ICE OBSERVATION HANDBOOK 1991

PREPARED BY

COMMANDING OFFICER
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FOREWORD

This handbook is provided as an aid to understanding the characteristics of sea ice, and the techniques and procedures utilized in sea ice observation and reporting. It is hoped that this handbook will aid in the interpretation of all Navy/NOAA Joint Ice Center sea ice information provided to our varied users.

INTRODUCTION

The Navy/NOAA Joint Ice Center was formed in 1976 and is tasked with providing sea ice analysis, forecasting, and reconnaissance services to the Department of Defense, U.S. and foreign government agencies as well as academic institutions, commercial concerns and the general public. Collocated with the Naval Polar Oceanography Center (NAVPOLAROCEANCEN), the Joint Ice Center is staffed by U.S. Navy and NOAA personnel.

The **Ice Observation Handbook**, a compendium of aerial, ship, and shore codes and terminology, has been designed primarily for use by the ice observer in the field and by those activities routinely making use of sea ice products. Complete explanations of all NAVPOLAROCEANCEN ice codes, as well as a complete explanation of the World Meteorology Organization (WMO) ice codes, abbreviations and glossary of the ice terminology are included. Additionally, graphic aides defining the forms of sea ice are included for reference.

As resource development increases in the polar regions, so will ship traffic and the need for accurate sea ice forecasting. Reliable observations provide input for the Arctic and Antarctic analysis and forecast. The information contained in this handbook should clarify communications between the observer/forecaster and the field user by standardizing reporting procedures and eliminating confusion regarding current codes and terminology.

A handbook of this type is naturally only as good as the feedback received; your comments as to the usefulness of this handbook and recommendations for its future improvement are whole-heartedly solicited.

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Director
Joint Ice Center

NOTE: This Ice Observation Handbook supercedes all previous editions.

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2. Examples of WMO Symbology
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This handbook has been extensively revised and updated over the past year. It was originally intended as a reference manual for deployed ice observers. When it became apparent that no standard manual explaining the reporting of shipboard and aerial ice observations existed, this handbook took on greater importance. Not only is this handbook comprised of WMO terminology and symbology, but it also embodies the combined experience of several NAVPOLAROCEANCEN aerial ice observers; notably, AG1 (NAC) Andrews, AG1 (NAC) Ronan, AG2 (NAC) Olsen, AG2 (NAC) Fiano and AG2 (NAC) Bollinger. These Petty Officers represent 20 years of combined experience. I would especially like to thank Petty Officer David M. Fiano for meticulously re-writing and editing this handbook.

CHAPTER 1

THE NATURE OF SEA ICE

1.1 STAGES OF SEA ICE DEVELOPMENT

Because of its salinity, seawater does not begin to freeze until it reaches approximately -1.9 degrees Celsius (28 degrees Fahrenheit). The higher the salinity, the lower the freezing point. The thickness and physical characteristics of sea ice vary greatly with its age and stage of development.

1.1.1 **NEW ICE**. As sea water begins to freeze, individual ice crystals, spicules and platelets begin to form. These ice formations are mixed within the upper layers of the sea and have no given form. Depending upon the sea state and weather conditions under which new ice is formed (calm, agitated, snowfall, etc), various different types of new ice are found.

a) FRAZIL - First stage in the freezing process
b) GREASE - Formed under calm conditions
c) SHUGA - Formed under agitated conditions
d) SLUSH - Formed during snowfall
e) ICE RIND - Formed by direct freezing or from grease ice.
f) NILAS - A later stage of new ice in which the ice has consolidated into a thin elastic crust of ice. This sheet is very flexible and will conform to swell.
There are two forms of nilas:

1) DARK NILAS: (0-5 cm)
2) LIGHT NILAS: (5-10 cm)

1.1.2 **YOUNG ICE**. Continued cold temperatures will cause additional freezing of the ice at the bottom and along the sides of the ice. This will increase the thickness of the ice and change its color. When the ice is between 10 and 30 cm thick it is known as young ice. There are two forms of young ice based on thickness and color:

a) GREY ICE: (10-15 cm)
b) GREY-WHITE ICE: (15-30 cm)

1.1.3 **FIRST-YEAR ICE**. After the thickness of the ice exceeds 30 cm the ice is then known as first-year ice. While there is no upper limit on the thickness of first-year ice, it normally does not exceed 2 meters. It should be noted that all of these thickness categories pertain to level, undeformed ice only. Deformed first-year ice can reach a thickness in excess of 20 meters.

a) FIRST-TEAR THIN: (30-70 cm)
b) FIRST-YEAR MEDIUM: (70-120 cm)
c) FIRST-YEAR THICK: (Greater than 120 cm)

1.1.4 **OLD ICE**. Old ice is sea ice that has survived at least one melt season. There are no thickness limits on old ice. Old ice is differentiated from other ages of ice based on chemical and physical characteristics rather than by thickness. Old ice is considerably less saline than first-year ice and as a result is considerably stronger. The topography of old ice is more weathered than that found on first-year ice. There are two subdivisions of old ice:

a) SECOND-YEAR ICE: Ice that has survived one melt season.
b) MULTI-YEAR ICE: Ice that has survived more than one melt season.

TABLE 1.1

STAGES OF DEVELOPMENT

ABBREVIATION	STAGE OF DEVELOPMENT	THICKNESS
N	Frazil, Grease, Shuga, Slush	0-10 cm (0-4 in)
N	Ice Rind	0-5 cm (0-2 in)
N	Dark Nilas	0-5 cm (0-2 in)
N	Light Nilas	5-10 cm (2-4 in)
YN	Young Ice	10-30 cm (4-12 in)
G	Grey	10-15 cm (4-6 in)
GW	Grey-White	15-30 cm (6-12 in)
FY	First-Year Ice	30-120 cm (12 in to greater than 48 in)
FL	First-Year Thin	30-70 cm (12-28 in)
FM	First-Year Medium	70-120 cm (28-48 in)
FT	First-Year Thick	Greater than 120 cm (Greater than 48 in)
SY	Second-Year	More than 2 m (80 in)
MY	Multi-Year	More than 2 m (80 in)

1.2 FORMS OF ICE AND FLOE SIZE

As sea ice forms, it does not remain as a solid sheet of ice. The effects of wind, sea, swell, currents and tides all act to break the ice into pieces. The pieces have various names depending upon their size, but they are generally known as floes. Table 1.2 describes the sizes of ice pieces and Figure 1-1 provides a comparison table for identifying floe size. Detailed descriptions of these terms are found in Appendix 1.

TABLE 1.2

FLOE SIZE

NAME	ABBREVIATION	DIMENSIONS
Brash	BSH	Less than 2 m
Pancake	PK	30 cm - 3 m
Ice Cake	CK	20 m or less
Small Floe	SF	20-100 m
Medium Floe	MF	100-500 m
Big Floe	BF	500 m - 2 km
Vast Floe	VF	2 km - 10 km
Giant Floe	GF	More than 10 km

1.2.1 **FLOEBERG.** A massive piece of sea ice composed of a hummock or a group of hummocks frozen together and separated from any ice surroundings. It may float up to 5 m above sea level.

1.2.2 **FLOEBIT.** A relatively small piece of sea ice, normally not more than 10 m across, composed of a hummock(s) or part of a ridge(s), frozen together and separated from any surroundings. It typically protrudes up to 2 m above sea level.

1.2.3 **ICE BRECCIA.** Ice pieces of different age frozen together.

1.2.4 **BRASH ICE.** Accumulations of floating ice made up of fragments not more than 2 m across, the wreckage of other forms of ice.

1.2.5 **SMALL ICE CAKE.** An ice cake less than 2 m across.

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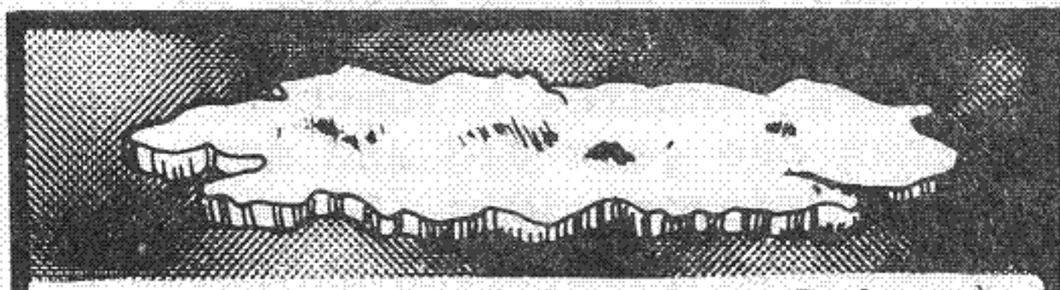
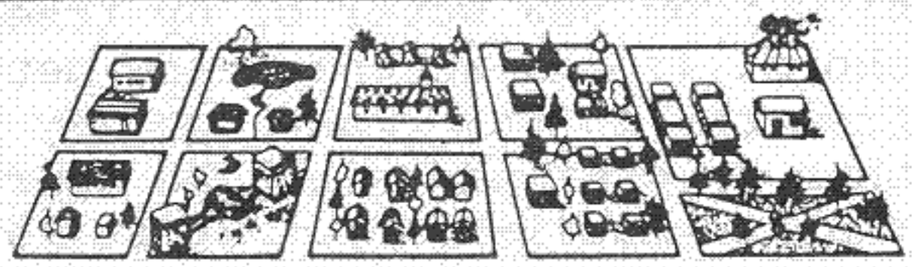
RELATIVE SIZES OF ICE FLOES

GIANT FLOE: Greater than 10 km (5.4 nm)

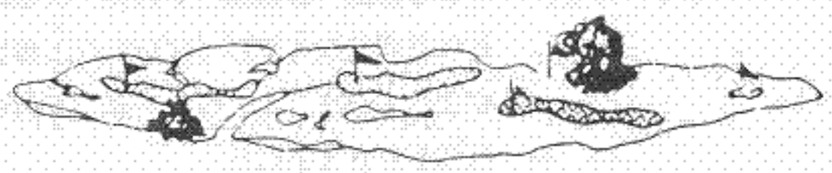


VAST FLOE: 2-10 km (1.1-5.4 nm)



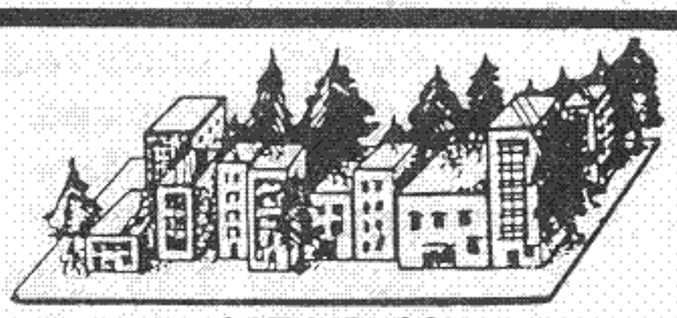
SMALL CITY

BIG FLOE: 500m-2km (1640 ft-1.1 nm)

