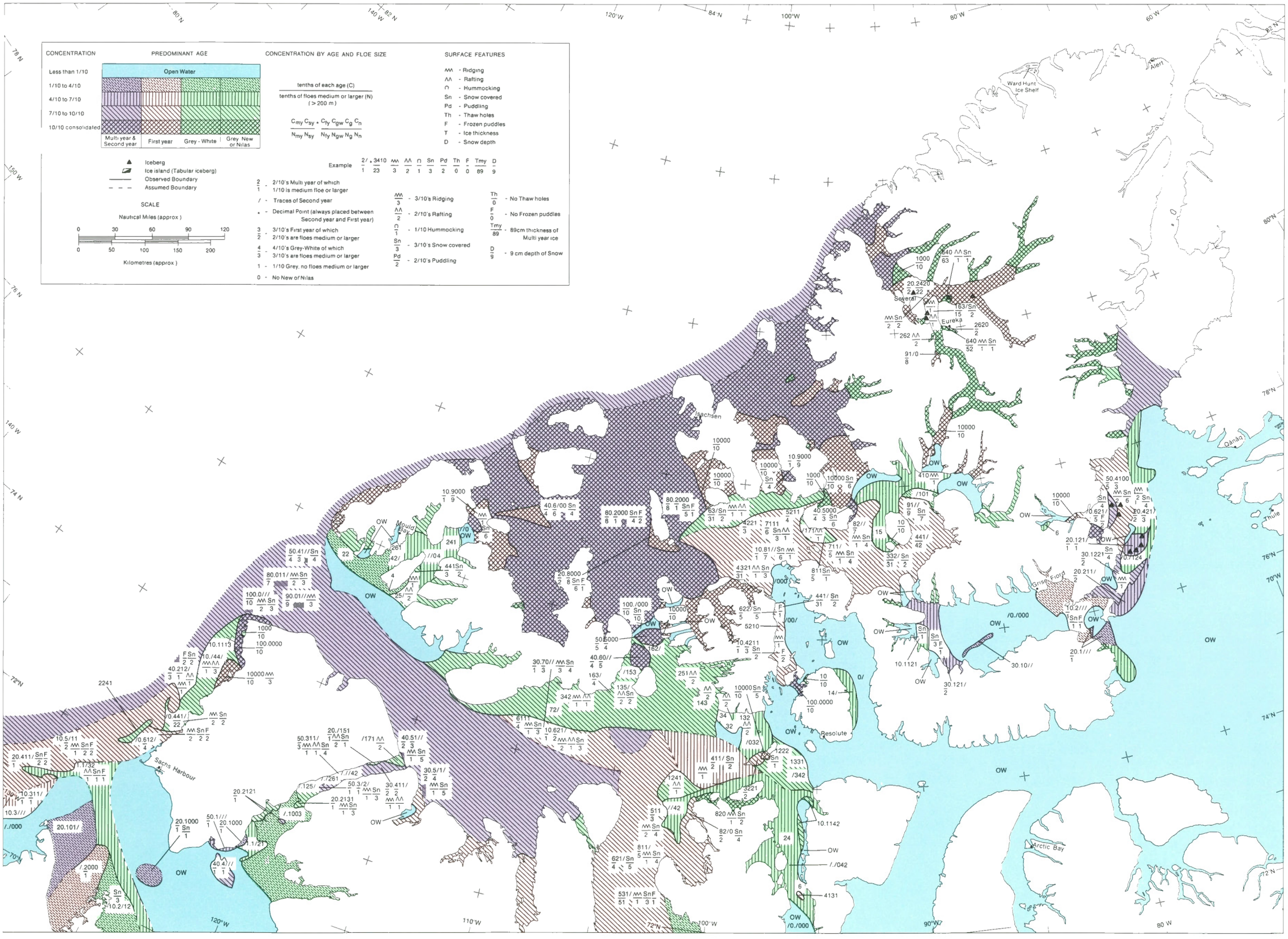
Unobserved Areas

Satellite photographs provided the basic information to deduce ice conditions in Baffin Bay, Lancaster Sound and the channels running south from it. Patterns shown in the northern channels and along the fringe of the archipelago adjacent to the Arctic Ocean were determined from previous and subsequent surveys. Probably, the concentrations in the portion of Nares Strait not shown on this map would resemble those indicated on Map 7-1974 East.

Comments

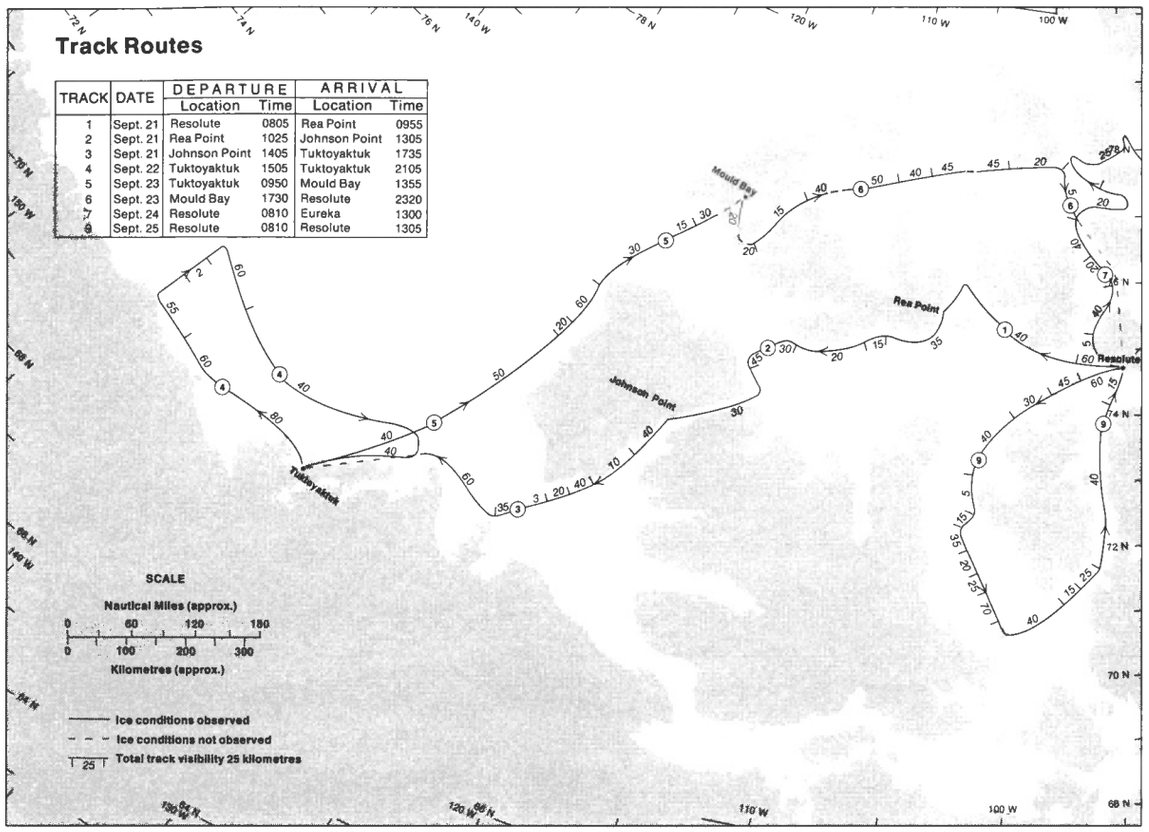
There is a considerable variation in drift rate of ice through Nares Strait. These variations are primarily dependent upon the speed and direction of surface winds, although type and concentrations of ice, the area of the strait, and the southerly flowing current in the strait, are other influencing factors.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 6 - 1974 EAST

September 21 - 25, 1974



MAP 6-1974 West

September 21-25

Flight Effectiveness

Low cloud ceilings and the occasional area of fog limited the horizontal visibilities during Flight 6 resulting in a Flight effectiveness of about 75 per cent.

Ice Conditions

Apart from the southerly drift of the older forms of ice in the eastern half of Viscount Melville Sound and western Barrow Strait, the formation of new ice in most of the areas that were previously ice-free, and the drift of multi-year ice in M'Clure Strait and Viscount Melville Sound, only small differences in ice conditions had developed in the western part of the archipelago during the interval between the end of Flight 5 and the start of Flight 6.

The easterly drift of multi-year ice through M'Clure Strait and into Viscount Melville Sound had persisted since the ice cover in the western part of Parry Channel broke up sometime during the first two weeks in August. The invasion of this ice was a very gradual process and the actual total area of ice that entered M'Clure Strait would be less than one third of the total area of M'Clure Strait.