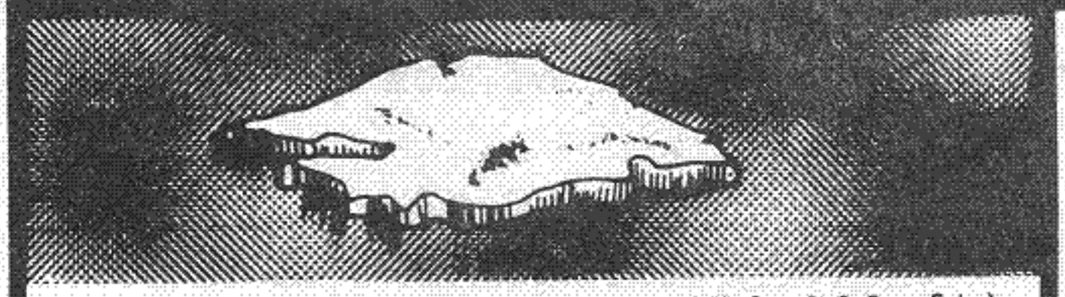


GOLF COURSE

MEDIUM FLOE: 100-500 m (328-1640 ft)



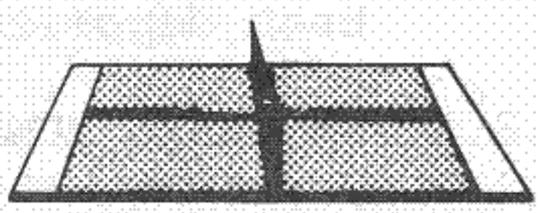
CITY BLOCK



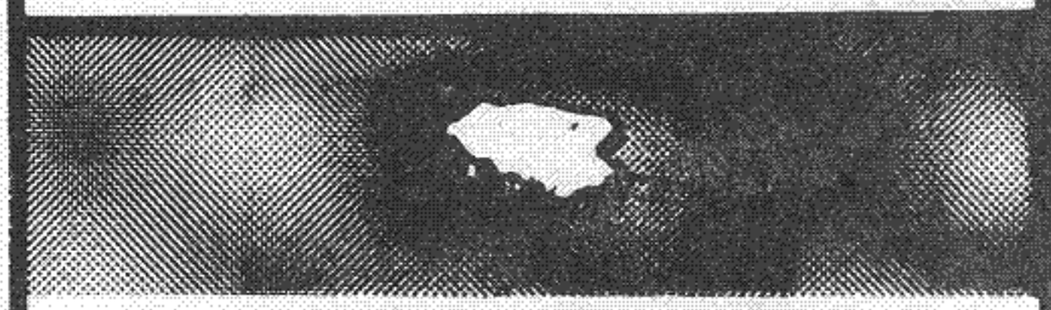
SMALL FLOE: 20-100 m (66-328 ft)

WAREHOUSE

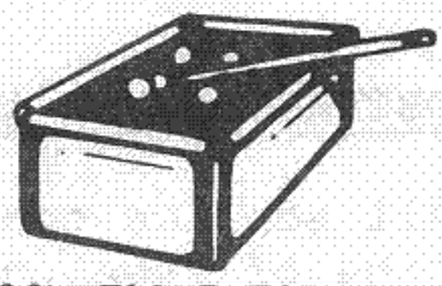
ICE CAKE: 3-20 m (10-66 ft)



VOLLEY BALL COURT



PANCAKE: Less than 3 m (10 ft)



POOL TABLE TOP

FIGURE 1-1

1.3 FORMS OF FAST ICE

Fast ice is defined as sea ice which has formed along or has become attached to the shore, to an ice wall, to an ice front, between shoals or grounded ice bergs. Fast ice may be formed in situ from sea water or by freezing of pack ice of any age to the shore. It may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (Old, Second-Year or Multi-Year). If it is thicker than about 2 m above sea level it is called an ice shelf.

1.3.1 **YOUNG COASTAL ICE.** The initial stage of fast ice formation consisting of nilas or young ice; its width varies from a few meters up to 100-200 m from the shoreline.

1.3.2 **ICEFOOT.** A narrow fringe of ice attached to the coast, unmoved by tides and remaining after the fast ice has moved away. The base of the ice is at or below the low water mark. The action of tide, waves and sea spray causes the development of the icefoot during the freezing season.

1.3.3 **ANCHOR ICE.** Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.

1.3.4 **GROUNDED ICE.** Floating ice which is aground in shoal water.

1.3.5 **STRANDED ICE.** Ice which has been floating and has been deposited on the shore by retreating high water.

1.3.6 **GROUNDED HUMMOCK.** Hummocked grounded ice formation. There are single grounded hummocks and lines (or chains) of grounded hummocks.

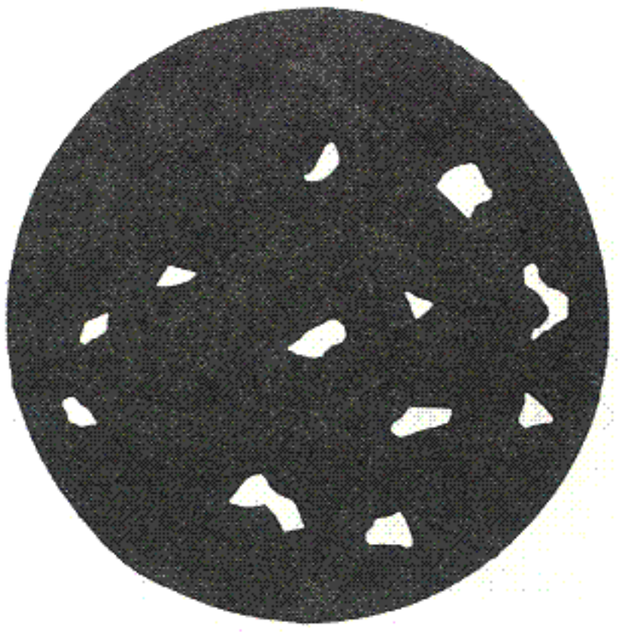
1.4 DETERMINATION OF CONCENTRATION

All sea ice concentrations in this handbook are expressed in tenths of areal coverage. For instance, 3 tenths of ice coverage means that 30 percent of the surface of the water is covered with sea ice. Concentrations of less than one tenth (a trace) are reported as open water.

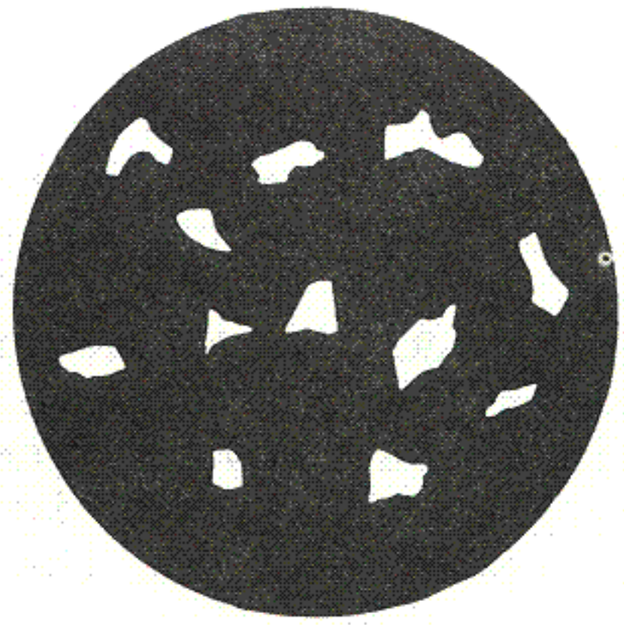
1.4.1 **AREA OF CONSIDERATION.** Sea ice concentrations should be observed within one kilometer of the ship or aircraft. Any attempt to estimate the concentration beyond this limit may result in an overestimation of the concentration due to the slant range of vision. Under no circumstances should an estimate of the sea ice concentration on the horizon be attempted.

1.4.2 **CONCENTRATION BOUNDARIES.** Whenever sea ice concentrations vary within the area of observation, an effort should be made to provide the location of the concentration boundaries. Figure 1-2 contains representative examples of sea ice concentrations.

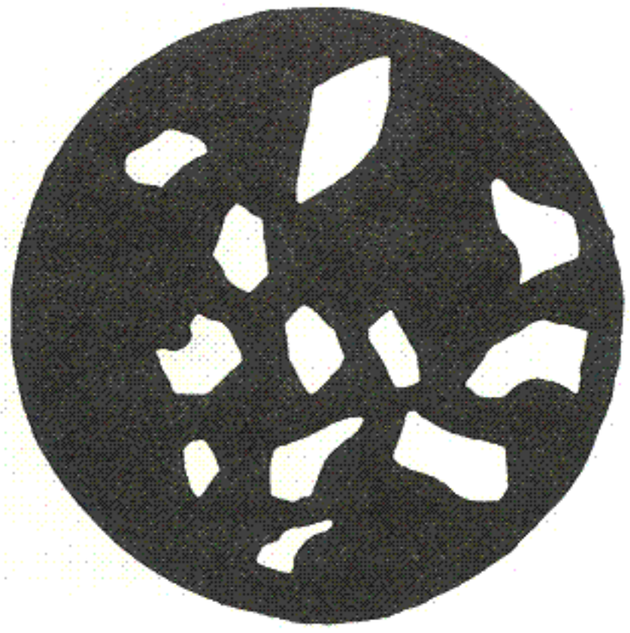
REPRESENTATIVE ICE CONCENTRATIONS



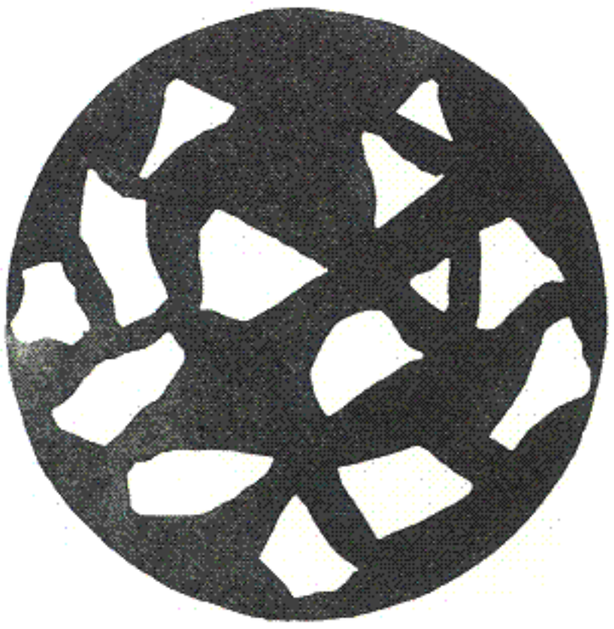
LESS THAN 1 TENTH
OPEN WATER



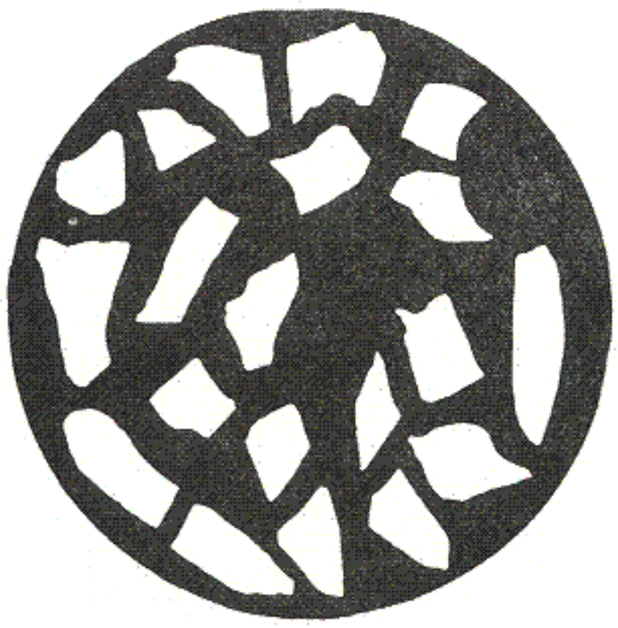
1 TENTH
VERY OPEN DRIFT



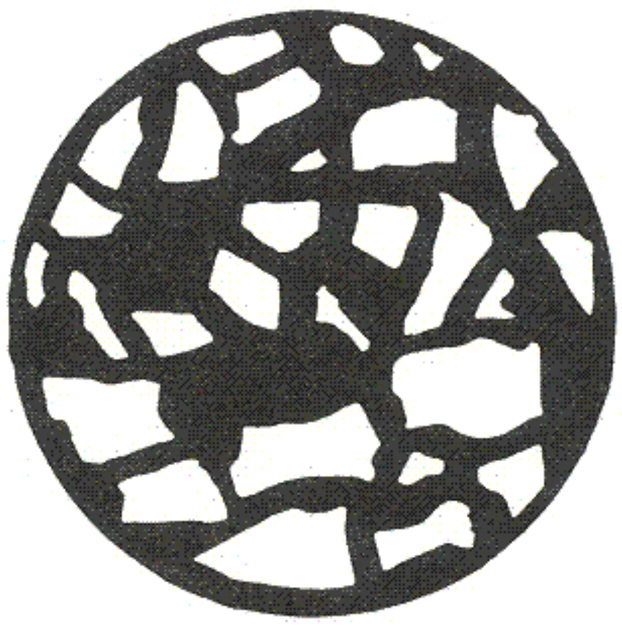
2-3 TENTHS
VERY OPEN DRIFT



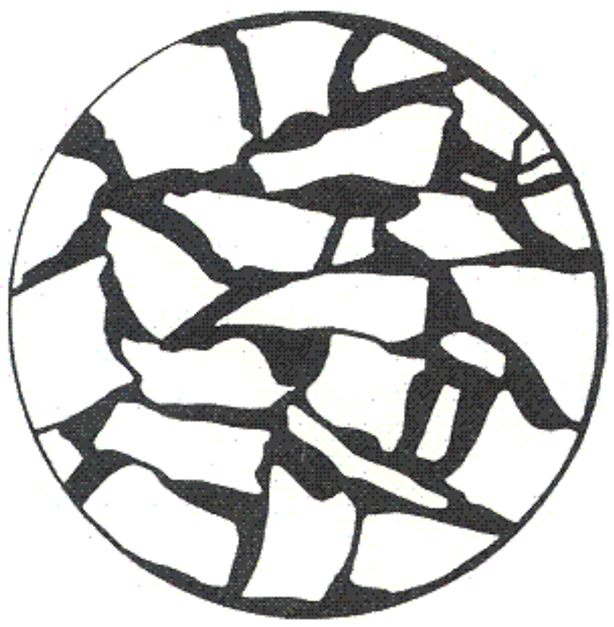
4 TENTHS
OPEN DRIFT



5 TENTHS
OPEN DRIFT

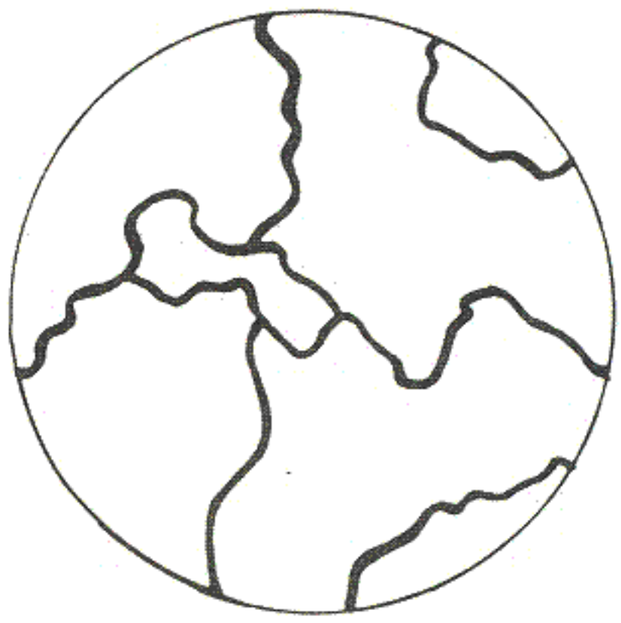


6 TENTHS
OPEN DRIFT



7-8 TENTHS
CLOSE PACK

9-10 TENTHS
VERY CLOSE PACK



10 TENTHS
COMPACT OR
CONSOLIDATED

FIGURE 1-2

1.5 ARRANGEMENT OF SEA ICE

1.5.1 **ICE EDGE.** The demarcation at any given time between the open sea and sea ice of any kind. It may be a regular line with considerable tightening of the floes along the edge, it may consist of a succession of belts or patches, or it may be frayed out into a number of points and bights, with perhaps off-lying isolated fragments. The position of the ice edge depends on wind, tide and currents and varies considerably from month to month and from year to year.

a) **COMPACTED ICE EDGE.** Close, clear-cut ice edge compacted by wind or current; usually on the windward side of an area of pack ice.

b) **DIFFUSE ICE EDGE.** Poorly defined ice edge limiting an area of dispersed ice; usually on the leeward side of an area of pack ice.

c) **TONGUE.** A projection of the ice edge up to several kilometers in length, caused by wind or current.

d) **BIGHT.** An extensive crescent-shaped indentation in the ice edge, formed by either wind or current.

1.5.2 **ICE FIELD.** An area of drift ice consisting of floes of any size and having an area greater than 10 km across.

a) SMALL ICE FIELD: 10-15 km across
b) MEDIUM ICE FIELD: 15-20 km across
c) LARGE ICE FIELD: Greater than 20 km across

1.5.3 **ICE PATCH.** An area of drift ice less than 10 km across.

1.5.4 **BELT.** A large feature of drift ice arrangement; longer than it is wide; from 1 km to more than 100 km in width.

1.5.5 **STRIP.** Long narrow area of drift ice, about 1 km or less in width, usually composed of small fragments detached from the main mass of ice and run together under the influence of wind, swell or current.

1.6 OPENINGS IN THE ICE

1.6.1 **FRACTURE.** Any break or rupture through very close ice, compact ice, consolidated ice, fast ice or a single floe resulting from deformation processes. Fractures may contain brash ice and/or be covered with nilas and/or young ice. Length may vary from a few meters to many kilometers.

a) VERY SMALL FRACTURE: 1-50 m wide
b) SMALL FRACTURE: 50-200 m wide
c) MEDIUM FRACTURE: 200-500 m wide
d) LARGE FRACTURE: Greater than 500 m wide

1.6.2 **CRACK.** Any fracture which has a separation of a few centimeters to 1 meter.

a) **TIDE CRACK.** Crack at the line of junction between an immovable ice foot or ice wall and fast ice, the latter subject to rise and fall of the tide.

b) **FLAW.** A narrow separation zone between pack ice and fast ice, where the pieces of ice are in chaotic state; it forms when pack ice shears under the effect of a strong wind or current along the fast ice boundary.

1.6.3 **LEAD.** Any fracture or passage-way through sea ice which is navigable by surface vessels.

a) **SHORE LEAD.** A lead between pack ice and the shore or between pack ice and an ice front.

b) **FLAW LEAD.** A passage-way between pack ice and fast ice which is navigable by surface vessels.

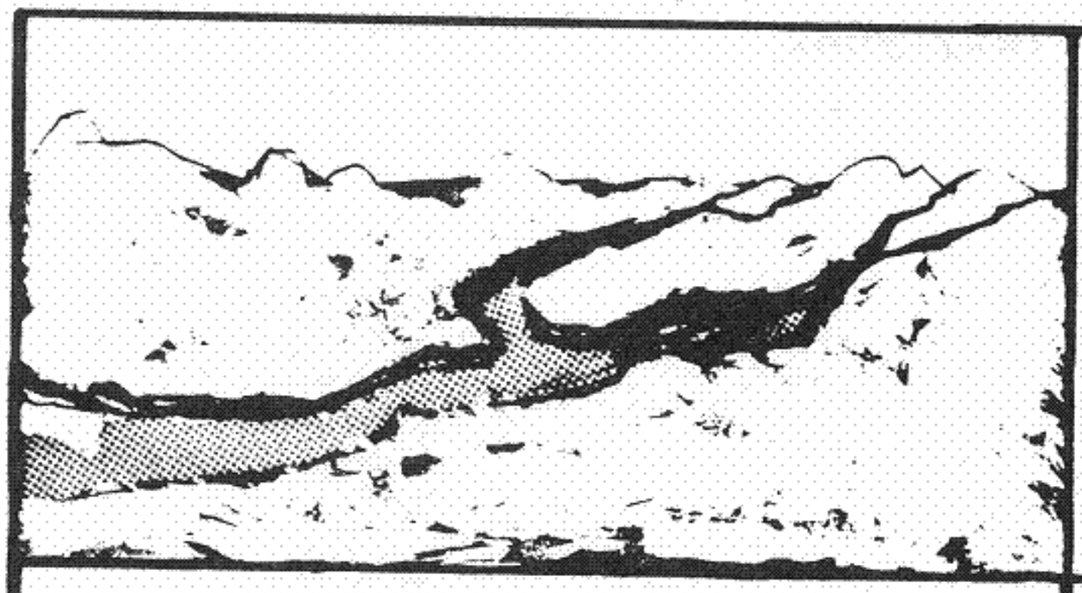
1.6.4 **POLYNYA.** Any non-linear shaped opening enclosed in ice. Polynyas may contain brash ice and/or be covered with new ice, nilas or young ice; submariners refer to these as skylights.

a) **SHORE POLYNYA.** A polynya between pack ice and the coast or between pack ice and an ice front.

b) **FLAW POLYNYA.** A polynya between pack ice and fast ice.

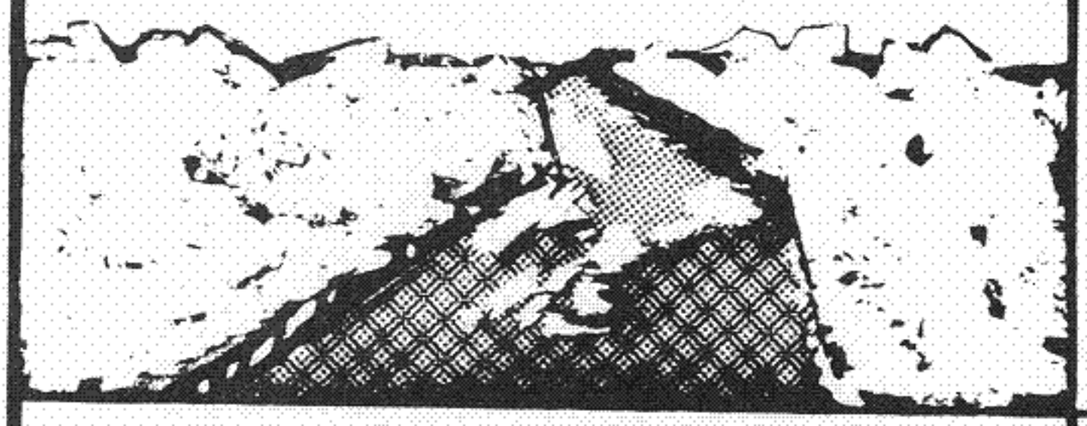
c) **RECURRING POLYNYA.** A polynya which recurs in the same location every year.