The area of open water, now covered with a variety of young ice types, which once existed south of Byam Martin Channel, usually appears in this area each year. The width of the area was slightly greater in 1974 than normal.

In the Beaufort Sea the southern boundary of the multi-year ice continued to exist in the same area. Some of the concentrations in the eastern part of the sea adjacent to Amundsen Gulf were reduced, but there was a corresponding increase in concentration and decrease in the amount of open water in the extreme southern portion of the Beaufort Sea extending along the mainland.

Unobserved Areas

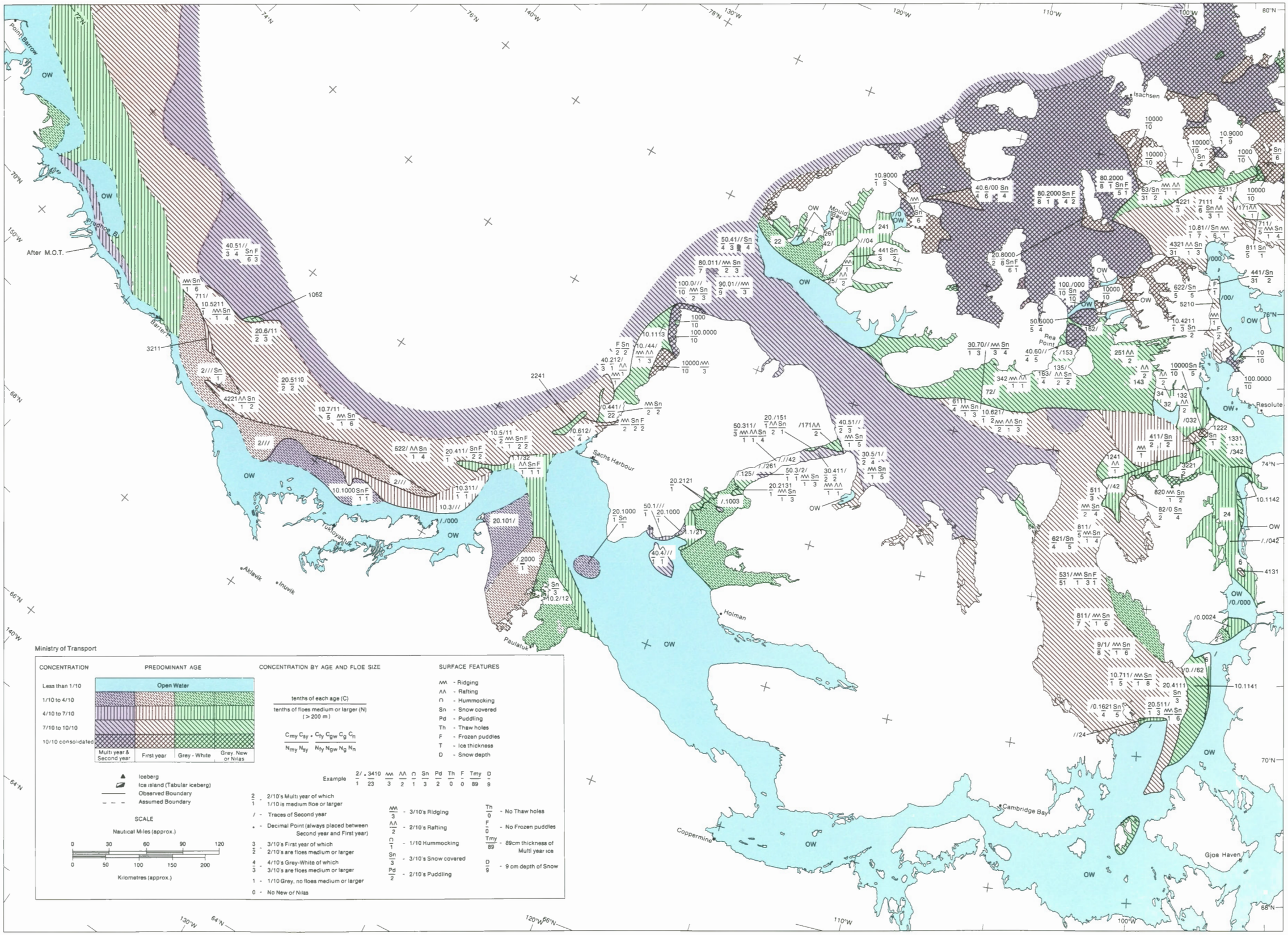
The first-year ice in the eastern part of Amundsen Gulf as well as Dolphin and Union Strait had finally melted leaving an ice-free passage to Cambridge Bay and on to Resolute. However, by the third week in September the younger forms of ice were beginning to appear once again. Satellite photographs showed the gradual decrease of the first-year ice cover. Satellite pictures were also used to help determine the situation in the central parts of M'Clure Strait and Viscount Melville Sound.

Comments

The search for the ice island, P-1, in the western part of the Beaufort Sea was thwarted by poor weather and the accompanying low range of visibilities. The island was not located.

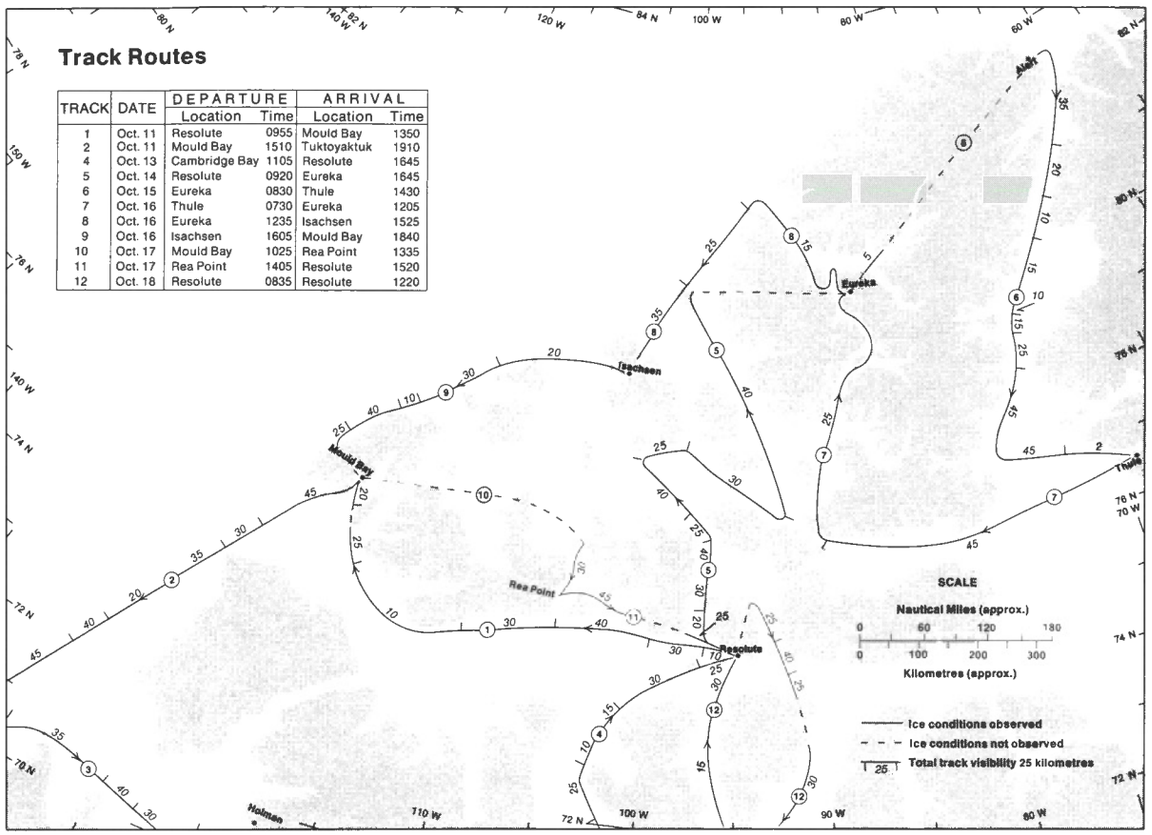
Occasionally multi-year ice does enter M'Clure Strait and some moves further east into Viscount Melville Sound in response to favourable winds. Probably, winds from the same general direction were responsible for pressing the ice in the Beaufort Sea close to the mainland coast throughout the summer.

The vessel "CARINO", a seismic survey vessel operated by Geophysical Services Incorporated, Calgary, made the first visit on record to Mould Bay.



MAP 6 - 1974 WEST

September 21 - 25, 1974



TRACK	DATE	DEPARTURE		ARRIVAL	
		Location	Time	Location	Time
1	Oct. 11	Resolute	0955	Mould Bay	1350
2	Oct. 11	Mould Bay	1510	Tuktoyaktuk	1910
4	Oct. 13	Cambridge Bay	1105	Resolute	1645
5	Oct. 14	Resolute	0920	Eureka	1645
6	Oct. 15	Eureka	0830	Thule	1430
7	Oct. 16	Thule	0730	Eureka	1205
8	Oct. 16	Eureka	1235	Isachsen	1525
9	Oct. 16	Isachsen	1605	Mould Bay	1840
10	Oct. 17	Mould Bay	1025	Rea Point	1335
11	Oct. 17	Rea Point	1405	Resolute	1520
12	Oct. 18	Resolute	0835	Resolute	1220

MAP 7-1974 East

October 11-18

Flight Effectiveness

Considering the time of year, visibilities during the eight tracks over the eastern part of the region were generally good, although ice crystals and poor light did affect visibilities. The effectiveness of Flight 7 was about 60 per cent.

Ice Conditions

Almost three weeks had elapsed between the end of the previous Flight and the beginning of Flight 7. During this interval new forms of ice had continued to develop until all the previously open areas of the interior channels ceased to exist. The ice cover in the northern channels had remained solid and unmoving while the ice edges separating the unbroken ice from the moving ice remained stationary. This lack of movement or advance of the ice edges was expected because the ice usually does not break up in the northern channels during a normal year and the ice conditions which developed during the summer of 1974 were typical for an average year.

Unobserved Areas

The fall weather together with the reduced amounts of sunlight considerably restricted horizontal visibilities. The result is that only portions of the ice conditions in the wider channels could be surveyed. In those cases where data gathered in previous and subsequent surveys of a particular channel indicated identical trends, these partial observations were assumed to reflect the ice conditions across the entire width of the channel. This technique was used to reduce the situation on many channels shown on Map 7-1974 East including Nares Strait, Jones Sound, Nansen Sound and Wellington Channel.

In areas such as the central area of Prince Gustaf Adolf Sea ice conditions shown on Map 7 are based on the knowledge that if observations show the extremities of the area to be solid, the central part will also remain unbroken. A similar approach was used for Hazen Strait and Hecla and Griper Bay.

Satellite photographs along with observations in adjacent areas were used to establish the situation in central Baffin Bay, Lancaster Sound and the channels to the south of it.

At this time of year the sun does not rise above the horizon in the latitudes of northern Ellesmere Island and no attempt was made to survey the area. Probably a solid fringe of ice a few kilometres wide paralleled the coast to the boundary zone where the moving ice in the Arctic Ocean would be met. This condition would likely extend from Nansen Sound to Alert.

Comments

If a solid ice cover continues to exist across the northern channels throughout September and into October, as it did in all these areas in 1974, the ice will remain unbroken for the rest of the winter.

CONCENTRATION

Less than 1/10
1/10 to 4/10
4/10 to 7/10
7/10 to 10/10
10/10 consolidated

PREDOMINANT AGE

Open Water

Multi year & Second year	First year	Grey - White	Grey, New or Nilas

Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary

SCALE

Nautical Miles (approx.)

0 30 60 90 120

0 50 100 150 200

Kilometres (approx.)

CONCENTRATION BY AGE AND FLOE SIZE

$$\frac{\text{tenths of each age (C)}}{\text{tenths of floes medium or larger (N)}\ (>200\ \text{m})}$$

$$\frac{C_{my}\,C_{sy} \bullet C_{fy}\,C_{gw}\,C_g\,C_n}{N_{my}\,N_{sy}\quad N_{fy}\,N_{gw}\,N_g\,N_n}$$

Example $\frac{2/\bullet 3410}{1\ 23}\ \frac{\wedge\wedge}{3}\ \frac{\wedge\wedge}{2}\ \frac{\cap}{1}\ \frac{Sn}{3}\ \frac{Pd}{2}\ \frac{Th}{0}\ \frac{F}{0}\ \frac{Tmy}{89}\ \frac{D}{9}$

$\frac{2}{1}$ - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
$\frac{3}{2}$ - 3/10's First year of which 2/10's are floes medium or larger
$\frac{4}{3}$ - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas

SURFACE FEATURES

$\wedge\wedge$ - Ridging
$\wedge\wedge$ - Rafting
$\cap$ - Hummocking
Sn - Snow covered
Pd - Puddling
Th - Thaw holes
F - Frozen puddles
T - Ice thickness
D - Snow depth

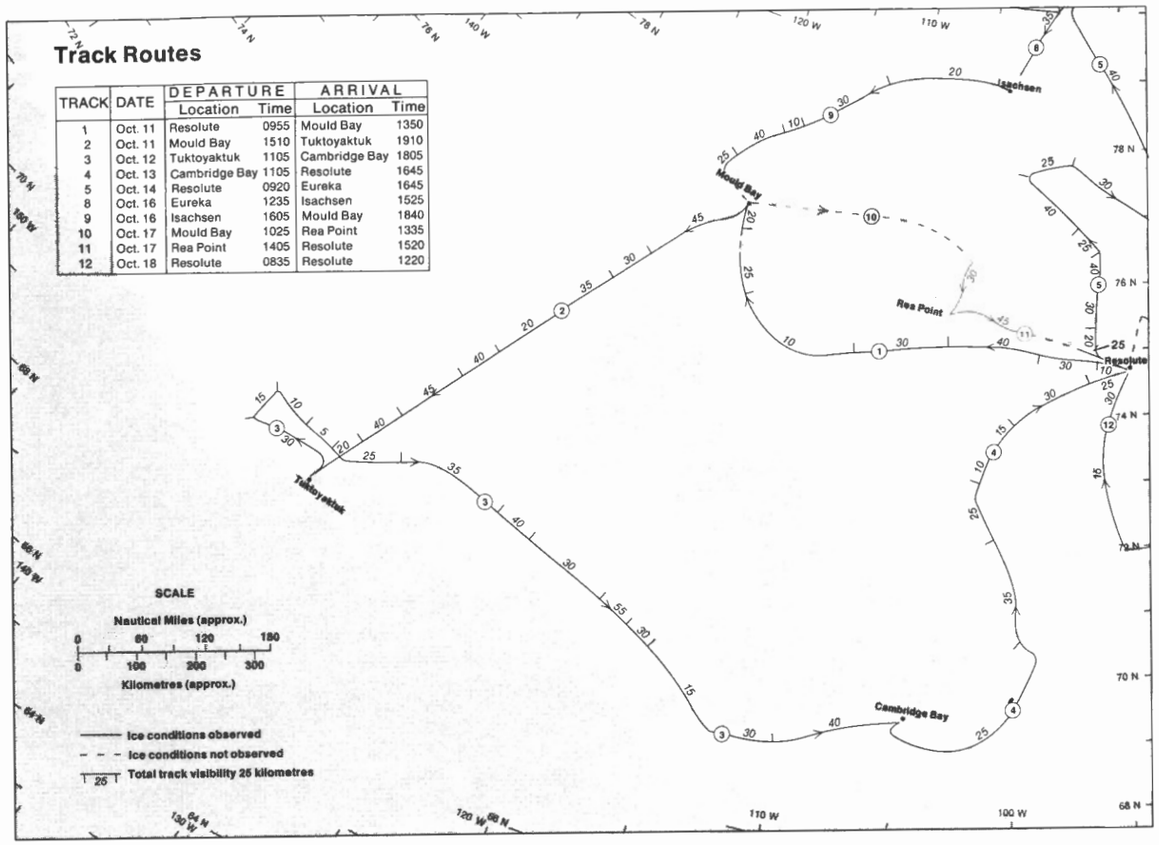
$\frac{\wedge\wedge}{3}$ - 3/10's Ridging
$\frac{\wedge\wedge}{2}$ - 2/10's Rafting
$\frac{\cap}{1}$ - 1/10 Hummocking
$\frac{Sn}{3}$ - 3/10 s Snow covered
$\frac{Pd}{2}$ - 2/10's Puddling

$\frac{Th}{0}$ - No Thaw holes
$\frac{F}{0}$ - No Frozen puddles
$\frac{Tmy}{89}$ - 89cm thickness of Multi year ice
$\frac{D}{9}$ - 9 cm depth of Snow

Alert
Ward Hunt Ice Shelf
Eureka
Isachsen
Resolute
Arctic Bay
Qânaq
Several (50)
Several (100)
Griselle Fiord
Sachs Harbour
OW

MAP 7 - 1974 EAST

October 11 - 18, 1974



MAP 7-1974 West

October 11-18

Flight Effectiveness

The visibilities during all five tracks over the western part of the region during Flight 7 were considerably reduced by low cloud ceilings, fog and ice crystals. These conditions are normally expected at this time of year. The Flight was slightly more than 50 per cent effective.