OPENINGS IN THE ICE



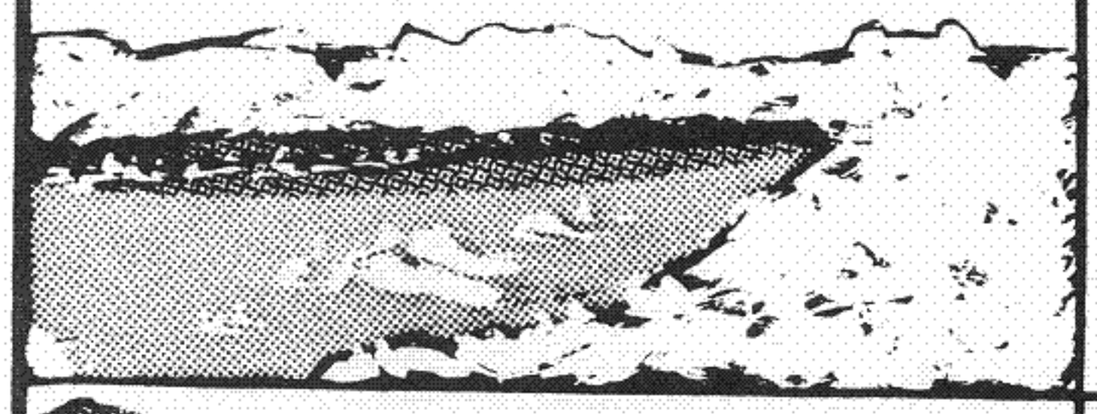
CRACK

A small unnavigable break along two floes in sea ice, not sufficently wide to be described as a lead. It is usually possible to jump across a crack.



OPEN LEAD

A long, navigable break in pack ice which may vary in width from approximately fifty feet to a few miles.



BLIND LEAD

The same dimensions as that of an open lead except that one end of the lead narrows and ends inside the pack ice.

SHORE LEAD

A lead between floating ice and the shore.

FLAW LEAD

A lead between floating ice and fast ice attached to the shore.

FIGURE 1-3

1.7 ICE DEFORMATION AND SURFACE FEATURES

Sea ice, as stated before, does not remain as a single smooth sheet. Not only do the pressure forces of wind and sea break the ice into pieces, they also deform the ice by forcing it together or against the coast. Additionally, the seasonal changes in the weather will affect the topography of the ice.

1.7.1 ICE DEFORMATION

a) **FRACTURING.** Pressure process whereby ice is permanently deformed and rupture occurs. Most commonly used to describe breaking across very close ice, compact ice and consolidated ice.

b) **HUMMOCKING.** Pressure process by which sea ice is piled haphazardly one piece over another to form an uneven surface. When the floes rotate in the process it is termed screwing.

c) **RIDGING.** Pressure process by which sea ice is forced upward into a line or wall called a ridge.

d) **WEATHERING.** Process in which irregularities are gradually eliminated by thermal and mechanical means.

1.7.2 ICE SURFACE FEATURES

a) **LEVEL ICE.** Sea ice which is unaffected by deformation.

b) **DEFORMED ICE.** A general term for ice which has been squeezed together and in places forced upwards or downwards.

c) **RAFTED ICE.** Type of deformed ice formed by one piece of ice overriding another. Occurs mostly on new and grey ice.

d) **FINGER RAFTED ICE.** Type of rafted ice in which floes thrust "fingers" alternately over and under one another. Occurs mostly on nilas and grey ice.

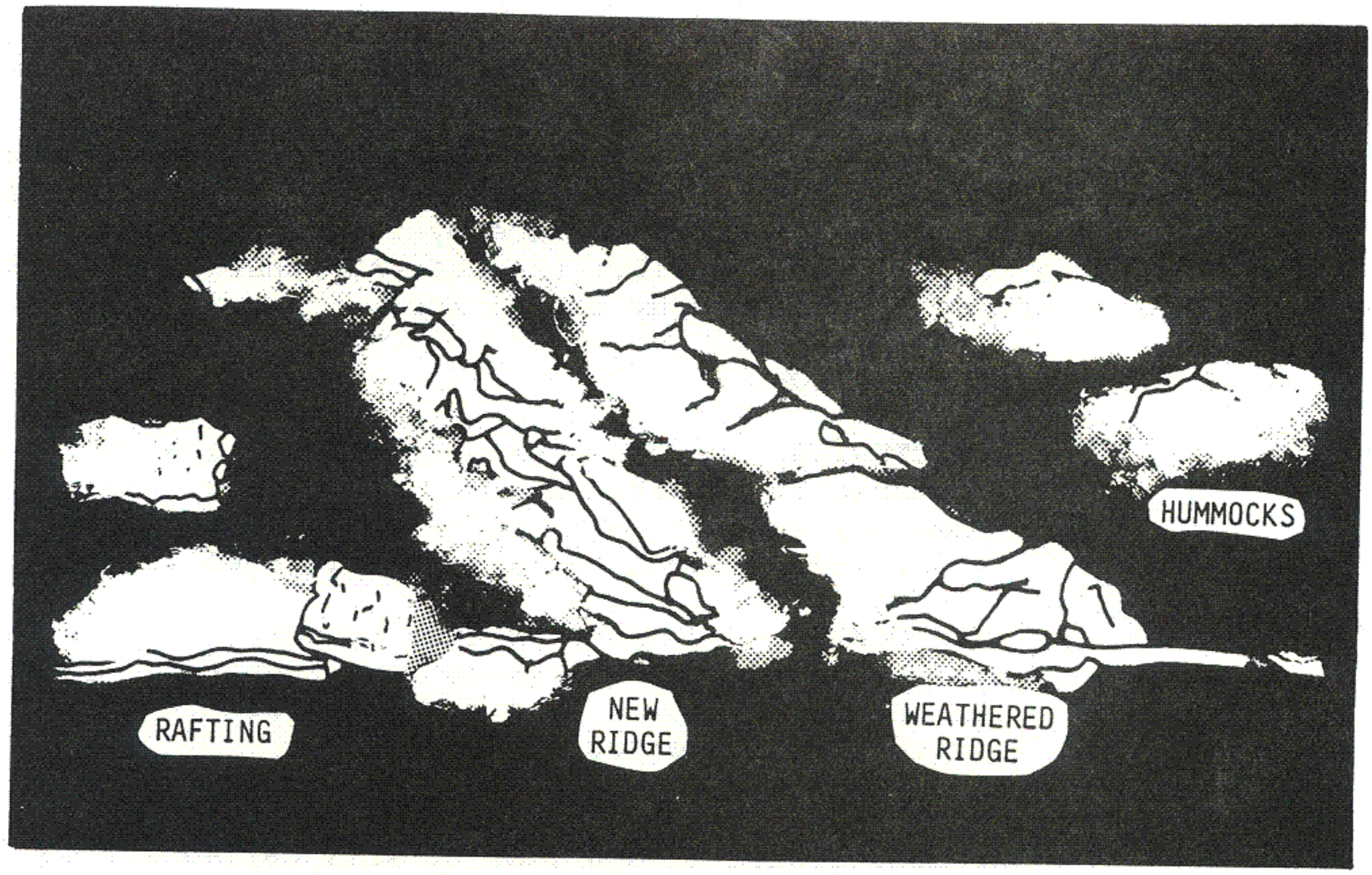


FIGURE 1-4

e) **RIDGE.** A line or wall of broken ice forced upwards by pressure. May be new or weathered. The submerged portion of broken ice under a ridge forced downwards by pressure is termed an ice keel.

1) **NEW RIDGE.** Newly formed ridge with sharp peaks and side slopes approximately 40 degrees. Fragments are visible from the air at low altitude. Can be formed on any age of ice other than new and grey ice. They are predominate on grey-white and first-year ice, however.

2) **WEATHERED RIDGE.** Ridge with peaks slightly rounded and slope of sides usually 30 to 40 degrees. Individual fragments are not discernable. Generally found on first-year ice late in the winter, or on second-year ice.

3) **VERY WEATHERED RIDGE.** Ridge with tops very rounded, slope of sides usually 20 to 30 degrees. Normally found on second and multi-year ice.

4) **AGED RIDGE.** Ridge which has undergone considerable weathering. These ridges are best described as undulations. A topographical feature common to multi-year ice.

5) **CONSOLIDATED RIDGE.** A group of ridges in which the bases have frozen together.

f) **RIDGED ICE ZONE.** An area in which much ridged ice with similar characteristics has formed.

g) **HUMMOCK.** A hillock of broken ice which has been forced upwards by pressure. May be fresh or weathered. The submerged portion of broken ice under the hummock, forced downwards by pressure, is termed a bummock.

h) **HUMMOCKED ICE.** Sea ice piled haphazardly one piece over another to form an uneven surface. When weathered, has the appearance of smooth hillocks. Normally occurs on first-year, second-year and multi-year ice.

i) **STANDING FLOE.** A separate floe standing vertically or inclined and enclosed by rather smooth ice.

j) **RAM.** An underwater ice projection from an ice wall, ice front, iceberg or floe. Its formation is usually due to a more intensive melting or erosion of the above water portion.

k) **SASTRUGI.** Sharp, irregular ridges formed on a snow surface by wind erosion and deposition. On mobile, floating ice, the ridges are parallel to the direction of the prevailing wind at the time they were formed.

1.8 STAGES OF MELT

As the summer season approaches, the occurrence of water on the ice surface causes a sequence of events resulting in a changing appearance of the ice.

1.8.1 **PUDDLE.** An accumulation of melt water on the ice, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

1.8.2 **THAW HOLES.** Vertical holes in sea ice formed when surface puddles melt through to the underlying water.

1.8.3 **DRIED ICE.** Sea ice from which melt water has disappeared from the surface after the formation of cracks and thaw holes. During the period of drying, the surface whitens.

1.8.4 **ROTTEN ICE.** Sea ice which has become honeycombed and which is in an advanced stage of disintegration.