Ice Conditions

A number of changes had taken place in the western part of the archipelago during the interval between the end of Flight 6 and the finish of Flight 7. The first of these was the normal aging process for first-year ice. All of this type of ice which remained unmelted at the beginning of October was renamed second-year ice. Because of this name change, the colour indicating the major concentration of ice also changes from the red, designating a predominant cover of first-year, to purple which shows that multi-year ice is the major component of the ice cover. A cursory comparison of Maps 6 and 7 might be misleading if it was assumed that the colour change, especially in M'Clintock Channel, meant that large amounts of multi-year ice had drifted into the area since the previous Flight. In reality, the ice in this area was the same as it was before October first except that convention and convenience arbitrarily made it one year older.

The second change was the continued expansion of the young types of ice into all areas which were previously ice-free. The last two changes were the movements of ice in Barrow Strait and M'Clintock Channel. All the older ice in the southwestern half of the former area had disappeared. Probably it had moved into the northern part of M'Clintock Channel because no signs of similar ice were noted in eastern Barrow Strait, and it was unlikely that this amount of ice had melted in situ at this time of year. The southerly movement throughout the length of M'Clintock Channel and into Victoria Strait was considerable. During the 19 days which separated surveys over the southern regions of M'Clintock Channel, the ice had drifted nearly 200 kilometres or about 10 kilometres per day. Winds from the north were the probable cause of the drifts in M'Clintock Channel and Barrow Strait.

Unobserved Areas

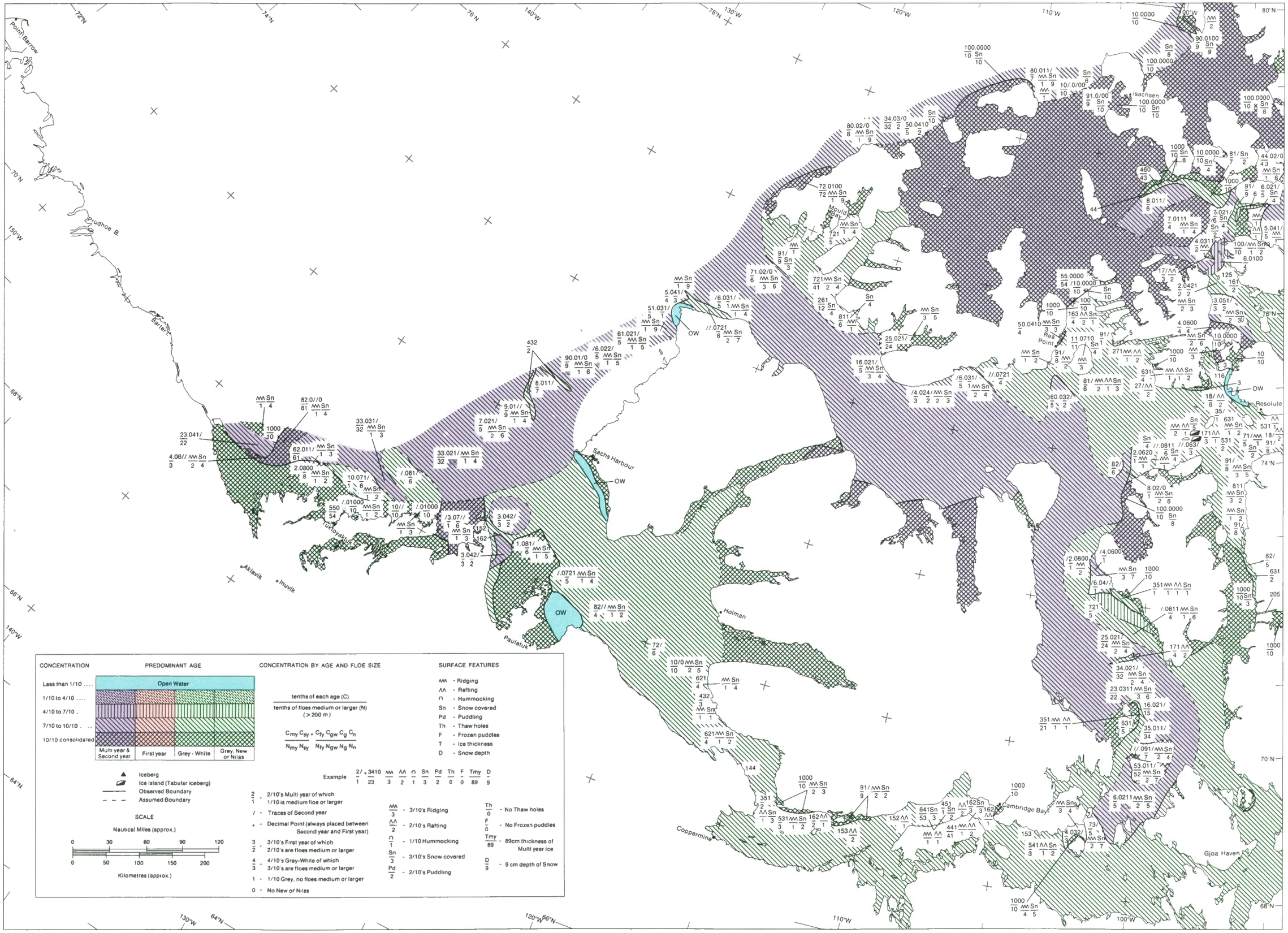
On the basis of previous and subsequent observations, the limited horizontal coverage gained in the surveys from Amundsen Gulf through M'Clintock Channel and Peel Sound and on to Resolute were considered to reflect the conditions in the adjacent parts of these channels.

Similarly, the western part of Parry Channel was only partially surveyed during track 1 while the regime in the remainder of this channel was established on the basis of the results of this track and those noted during tracks completed before and after Flight 7-1974 West.

Comments

No changes in the ice concentrations in the southern part of the Beaufort Sea were noted. The ice in this area continued to be extremely unfavourable for shipping.

Two small fragments that appeared to be remnants of ice islands, but could also have been the remains of icebergs, were seen in Barrow Strait midway between Young Island and Lowther Island. The route followed by these masses of ice to enter the area is unknown.


Point Barrow
Prudhoe B.
Barter I.
Sachs Harbour
Holman
Paulatuk
Aklavik
Inuvik
Cambridge Bay
Coppermine
Gjoa Haven
Resolute
Mould Bay
Isachsen
Rea Point
OW
72°N
74°N
76°N
78°N
80°N
68°N
70°N
64°N
66°N
130°W
140°W
150°W
120°W
110°W
100°W
CONCENTRATION
PREDOMINANT AGE
Less than 1/10 ....
1/10 to 4/10 ....
4/10 to 7/10 .
7/10 to 10/10 . ..
10/10 consolidated
Open Water
Multi year & Second year
First year
Grey - White
Grey, New or Nilas
Iceberg
Ice island (Tabular iceberg)
Observed Boundary
Assumed Boundary
SCALE
Nautical Miles (approx.)
0 30 60 90 120
0 50 100 150 200
Kilometres (approx.)
CONCENTRATION BY AGE AND FLOE SIZE
tenths of each age (C)
tenths of floes medium or larger (N)
(> 200 m)
Example 2/1 • 3410 mm 3 AA 2 ∩ 1 Sn 3 Pd 2 Th 0 F 0 Tmy 89 D 9
2/1 - 2/10's Multi year of which 1/10 is medium floe or larger
/ - Traces of Second year
• - Decimal Point (always placed between Second year and First year)
3/2 - 3/10's First year of which 2/10's are floes medium or larger
4/3 - 4/10's Grey-White of which 3/10's are floes medium or larger
1 - 1/10 Grey, no floes medium or larger
0 - No New or Nilas
mm 3 - 3/10's Ridging
AA 2 - 2/10's Rafting
∩ 1 - 1/10 Hummocking
Sn 3 - 3/10's Snow covered
Pd 2 - 2/10's Puddling
SURFACE FEATURES
mm - Ridging
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Th 0 - No Thaw holes
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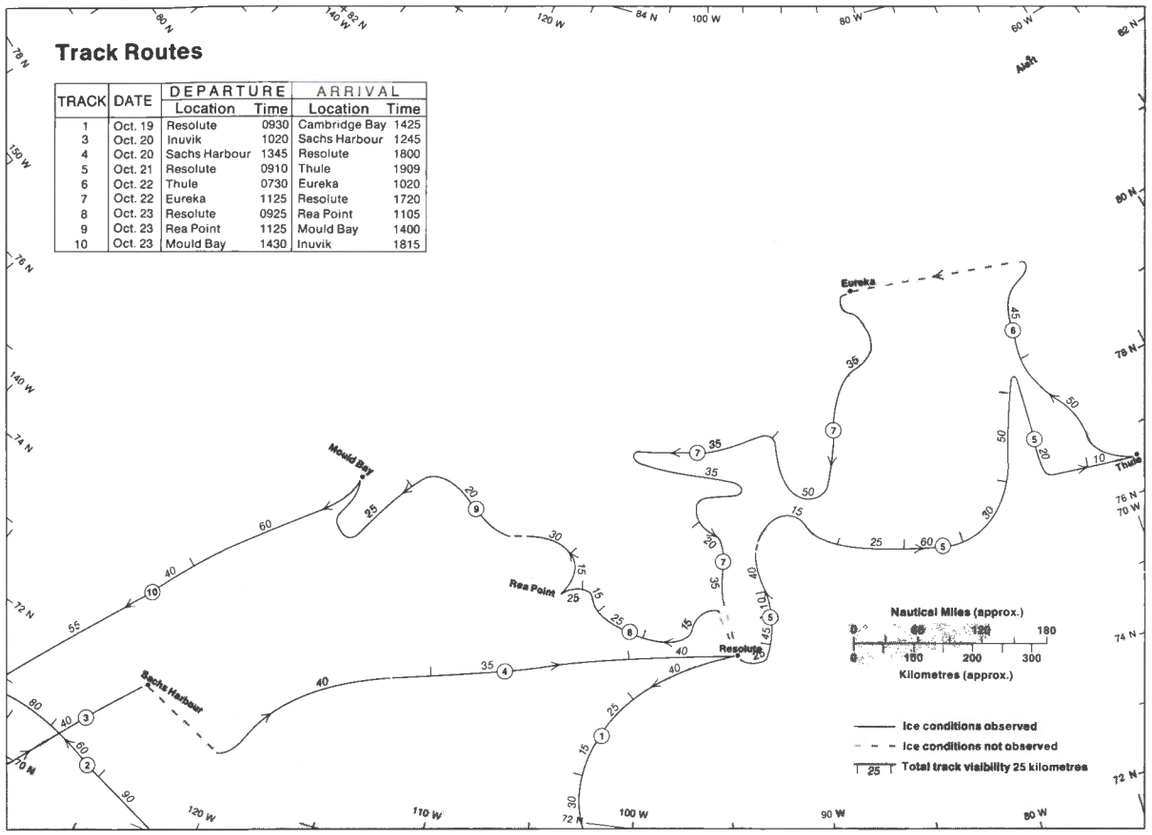
Tmy 89 - 89cm thickness of Multi year ice
D 9 - 9 cm depth of Snow



MAP 8-1974 East

October 19-23

Flight Effectiveness

Almost half the area in the eastern part of the region was surveyed during five tracks of Flight 8. Although low clouds hampered the surveys, the main restrictions were related to the lack of sufficient light. At this time of year the sun does not move above the horizon in the latitude through Eureka. Because of the lack of light and the fact that no change in ice conditions in the northern channels was expected, surveys in the northern parts were deliberately cancelled. The results of the tracks over the remaining channels ranged from fair to good and the overall Flight effectiveness ranged between 65 and 75 per cent.

Ice Conditions

Very few changes from the previous Flight were observed during Flight 8. The young types of ice continued to grow and in some areas they were approaching the thickness required for thin first-year ice. All boundaries separating unbroken ice in the northern channels from moving ice in the southern channels remained stationary and no significant movements or drifts were observed. A solid ice cover had appeared in the central part of the unnamed Sea north of Penny Strait and in the northern part of Norwegian Bay. Likely this state was temporary and some movements would still take place in these areas. No signs of consolidation were observed in the large channels such as Jones Sound, Lancaster Sound, Prince Regent Inlet and the channels from Penny Strait through Wellington Channel. However, solid ice covers had appeared in the narrow and protected bays and fiords adjacent to these channels.

A considerable part of Baffin Bay still remained free of new forms of ice but their appearance was expected in the near future. Some of the multi-year ice in the western part of Baffin Bay appeared to have entered the eastern part of Jones Sound. A similar invasion seems to occur about this time in most years.

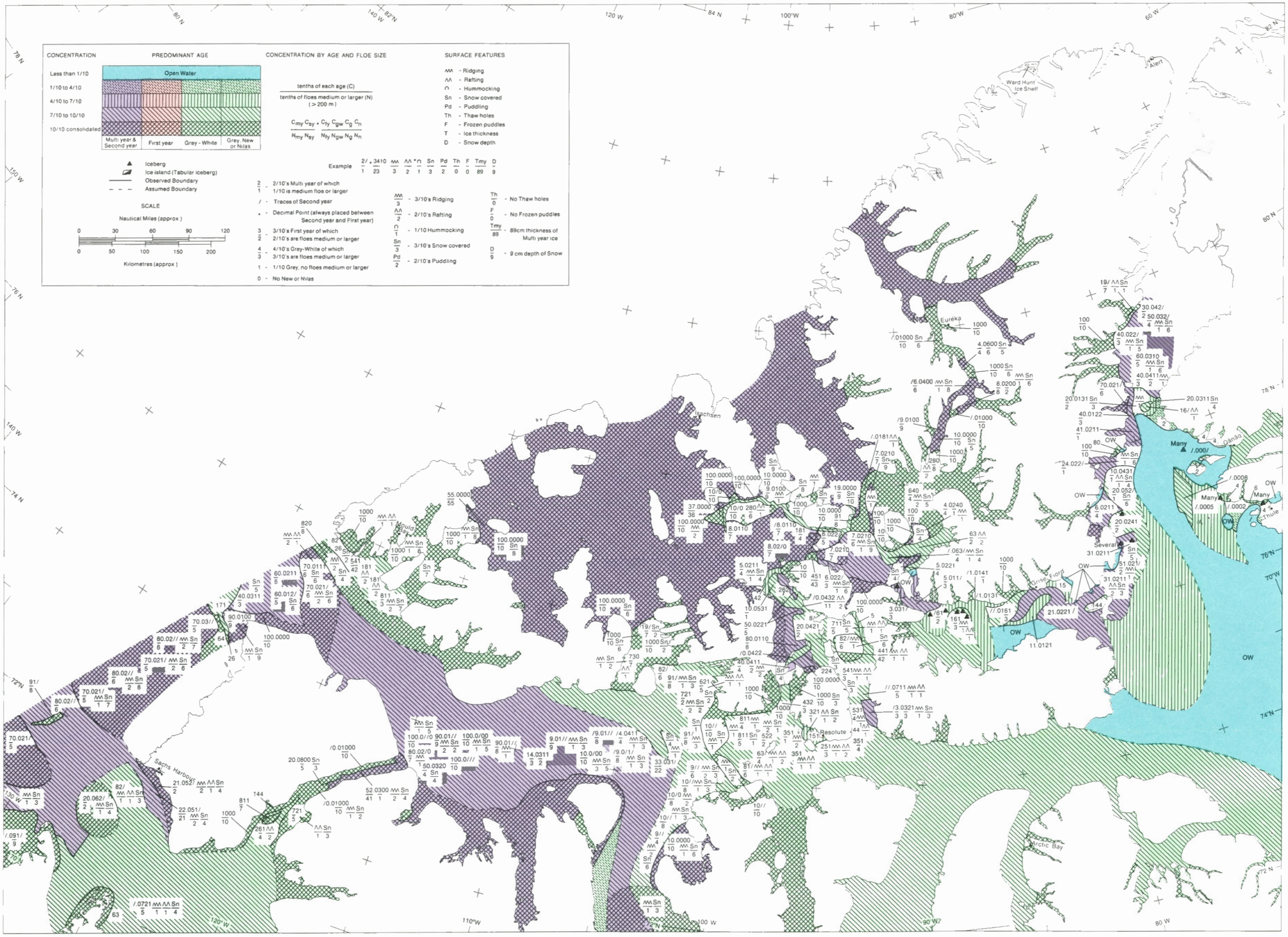
Unobserved Areas

Satellite photographs, previous ice conditions and information from other seasons were used to establish the situation shown on Map 8-1974 East for central Baffin Bay as well as Lancaster Sound and the adjacent channels. Since no changes had developed in their southern parts, it was assumed that the northern parts of these areas had remained solid and unbroken as shown on Map 8. Ice conditions along the northern fringe of the archipelago between Alert and Lands End on Prince Patrick Island were likely very similar to those shown on Map 5-1974 East. Also, a moving cover of predominantly multi-year ice probably prevailed throughout the length of Nares Strait.