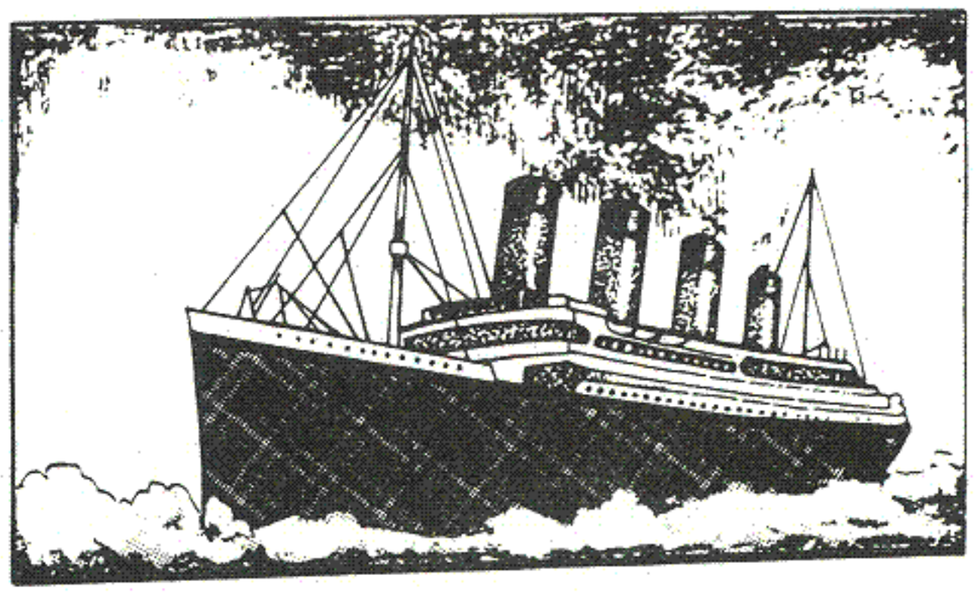
1.8.5 **FLOODED ICE.** Sea ice which has been flooded by melt water or river water and is heavily loaded by water and wet snow.

1.9 ICE OF LAND ORIGIN

Ice that has been formed on land as a result of the compaction of snow into glaciers is frequently found in certain areas of the polar regions. In these regions, the glaciers flow to the sea and form ice shelves. The ice shelves calve off icebergs or ice islands. Because of their large mass and unusual strength, icebergs are a hazard to navigation. Figure 1-5 provides size comparisons for ice of land origin.

RELATIVE SIZES OF ICE OF LAND ORIGIN

ICEBERG

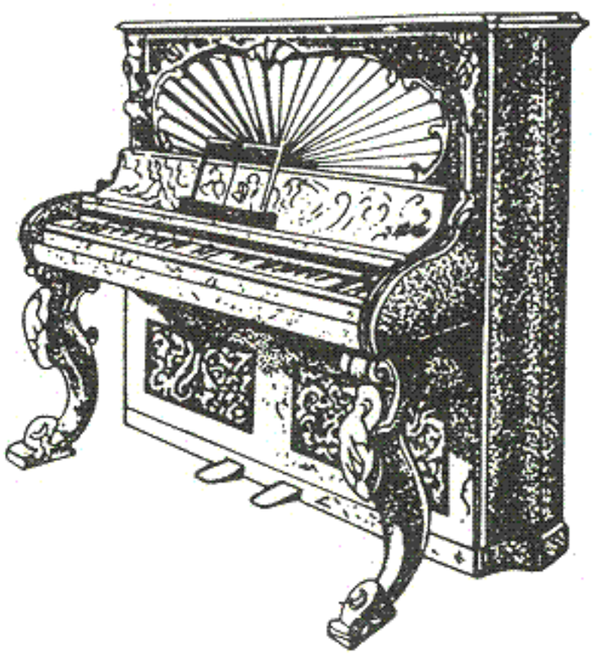


SHIP

BERGY BIT

SMALL COTTAGE

GROWLER



PIANO

FIGURE 1-5

CHAPTER 2

SEA ICE SYMBOLOGY

2.1 INTERNATIONAL SYSTEM OF SEA ICE SYMBOLOGY

Until recently, countries in which sea ice affected their marine activities each had their own unique ice codes and symbols. Canada had two: The Canadian Sea-Ice system and the Great Lakes Ice reporting system. The Americans had their own code (reporting ice in oktas), as did the Swedes, Russians, Japanese and Argentineans. Since there was no international agreement, marine interests were presented with major problems interpreting the various domestic symbols.

As a result, in 1977 the International World Meteorological Organization (WMO) working group on sea ice convened in Gander, Newfoundland to develop an international ice symbology. The basics of this system were worked out at a series of meetings and were then experimented with, on a national basis, by each nation involved. The working group met again in December 1979 in Leningrad where the final proposal was developed and submitted to the WMO for ratification.

This was approved by WMO for implementation on an international scale, effective October 01 1981, and is known as the International System of Sea Ice Symbols or the "EGG" code, based on the oval shape of the main symbol.

The WMO system of sea ice symbols is intended for use on synoptic and prognostic ice charts which are issued by national ice centers primarily to serve operational marine activities. Charts transmitted by ice observing units to users should also follow the international system.

2.2 **MAIN ELEMENTS**

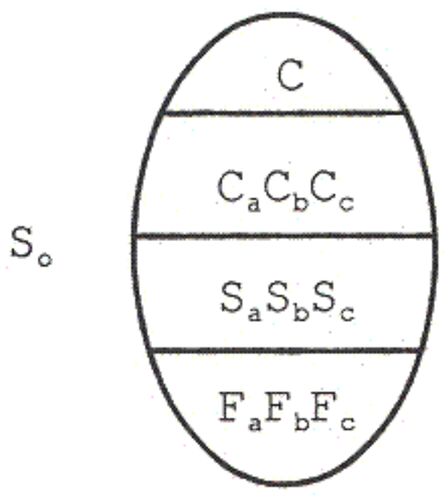
The system encompasses ice elements and features which can be grouped under the following headings:

a) Concentration
b) Stage of Development
c) Forms of Ice
d) Dynamic Processes
e) Water Openings
f) Topography
g) Ice Thicknesses
h) Stage of Melting
i) Surface Features
j) Ice of Land Origin
k) Limits
l) Strips and Patches

2.3 **MAIN SYMBOL**

The basic data concerning concentration, stage of development (with amounts of up to three age classes) and forms of ice are contained in a simple oval form, or egg.

The egg is divided into 4 sections:



Total Concentration

Partial Concentrations

Stage of Development - Age

Floe Size - Forms of Ice

C - TOTAL CONCENTRATION of ice in area, reported in tenths. The reporting of concentration ranges may be made as indicated in Table 2.1

$C_aC_bC_c$ - PARTIAL CONCENTRATIONS of sea ice are reported in tenths relative to the thicknesses of sea ice (Table 2.1). C_a is the thickest and C_c is the least thick. Less than 1/10 is not reported. 10/10 of one stage of development is reported by C, S_a, F_a, or C, S_a, F_p and F_s.

TABLE 2.1

CONCENTRATION (C, C_a, C_b, C_c)

CODE FIGURE	CONCENTRATION
0	< 1/10
1	1/10
2	2/10
3	3/10
4	4/10
5	5/10
6	6/10
7	7/10
8	8/10
9	9/10
10	10/10

$S_aS_bS_c$ - STAGES OF DEVELOPMENT of sea ice are reported in tenths with S_a reporting the thickest stage of development. S_b indicates the next thickest stage and S_c the third thickest stage of development. The three stages with the highest concentrations should generally be reported in $S_aS_bS_c$. An additional stage of development can be reported in S_d. A stage of development thicker than indicated in S_a but less than 1/10 in concentration is reported in S_o.

TABLE 2.2

STAGES OF DEVELOPMENT **(S_a, S_b, S_c, S_o, S_d)**

CODE FIGURE

0	No Stage of Development
1	Frazil Ice, Grease Ice, Slush, Shuga
2	Ice Rind, Dark Nilas, Light Nilas
3	Young Ice
4	Grey Ice
5	Grey-White Ice
6	First-Year Ice
7	Thin First-Year Ice
8	Thin First-Year Ice: First Stage
9	Thin First-Year Ice: Second Stage
1.	Medium First-Year Ice
4.	Thick First-Year Ice
7.	Old Ice
8.	Second-Year Ice
9.	Multi-Year Ice
▲.	Ice of Land Origin

F - FORMS OF ICE are indicated in one of two ways:

1) **$F_aF_bF_c$** indicates the form of ice (floe size) corresponding to the stage identified in ($S_aS_bS_c$) respectively (Table 2.3). Absence of information on any one of these forms is indicated with a (/) at the corresponding position. Should icebergs be present in sufficient numbers to have a concentration, F_a is reported as a (9) and the appropriate symbol for S_a and C_a is depicted in example 5 in Appendix 2.

2) **F_pF_s** indicates the predominant floe size (F_p) and the secondary floe size (F_s). Predominant and secondary floe sizes are reported independently from S_a, S_b, S_c (Table 2.3). Should only a predominate floe size be identified, (F_s) will not be reported. See example 2 in Appendix 2.

TABLE 2.3

FORMS OF ICE (F_a, F_b, F_c, F_p, F_s)

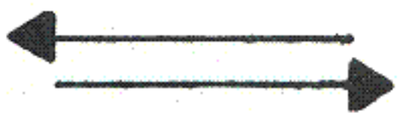
CODE FIGURE

X	New Ice
0	Pancake Ice
1	Small Ice Cake, Brash Ice
2	Ice Cake
3	Small Ice Floe
4	Medium Ice Floe
5	Big Ice Floe
6	Vast Ice Floe
7	Giant Ice Floe
8	Fast Ice, Growlers or Floebergs
9	Icebergs
/	Undetermined or Unknown (Used for $F_a, F_b,$ or F_c only)

2.4 SYMBOLS FOR DYNAMIC PROCESSES

COMPACTING 

DIVERGING 

SHEARING 

DRIFT 

Supplementary procedures (optional):

COMPACTING:  (degree)

Degree of Compacting
1) Slight compacting
2) Considerable compacting
3) Strong compacting

DRIFT: (in tenths of knots)  (e.g. 15 = 1.5 kts)

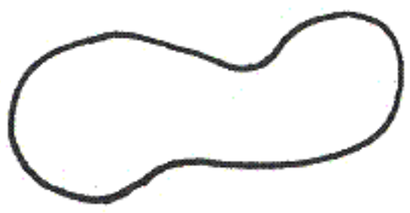
2.5 SYMBOLS FOR WATER OPENINGS

CRACK  (symbol indicating presence of cracks in the area)

CRACK  (symbol for a crack at a specific location)

LEAD  or 

FROZEN LEAD  (the orientation of the cross-lines may be varied to distinguish them from other hatching lines)

POLYNYA 

Supplementary procedures (optional):

LEAD:  (width) (width of lead in meters or kilometers, e.g. 100-300 m)

2.6 SYMBOLS FOR TOPOGRAPHY FEATURES

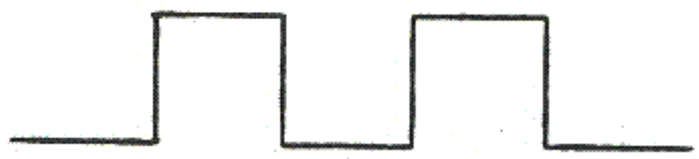
RIDGES/HUMMOCKS

a
f  **h/h_x**
C

C - Concentration (areal coverage) in tenths.
f - Frequency in numbers per nautical mile.
(f is an alternative for C)
h/h_x - Mean height (h) and maximum height (h_x) expressed in decimeters.

The data for C or f, h and h_x are added where known.

An optional element "a" can be used to indicate the type of topography present.

RAFTING 

Concentration C is indicated where known.