Comments

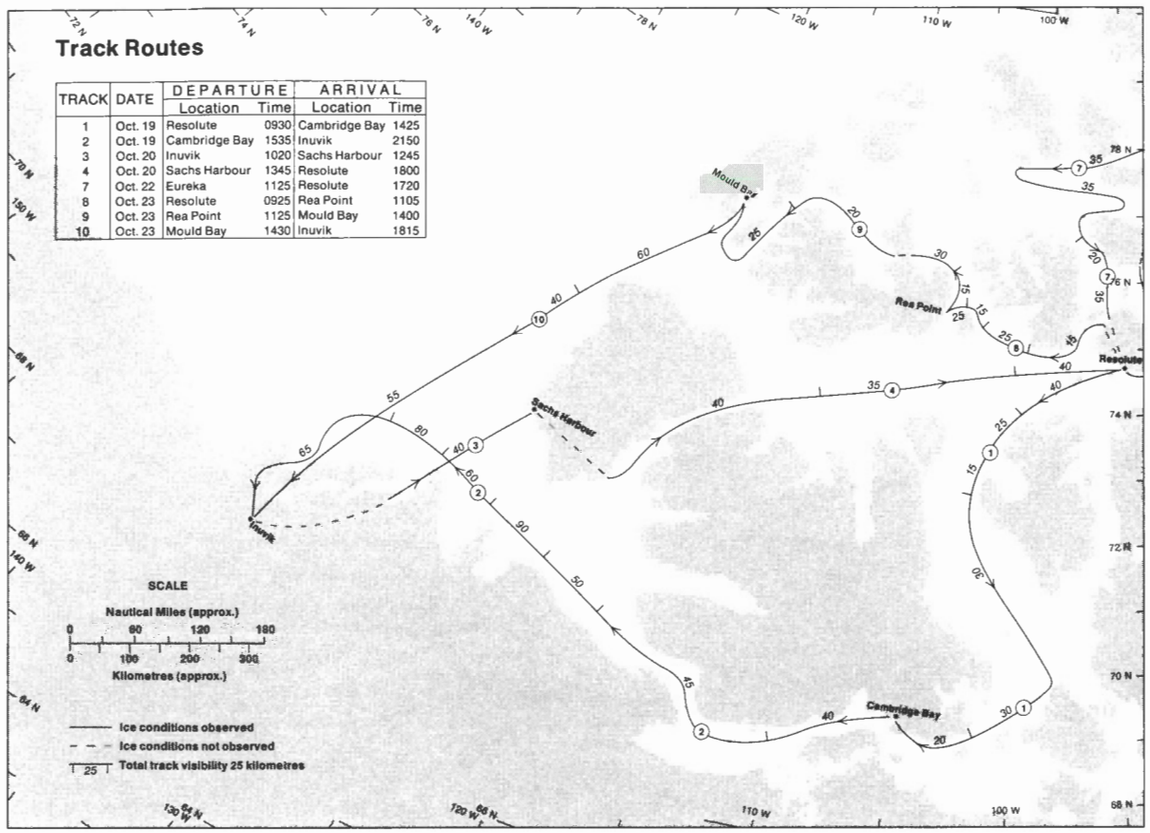
The patterns of ablation, break-up, movement and clearing which developed in the eastern part of the archipelago during the summer of 1974 were typical of a normal ice year. The patterns and rate of freeze-up in the fall also corresponded with those expected in an average ice year.

SEA-ICE ATLAS OF ARCTIC CANADA



MAP 8 - 1974 EAST

October 19 - 23, 1974



MAP 8-1974 West

October 19-23

Flight Effectiveness

Considering the time of year, the results of the four tracks carried out over the western part of the archipelago during Flight 8 were very favourable. The main limits to visibility were caused by ice crystals and the low sun angle. Most of the area was surveyed and the Flight effectiveness approached 80 per cent.

Ice Conditions

Few changes had taken place during the interval between the start of Flight 7 and the end of Flight 8. Young forms of ice were developing in all areas and, although the ice throughout the region continued to move, the degree of motion was gradually being reduced as the new ice forming between the older floes increased in thickness and strength.

A solid ice cover had developed in many of the small and protected bays and these areas would probably remain unbroken for the remainder of the year. The solid ice cover on M'Clintock Channel was temporary, and it was likely that some movement would still take place in Peel Sound before final consolidation was effected. In Barrow Strait and Viscount Melville Sound the degree of potential movement appeared to decrease from north to south.

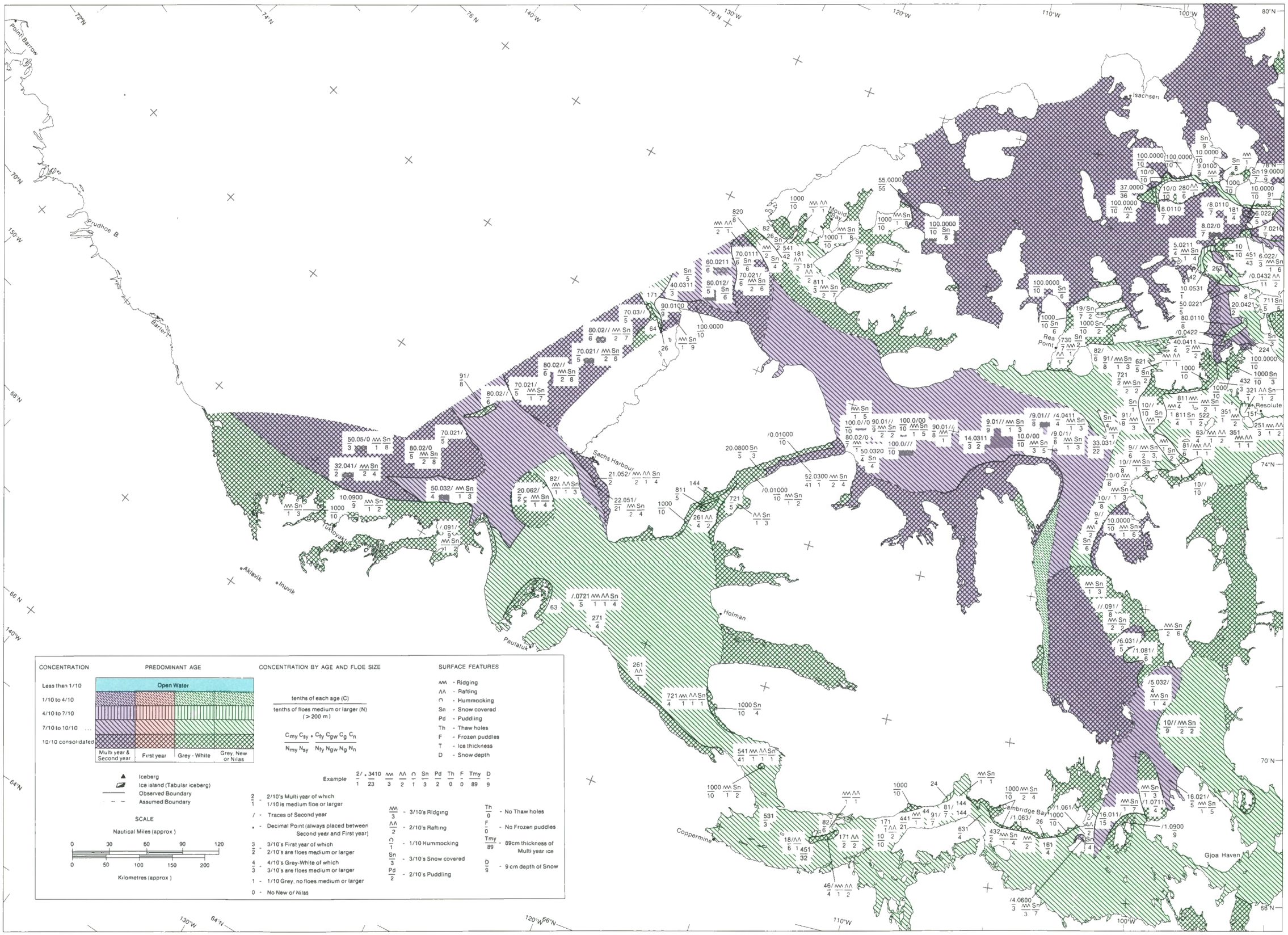
Unobserved Areas

Ice conditions shown for Peel Sound and the major portion of M'Clure Strait were estimated on the basis of previous surveys and according to the situation which usually prevails in these areas at this time of year. Likewise, it was assumed that the ice in the channels to the south and east of King William Island would be similar to those observed in adjacent areas.

Comments

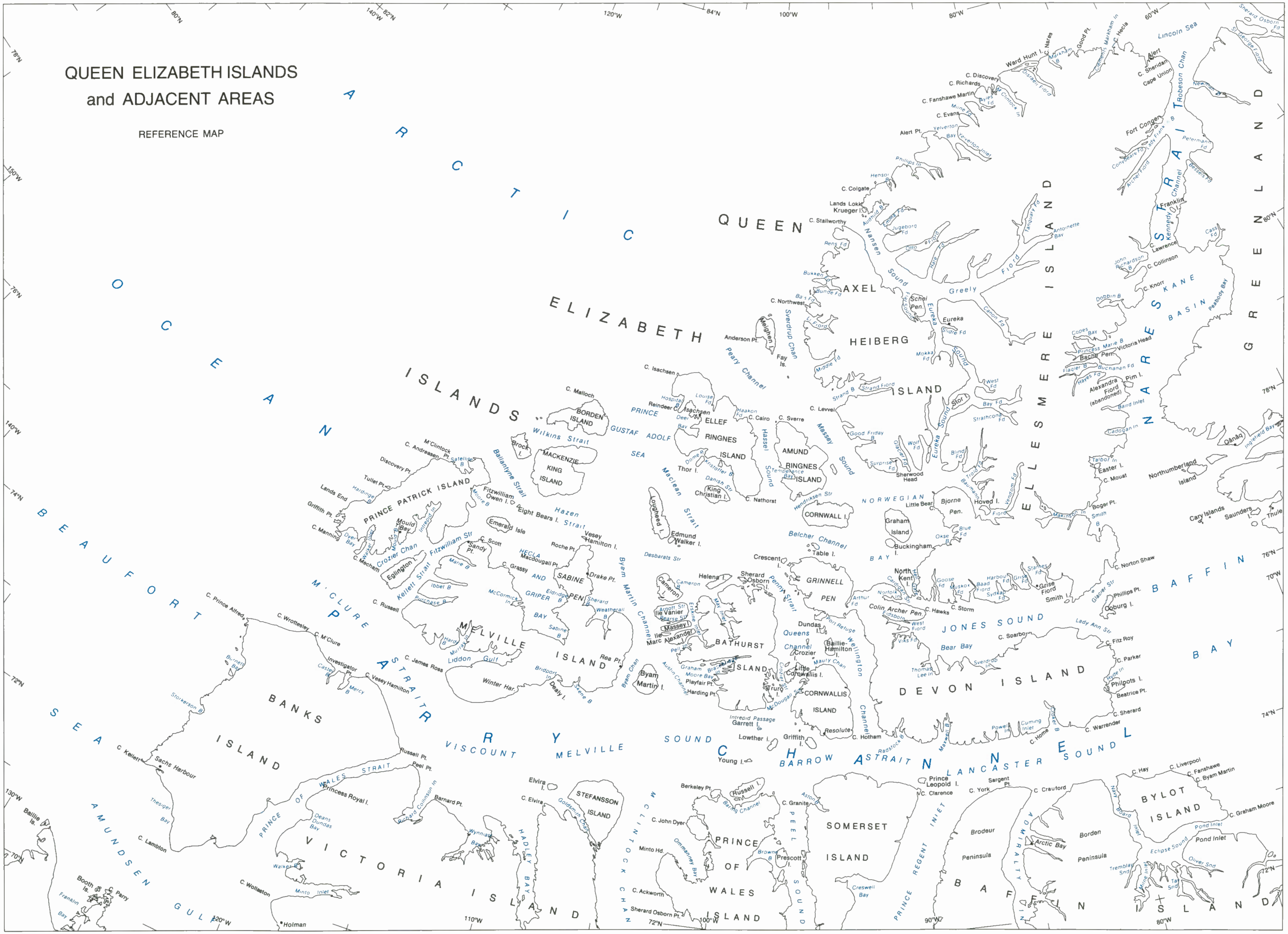
It is difficult to make a general statement to describe ice conditions which developed in the western part of the archipelago during the summer of 1974. The difficulty arises because two opposite situations developed. In M'Clintock Channel the ice developed in a manner associated with favourable years while in the Beaufort Sea the ice conditions which prevailed were typical of the worst type of year that might occur. The situation which developed in western Parry Channel was typical of normal seasons while the advance of the season in the southern channels such as Amundsen Gulf, Dolphin and Union Strait and Coronation Gulf was slightly behind the usual timing.

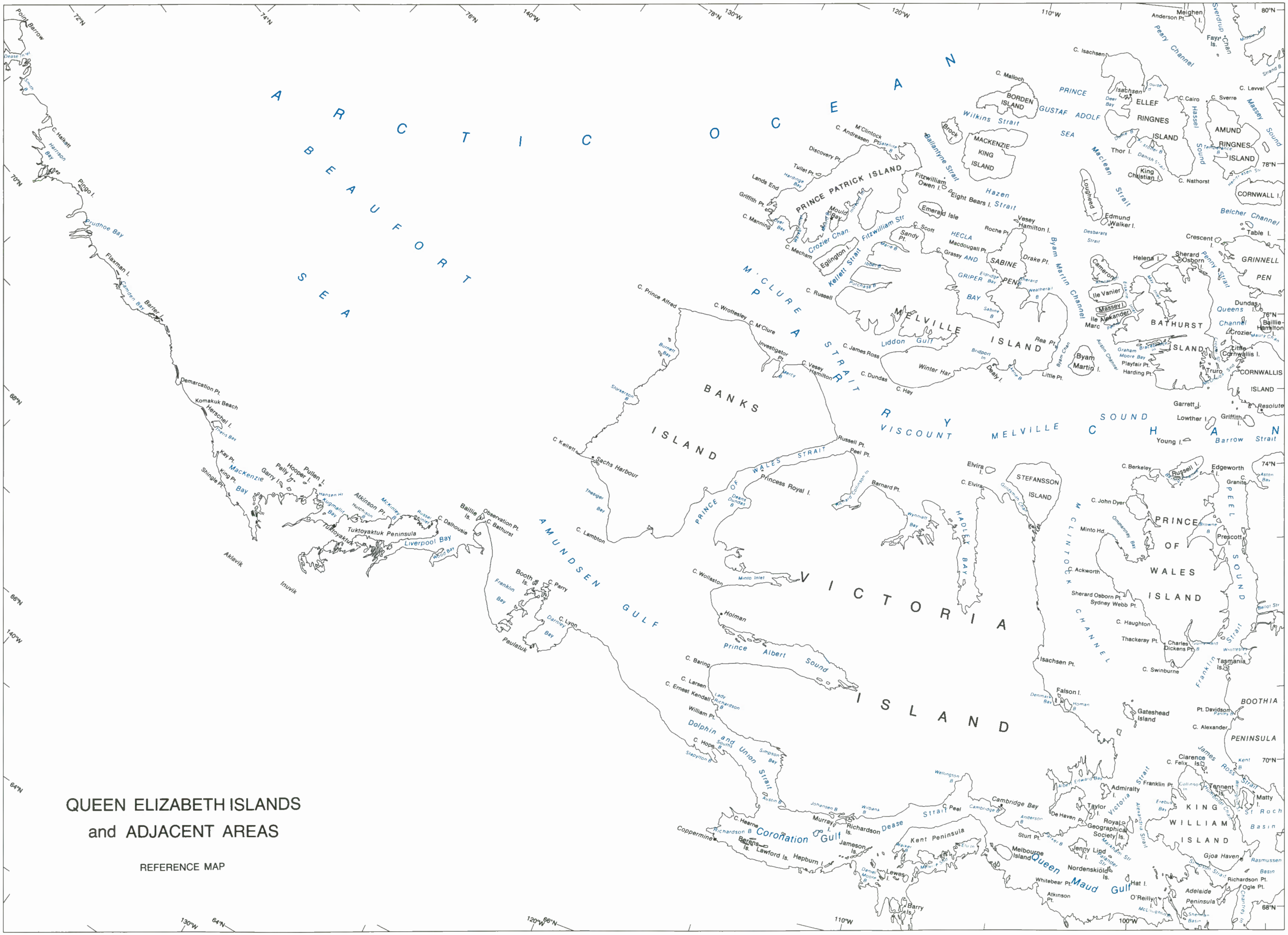
The Mackenzie River was observed on October 19th. At that time the portion of the river between Kugmallit Bay and Inuvik supported a solid cover of grey-white ice. Some small areas of open water still existed near some of the islands and adjacent to some of the major curves. The snow cover ranged from six tenths near the mouth of the river to nine tenths near Inuvik.