JAMMED BRASH BARRIER 

2.7 SYMBOL FOR ICE THICKNESS

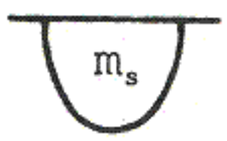
Thickness measured t_E (t_E in centimeters)

Thickness estimated t_E (example: 35)

When more than one measurement has been taken, both mean and maximum thicknesses are reported as:

30/40

2.8 SYMBOL FOR STAGE OF MELTING

Stage of melting 

m_s - See Table 2.4

TABLE 2.4

STAGE OF MELT (m_s)

CODE FIGURE	
0	No melt
1	Few Puddles
2	Many Puddles
3	Flooded Ice
4	Few Thawholes
5	Many Thawholes
6	Dried Ice
7	Rotten Ice
8	Few Frozen Puddles
9	All Puddles Frozen

2.9 SYMBOL FOR SURFACE FEATURES

Snow cover

C - Concentration in tenths (Table 2.1)
s_2 - Snow depth (Table 2.5)

The orientation of the symbol shows the direction of sastrugi as indicated below:

TABLE 2.5

SNOW DEPTH (s_2)

CODE FIGURE	
0	No Snow
1	Up to 5 cm
2	Up to 10 cm
3	Up to 20 cm
4	Up to 30 cm
5	Up to 50 cm
6	Up to 75 cm
7	Up to 100 cm
8	Greater than 100 cm
/	Undetermined or Unknown

2.10 SYMBOLS FOR ICE OF LAND ORIGIN

n - Number of Bergs (Table 2.6)

YY - The day of month sighted

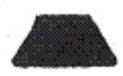
TABLE 2.6

BERG COUNT (n)

CODE FIGURE	COUNT	CODE FIGURE	COUNT
00	None	15	15
01	1	16	16
02	2	17	17
03	3	18	18
04	4	19	19
05	5	20	01-09
06	6	21	10-19
07	7	22	20-29
08	8	23	30-39
09	9	24	40-49
10	10	25	50-99
11	11	26	100-199
12	12	27	200-499
13	13	28	500 or More
14	14	99	No indication. Counting has become impossible.

TABLE 2.7

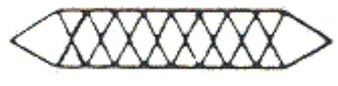
BERG SYMBOLS

	ACTUAL NUMBER OF BERGS KNOWN	UNKNOWN
Growler and/or Bergy Bit		
Iceberg (size unspecified)		
Iceberg, small		
Iceberg, medium		
Iceberg, large		

Iceberg, very large

Tabular bergs are indicated by adding a horizontal line through any of the above.

Ice Island



Radar Target (suspected berg)

Ice of Land Origin: Floeberg

SIZE	HEIGHT (m)	LENGTH (m)
Growler and Bergy Bit	Up to 05	Less than 15
Iceberg, small	06-15	16-60
Iceberg, medium	16-45	61-122
Iceberg, large	46-75	123-213
Iceberg, very large	Over 75	More than 213

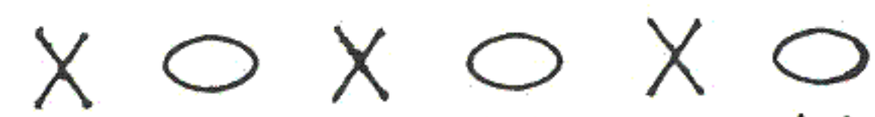
Note: Sizes refer to the above water portion only. If height and length of a berg in meters (m) fall into a different size classification, use the larger size. Dimensions (in kilometers) of a tabular berg or ice island may be indicated beneath the symbol. Iceberg size specifications are those established by the International Ice Patrol Service.

2.11 SYMBOLS FOR LIMITS OF OBSERVATION

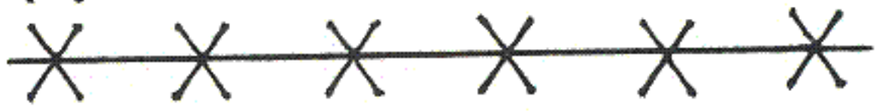
Undercast

Limit of Visual Observations

Limit of Radar Observations



Ice Edge by Radar



Observed Edge or Boundary (visual or satellite)

Estimated Edge or Boundary ——— ——— ——— ——— ——— ——— ——— ———

2.12 SYMBOL FOR BELTS AND STRIPS

Belts and strips S C

C - Concentration (in tenths of ice) within an area of belts and strips (optional addition). The actual concentration (C) of belts and strips is placed within the egg symbol in the section normally reserved for "Forms of Ice" (see example 6 in Appendix 2).

2.13 SUPPLEMENTARY PROCEDURES FOR INDICATING TOTAL CONCENTRATION

In order to facilitate readability of a sea ice chart, ice-covered areas may be hatched according to total ice concentration. Hatching may be applied to all areas of ice concentration or only to some of them. Whenever hatching has been applied, the hatching symbols as shown in this chapter shall be used. No international rules are given for the spacing or thickness of the hatching lines; the thickness may be the same throughout all the hatched areas, or may vary in the sense that thickest lines are used for areas of thicker ice.

Symbols for the hatching of total concentration of sea ice:

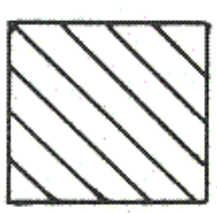
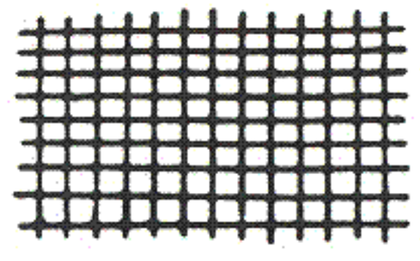
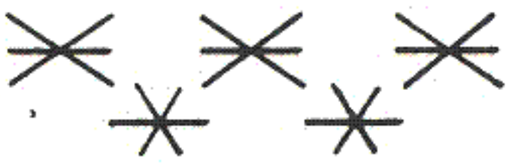
Fast ice  or  With national variation of hatching to show stage of development.

TABLE 2.8

CONCENTRATION

10/10	Consolidated Ice	
09-10/10	Very Close Ice	
07-08/10	Close Ice	
04-06/10	Open Ice (line spacing is twice that of close ice)	
01-03/10	Very Open Ice	
01/10	Open Water	
0	Ice Free	
	Bergy Water	
	New Ice	

When scattered stars are used to indicate the presence of new ice, reporting the actual amount of this stage of development as a component of the total concentration is optional.

The symbol for fast ice may also be used on individual giant floes in cases where there is no risk of the floes being interpreted as fast ice.

2.14 ADDITIONAL SYMBOLS FOR REGIONAL USE

Symbol adopted for use in the Baltic Sea area:

Level Ice  (line spacing is twice that of close ice).

CHAPTER 3

AERIAL ICE RECONNAISSANCE

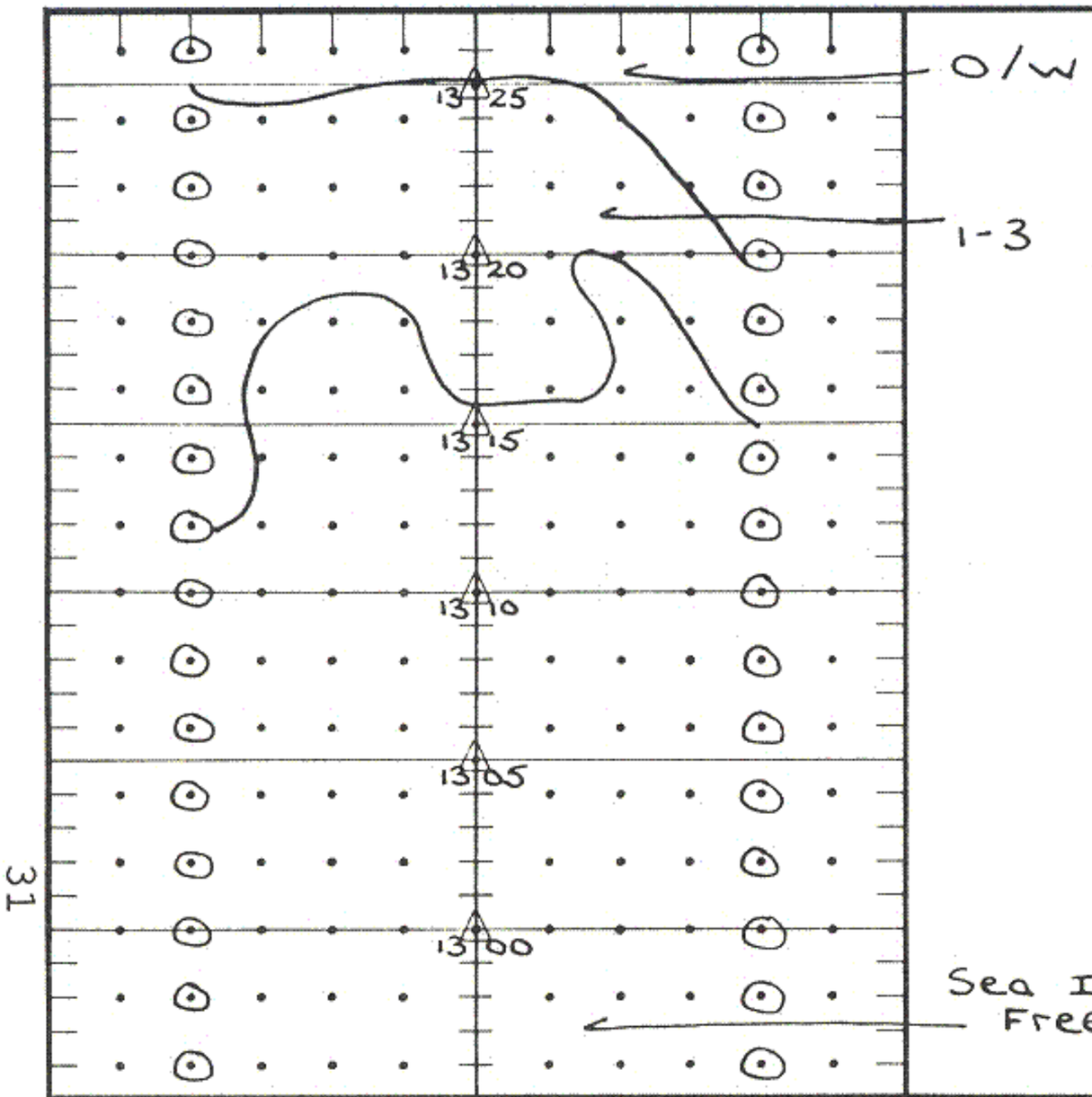
3.1 AERIAL ICE RECONNAISSANCE PROGRAM

The U.S. Navy/NOAA Joint Ice Center Aerial Ice Reconnaissance Program provides the ground truth information necessary to fulfill tailored operational support requirements such as shipping and U.S. Coast Guard ice breaking operations. Ice Reconnaissance personnel are trained in track planning, ice identification, ice observation and communications techniques. In addition to routine deployments of two to three enlisted personnel to Keflavik, Iceland; Anchorage, Alaska; McMurdo Station, Antarctica and Yokosuka, Japan, Ice Reconnaissance personnel are available to support specific fleet exercises, research and development efforts and real world tasking. The requesting organization is responsible for aircraft availability and the funding of all mission support.