MAP 8 - 1974 WEST

October 19 - 23, 1974


QUEEN ELIZABETH ISLANDS
and ADJACENT AREAS
REFERENCE MAP
ARCTIC OCEAN
QUEEN ELIZABETH ISLANDS
BEAUFORT SEA
AMUNDSEN GULF
M'CLURE STRAIT
PARRY CHANNEL
VISCOUNT MELVILLE SOUND
BARROW STRAIT
LANCASTER SOUND
JONES SOUND
BAFFIN BAY
NARES STRAIT
KANE BASIN
GREENLAND
ELLESMERE ISLAND
AXEL HEIBERG ISLAND
ELLEF RINGNES ISLAND
AMUND RINGNES ISLAND
BORDEN ISLAND
MACKENZIE KING ISLAND
PRINCE PATRICK ISLAND
MELVILLE ISLAND
BATHURST ISLAND
CORNWALLIS ISLAND
DEVON ISLAND
BANKS ISLAND
VICTORIA ISLAND
STEFANSSON ISLAND
PRINCE OF WALES ISLAND
SOMERSET ISLAND
BYLOT ISLAND
BAFFIN ISLAND
PRINCE GUSTAF ADOLF SEA
HECLA AND GRIPER BAY
SABINE PEN
GRINNELL PEN
CORNWALL I.
PRINCE OF WALES STRAIT
M'CLINTOCK CHAN
PEEL SOUND
PRINCE REGENT INLET
ADMIRALTY INLET
HADLEY BAY
Wilkins Strait
Ballantyne Strait
Hazen Strait
Maclean Strait
Peary Channel
Sverdrup Chan
Nansen Sound
Eureka Sound
Massey Sound
Hassel Sound
Belcher Channel
Penny Strait
Queens Channel
Wellington Channel
Byam Martin Channel
Kellett Strait
Fitzwilliam Str
Crozier Chan
Desbarats Str
Danish Str
Hendriksen Str
Austin Channel
Byam Chan
Goldsmith Chan
Barrow Strait
Lincoln Sea
Robeson Chan
Kennedy Channel
Lady Ann Str
Glacier Str
Eclipse Sound
Navy Board Inlet
Pond Inlet
Alert
Eureka
Resolute
Grise Fiord
Sachs Harbour
Holman
Thule
Qânâq
Ward Hunt I.
C. Nares
Good Pt.
C. Hecla
C. Sheridan
Cape Union
Fort Conger
C. Discovery
C. Richards
C. Fanshawe Martin
C. Evans
Alert Pt.
C. Colgate
Lands Lokk
Krueger I.
C. Stallworthy
C. Northwest
Meighen I.
Anderson Pt.
Fay Is.
C. Isachsen
C. Malloch
C. Levvel
C. Sverre
C. Cairo
C. Nathorst
Thor I.
King Christian I.
Lougheed I.
Edmund Walker I.
Vesey Hamilton I.
Emerald Isle
Brock I.
Eglington I.
Melville Island
Winter Har.
C. James Ross
C. Russell
C. Mecham
C. Manning
Griffith Pt.
Lands End
Tullet Pt.
Discovery Pt.
C. Andreasen
M'Clintock Pt.
Fitzwilliam Owen I.
Eight Bears I.
Roche Pt.
C. Scott
Sandy Pt.
C. Grassy
Macdougall Pt.
Drake Pt.
Rea Pt.
Dealy I.
Byam Martin I.
Ile Vanier
Massey I.
Ile Marc Alexander
Cameron I.
Helena I.
Sherard Osborn I.
Crescent I.
Table I.
Graham Island
Buckingham I.
North Kent I.
Bjorne Pen.
Little Bear C.
Hoved I.
Sherwood Head
Colin Archer Pen.
C. Hawks
C. Storm
Smith I.
C. Sparbo
Dundas I.
Baillie-Hamilton I.
C. Crozier
Little Cornwallis I.
Truro I.
Playfair Pt.
Harding Pt.
Garrett I.
Lowther I.
Griffith I.
Young I.
C. Hotham
C. Home
C. Warrender
C. Sherard
Beatrice Pt.
Philpots I.
C. Parker
C. Fitz Roy
Coburg I.
Phillips Pt.
C. Norton Shaw
Boger Pt.
C. Mouat
Easter I.
Pim I.
Victoria Head
Bache Pen.
Alexandra Fiord (abandoned)
Franklin I.
C. Lawrence
C. Collinson
C. Knorr
Northumberland Island
Cary Islands
Saunders I.
C. Prince Alfred
C. Wrottesley
C. M'Clure
Investigator Pt.
C. Vesey Hamilton
Russell Pt.
Peel Pt.
Princess Royal I.
Barnard Pt.
C. Kellett
C. Lambton
Baillie Is.
Booth Is.
C. Parry
C. Wollaston
Elvira I.
C. Elvira
Berkeley Pt.
Russell I.
C. Granite
C. John Dyer
Minto Hd.
C. Ackworth
Sherard Osborn Pt.
Prescott I.
Prince Leopold I.
C. Clarence
C. York
Sargent Pt.
C. Crauford
C. Hay
C. Liverpool
C. Fanshawe
C. Byam Martin
C. Graham Moore
Arctic Bay
Pond Inlet
Brodeur Peninsula
Borden Peninsula
Creswell Bay
Walker B
Minto Inlet
Franklin Bay
Thesiger Bay
Storkerson B
Burnett Bay
Castel B
Mercy B
Deans Dundas Bay
Wynniatt Bay
Richard Collinson In
Liddon Gulf
Bridport In
Skene B
McCormick In
Purchase B
Ibbet B
Marie B
Mould Bay
Intrepid In
Dyer Bay
Walker Inlet
Hardinge B
Satellite B
Moore B
Eldridge B
Sherard B
Weatherall B
Sabine B
Hardy B
Murray In
Cameron B
Arnott Str
Pearse Str
Erskine Inlet
May Inlet
Pell In
Graham Moore Bay
Bracebridge In
Crozier Str
McDougall Sd
Maury Chan
Port Refuge
Intrepid Passage
Radstock B
Maxwell B
Powell In
Cuming Inlet
Croker B
Thomas Lee In
Sverdrup In
Bear Bay
Viks Fd
West Fiord
Eidsbotn
Arthur Fd
Norfolk In
Cardigan Str
Hell Gate
Goose Fd
Muskox Fd
Baad Fiord
Harbour Fd
Sydkap Fd
Grise Fd
Starnes Fd
Okse B
Blue Fd
Fiord
Vendom Fd
Troid Fd
Baumann
Makinson In
Smith B
Talbot In
Cadogan In
Baird Inlet
Hayes Fd
Flagler B
Buchanan Fd
Princess Marie B
Copes Bay
Dobbin B
John Richardson B
Peabody Bay
Cass Fd
Bessels Fd
Petermann Fd
Lady Franklin B
Conybeare Fd
Archer Fiord
Newman Bay
Sherard Osborn Fd
St George Fiord
Clements Markham In
Markham B
Disraeli Fiord
M'Clintock In
Ayles Fd
Milne Fd
Yelverton Bay
Yelverton Inlet
Phillips In
Henson B
Audhild B
Emma Fd
Jugeborg Fd
Otto Fiord
Hare Fd
Greely Fiord
Tanquary Fd
Antoinette Bay
Canon Fd
Slidre Fd
Schei Pen.
Fjeld Sound
Rens Fd
Bukken Fd
Bunde Fd
Bay Fd
Li Fiord
Middle Fd
Strand B
Strand Fiord
Mokka Fd
West Fd
Stor I.
Bay Fd
Strathcona Fd
Good Friday B
Wolf Fd
Glacier Fd
Surprise Fd
Blind Fd
Temperance Bay
Dome B
Kristoffer B
Hospital B
Louise Fd
Haakon Fd
Reindeer C
Isachsen
Deer Bay
Tremblay Snd
Milne Inlet
Tay Snd
Oliver Snd
Inglefield Bay
NORWEGIAN BAY
120°W
100°W
80°W
60°W
140°W
150°W
130°W
110°W
90°W
84°N
82°N
80°N
78°N
76°N
74°N
72°N
70°N
70°W



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REFERENCE MAP