3.2 AERIAL ICE OBSERVATION REPORTING PROCEDURES

Ice observer responsibilities consist of making visual ice observations and recording this data at five minute intervals on NAVPOLAROCEANCEN aerial ice log forms as depicted in this chapter. Radar is used to locate the ice edge and open water features outside the limits of visibility. Whenever possible, sea surface temperatures are collected utilizing Airborne Expendable Bathythermographs to provide an indication of sea ice formation. Coded Ice Messages are sent to the Naval Polar Oceanography Center, Suitland, MD.

Each ice reconnaissance message, consisting of visual observations, radar data and SST information, is plotted on reconnaissance charts for a graphic display of sea ice conditions. A complete breakdown of the Aerial Ice Observation Code along with examples is provided to clarify usage, and is followed by a sample Sea Ice Observation Message.



TRACK FROM KEFLAVIK TO THULE DATE 05 Aug 89 OBSERVER FIANO PAGE 1 OF 4

NOTES

1257 Descent 010
1304 Ascent 019

CONVERSION TABLE

5cm - 2in	3m - 10ft
10cm - 4in	20m - 22yds
15cm - 6in	50m - 55yds
30cm - 1ft	100m - 110yds
70cm - 2ft 4in	200m - 220yds
120cm - 3ft 11in	500m - 550yds
200cm - 6ft 8in	2km - 1.1nm
	10km - 5.4nm

TABLE 2
CONCENTRATION, EXTENT OF TOPOGRAPHY, SNOW COVER (C, Co, Cft, Cfm, Cfl, Cy, Cn, Re, S)

(0) < 1/10
(1) 1/10
(2) 2/10
(3) 3/10
(4) 4/10
(5) 5/10
(6) 6/10
(7) 7/10
(8) 8/10
(9) 9/10
(A) 10/10 WITH OPENINGS
(B) 10/10 WITHOUT OPENINGS
(/) Undtr/Unk

TABLE 3 (Fp, Fs)
FORMS OF ICE

X New ice or Nilas
0 Pancake < 3m
1 Brash, Small Cake < 3m
2 Ice Cake < 20m
3 Small Floe 20-100m
4 Medium Floe 100-500m
5 Big Floe 500-2000m
6 Vast Floe 2-10km
7 Giant Floe > 10km
8 Fast Ice/Growlers or Floebergs
(/) Undtr/Unk

STAGES OF DEVELOPMENT

N - New Ice (types of New Ice) 0-10cm
NL - D.Nilas 0-5cm / L.Nilas 5-10cm
YNG - Young Ice 10-30cm
G - Gray 10-15cm
GW - Gray White 15-30cm
FL - Thin First Year 30-70cm
FM - Medium First Year 70-120cm
FT - Thick First Year > 120cm
SY - Second Year
MY - Multi Year

TABLE 4 (a1, a2)
TOPOGRAPHY

(0) None
(1) New Ridge
(2) Weathered Ridge
(4) Aged Ridge
(6) Hummocks
(7) Rafting
(/) Undtr/Unk

TABLE 5 (Wt)
TYPE OF OPENING

(0) No Openings
(1) Crack
(2) Frctv 0-50m
(3) Frcts 50-200m
(4) Frctm 200-500m
(5) Frctl 500m
(6) Lead
(7) Polynya
(8) Recur Polynya
(9) Wtr Btwn Floe
(/) Undtr/Unk

TABLE 6 (Dw)
ORIENTATION

(0) None
(1) No Distinct
(2) Major Axis Orient
NE - SW
(3) E - W
(4) SE - NW
(5) N - S
(6) Para SH to E
(7) Para SH to S
(8) Para SH to W
(9) Para SH to N
(/) Undtr/Unk

TABLE 7 (ms)
STAGE OF MELT

(0) No Melt
(1) Few Pd
(2) Many Pd
(3) Flooded
(4) Few Th
(5) Many Th
(6) Dried
(7) Rotten
(8) Few Fzn Pd
(9) Rfzn Pd
(/) Undtr/Unk

TABLE 8
LAND ICE

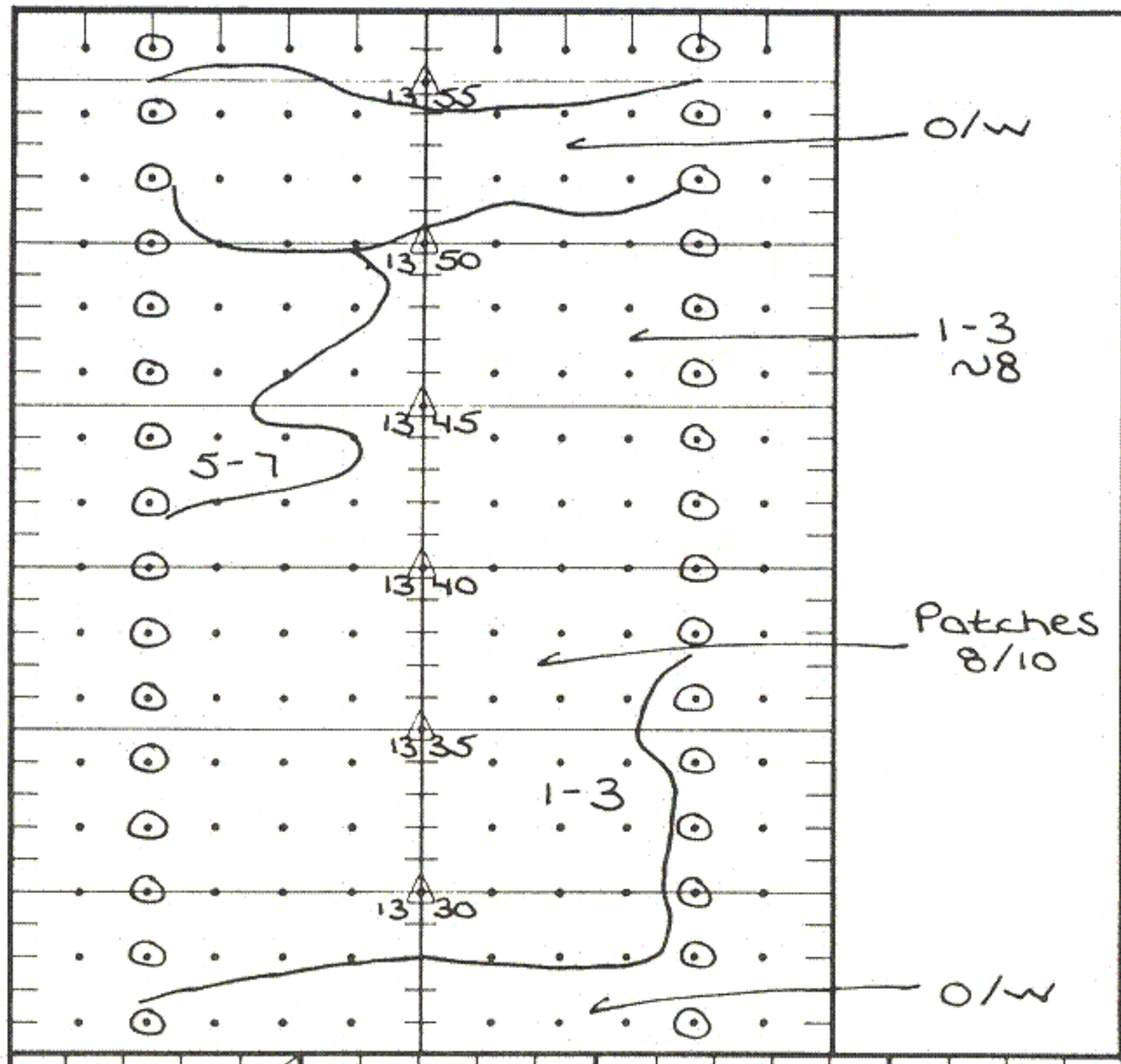
ACTUAL COUNT
(00) None
(01) 1
(02) 2
(03) 3 thru 19

ESTIMATE COUNT
(20) 1-9
(21) 10-19
(22) 20-29
(23) 30-39
(24) 40-49
(25) 50-99
(26) 100-199

G	G	8	9	/	Oc	La	Lo	La	La	Lo	Lo	La	La	Lo	OL	OL	h	h	C	S	S	Co	Cft	Clm	Cfl	Cy	Cn	Fp	Fs	Re	al	a2	h	hx	7	Wt	Dw	S	ms	9	nG	nG	nB	nB
1	3	0	0	/	7	6	6	2	7	0	3	2	0	0	2	0	1	0	0	s	s														7					9	2	0	2	0
1	3	0	5	/	7	6	6	3	7	0	3	1	0	9	2	0	1	2	0	s	s														7					9	2	0	0	3
1	3	1	0	/	7	6	6	4	7	0	3	0	2	3	2	0	1	9	0	s	s														7					9				
1	3	1	3		7	6	6	5	6	0	2	9	5	5	B	T	0	0	1	0	0	1	0	C																			
1	3	1	5	/	7	6	7	0	3	0	2	9	3	5	2	0	1	9	0	s	s														7					9	2	0	2	0
1	3	2	0	/	7	6	7	2	2	0	2	8	5	4	2	0	1	9	1	s	s	1	0	/	/	/	/	2	1	6	4	6	1	3	7	9	0	4	2	9	2	0	2	0
1	3	2	5	/	7	6	7	3	8	0	2	8	0	9	2	0	1	9	2	s	s	2	0	/	/	/	/	2	1	6	4	6	1	3	7	9	0	3	2	9	2	0	2	0

NDW/NPOC-3930 (REV 3-86)

FIGURE 3-1a



TRACK FROM Keflavik TO Thule DATE 05 Aug 89 OBSERVER FIANO PAGE 2 OF 4

NOTES

CONVERSION TABLE

5cm - 2in	3m - 10ft
10cm - 4in	20m - 22yds
15cm - 6in	50m - 55yds
30cm - 1ft	100m - 110yds
70cm - 2ft 4in	200m - 220yds
120cm - 3ft 11in	500m - 550yds
200cm - 6ft 8in	2km - 1.1nm
	10km - 5.4nm

TABLE 2
CONCENTRATION, EXTENT OF TOPOGRAPHY, SNOW COVER (C, Co, Cft, Cfm, Cfl, Cy, Cn, Re, S)

(0) < 1/10
(1) 1/10
(2) 2/10
(3) 3/10
(4) 4/10
(5) 5/10
(6) 6/10
(7) 7/10
(8) 8/10
(9) 9/10
(A) 10/10 WITH OPENINGS
(B) 10/10 WITHOUT OPENINGS
(/) Undtr/Unk

TABLE 3 (Fp, Fs)
FORMS OF ICE

X New ice or Nilas
0 Pancake < 3m
1 Brash, Small Cake < 3m
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7 Giant Floe > 10km
8 Fast Ice/Growlers or Floebergs
(/) Undtr/Unk

STAGES OF DEVELOPMENT

N - New Ice (types of New Ice) 0-10cm
NL - D.Nilas 0-5cm / L.Nilas 5-10cm
YNG - Young Ice 10-30cm
G - Gray 10-15cm
GW - Gray White 15-30cm
FL - Thin First Year 30-70cm
FM - Medium First Year 70-120cm
FT - Thick First Year > 120cm
SY - Second Year
MY - Multi Year

TABLE 4 (a1, a2)
TOPOGRAPHY

(0) None
(1) New Ridge
(2) Weathered Ridge
(4) Aged Ridge
(6) Hummocks
(7) Rafting
(/) Undtr/Unk

TABLE 5 (Wt)
TYPE OF OPENING

(0) No Openings
(1) Crack
(2) Frctv 0-50m
(3) Frcts 50-200m
(4) Frctm 200-500m
(5) Frctl 500m
(6) Lead
(7) Polynya
(8) Recur Polynya
(9) Wtr Btwn Floe
(/) Undtr/Unk

TABLE 6 (Dw)
ORIENTATION

(0) None
(1) No Distinct
(2) Major Axis Orient NE - SW
(3) E - W
(4) SE - NW
(5) N - S
(6) Para SH to E
(7) Para SH to S
(8) Para SH to W
(9) Para SH to N
(/) Undtr/Unk

TABLE 7 (ms)
STAGE OF MELT

(0) No Melt
(1) Few Pd
(2) Many Pd
(3) Flooded
(4) Few Th
(5) Many Th
(6) Dried
(7) Rotten
(8) Few Rfzn Pd
(9) Rfzn Pd
(/) Undtr/Unk

TABLE 8
LAND ICE

ACTUAL COUNT
(00) None
(01) 1
(02) 2
(03) 3 thru 19

ESTIMATE COUNT
(20) 1-9
(21) 10-19
(22) 20-29
(23) 30-39
(24) 40-49
(25) 50-99
(26) 100-199

TOTAL CONCENTRATION	STAGE OF DEVELOPMENT INDICATOR	SECOND-YR, MULTI-YR ICE	THICK FIRST-YR ICE	MEDIUM FIRST-YR ICE	THIN FIRST-YR ICE	YNG ICE (GRAY, GRAY-WHITE)	NEW ICE (NILAS, ICE RIND)	PRIMARY FORM OF ICE	SECONDARY FORM OF ICE	EXTENT OF TOPOGRAPHY	PRIMARY TYPE TOPOGRAPHY	SECONDARY TYPE TOPOGRAPHY	MEAN HEIGHT OF RIDGES (m)	MAX HEIGHT OF RIDGES (m)	WATER FEATURE INDICATOR	TYPE OF OPENING	ORIENTATION OF OPENING	SNOW COVER	STAGE OF MELTING	LAND ICE INDICATOR	GROWLERS AND BERGY BITS	ICEBERGS
		7.	4.	1.	7	3	1															
G	G	s	s	/	Oc	Lo	Lo	Lo	Lo	Lo	Lo	Lo	Lo	Lo	OL	OL	h	h	C	S	S	Co	Cfl	Cfm	Cfl	Cy	Cn	Fp	Fs	Re	al	a2	h	hx	7	Wt	Dw	S	ms	9	nG	nG	nB	nB
1	3	3	0	/	7	6	7	5	4	0	2	7	1	9	2	0	1	9	2	s	s	2	0	/	/	/	/	2	1	7	6	4	1	2	,	9	0	3	4	•	2	1	2	1
1	3	3	5	/	7	6	8	0	8	0	2	6	3	1	2	0	1	9	3	s	s	2	1	/	/	/	/	2	1	5	4	6	1	3	,	9	0	4	2	•	2	1	2	1
1	3	4	0	/	7	6	8	2	2	0	2	5	4	1	2	0	1	9	1	s	s	1	0	/	/	/	/	2	1	6	6	4	1	2	,	9	0	4	2	•	2	1	2	1
1	3	4	5	/	7	6	8	3	6	0	2	4	5	4	2	0	1	9	2	s	s	2	0	/	/	/	/	2	1	6	4	6	2	3	,	9	0	4	2	•	2	2	2	1
1	3	5	0	/	7	6	8	5	0	0	2	4	0	7	2	0	1	9	3	s	s	3	0	/	/	/	/	2	1	6	4	6	2	3	,	9	0	4	2	•	2	1	2	0
1	3	5	3		7	6	8	5	8	0	2	3	3	7	B	T	0	0	2	1	0	0	5	C																				
1	3	5	5	/	7	6	9	0	3	0	2	3	1	6	2	0	1	9	3	s	s	3	0	0	/	/	/	2	3	7	4	2	2	3	,	9	0	5	2	•	2	0	2	1

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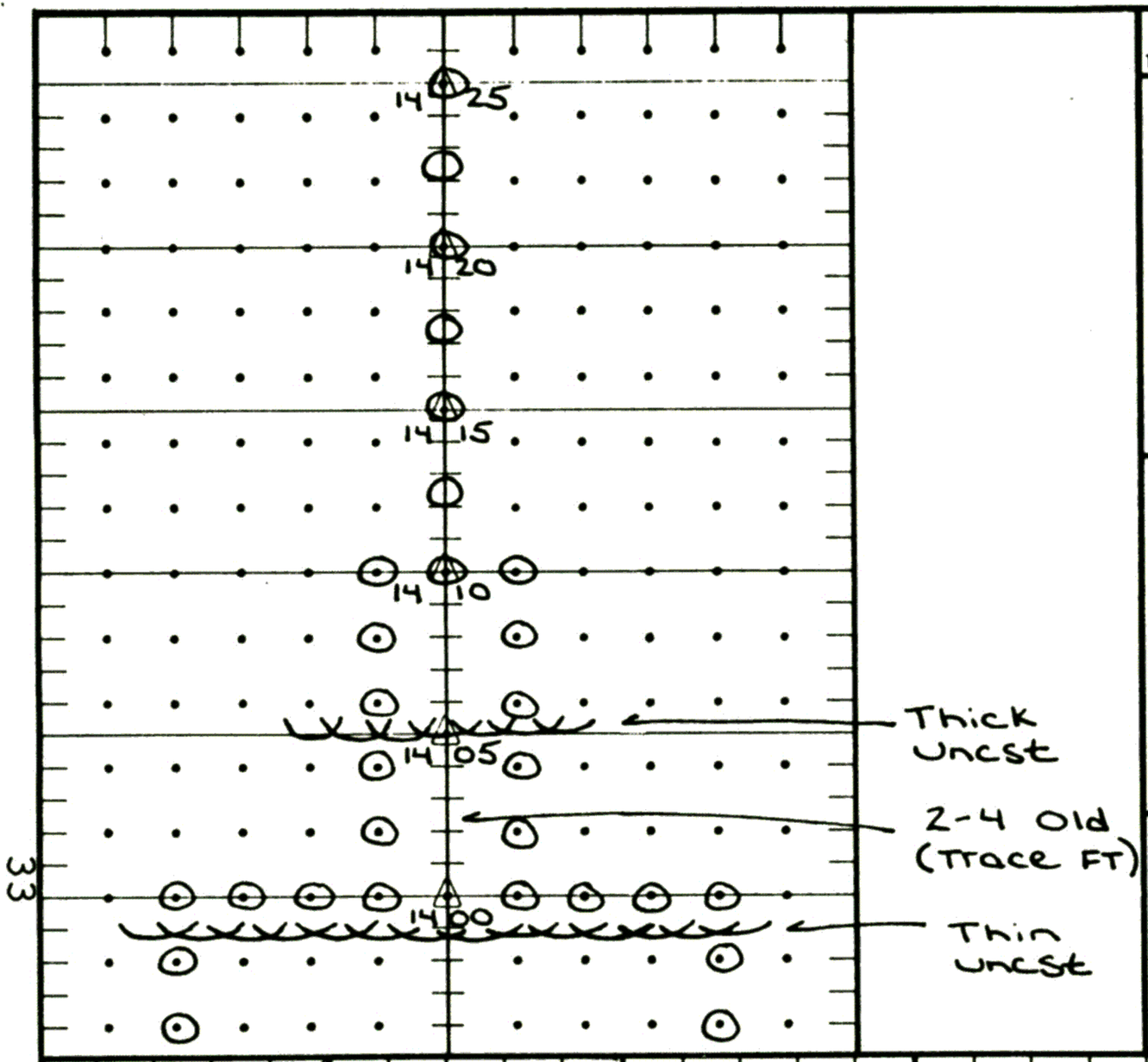
FIGURE 3-1b



TRACK FROM Keflavik TO Thule DATE 05Aug89 OBSERVER FIANO PAGE 3 OF 4

NOTES

1405 1:1
1411 Ascent 045

CONVERSION TABLE

5cm - 2in	3m - 10ft
10cm - 4in	20m - 22yds
15cm - 6in	50m - 55yds
30cm - 1ft	100m - 110yds
70cm - 2ft 4in	200m - 220yds
120cm - 3ft 11in	500m - 550yds
200cm - 6ft 8in	2km - 1.1nm
	10km - 5.4nm

TABLE 2
CONCENTRATION, EXTENT OF TOPOGRAPHY, SNOW COVER (C, Co, Cft, Clm, Clf, Cy, Cn, Re, S)

(0) < 1/10
(1) 1/10
(2) 2/10
(3) 3/10
(4) 4/10
(5) 5/10
(6) 6/10
(7) 7/10
(8) 8/10
(9) 9/10
(A) 10/10 WITH OPENINGS
(B) 10/10 WITHOUT OPENINGS
(/) Undtr/Unk

TABLE 3 (Fp, Fs)
FORMS OF ICE

X New ice or Nilas
0 Pancake < 3m
1 Brash, Small Cake < 3m
2 Ice Cake < 20m
3 Small Floe 20-100m
4 Medium Floe 100-500m
5 Big Floe 500-2000m
6 Vast Floe 2-10km
7 Giant Floe > 10km
8 Fast Ice/Growlers or Floebergs
(/) Undtr/Unk

STAGES OF DEVELOPMENT

N - New Ice (types of New Ice) 0-10cm
NL - D.Nilas 0-5cm / L.Nilas 5-10cm
YNG - Young Ice 10-30cm
G - Gray 10-15cm
GW - Gray White 15-30cm
FL - Thin First Year 30-70cm
FM - Medium First Year 70-120cm
FT - Thick First Year > 120cm
SY - Second Year
MY - Multi Year

TABLE 4 (a1, a2)
TOPOGRAPHY

(0) None
(1) New Ridge
(2) Weathered Ridge
(4) Aged Ridge
(6) Hummocks
(7) Rafting
(/) Undtr/Unk

TABLE 5 (Wt)
TYPE OF OPENING

(0) No Openings
(1) Crack
(2) Frctv 0-50m
(3) Frcts 50-200m
(4) Frctm 200-500m
(5) Frctl 500m
(6) Lead
(7) Polynya
(8) Recur Polynya
(9) Wtr Btwn Floe
(/) Undtr/Unk

TABLE 6 (Dw)
ORIENTATION

(0) None
(1) No Distinct
(2) Major Axis Orient
NE - SW
(3) E - W
(4) SE - NW
(5) N - S
(6) Para SH to E
(7) Para SH to S
(8) Para SH to W
(9) Para SH to N
(/) Undtr/Unk

TABLE 7 (ms)
STAGE OF MELT

(0) No Melt
(1) Few Pd
(2) Many Pd
(3) Flooded
(4) Few Th
(5) Many Th
(6) Dried
(7) Rotten
(8) Few Fzn Pd
(9) Rtzn Pd
(/) Undtr/Unk

TABLE 8
LAND ICE

ACTUAL COUNT
(00) None
(01) 1
(02) 2
(03) 3 thru 19

ESTIMATE COUNT
(20) 1-9
(21) 10-19
(22) 20-29
(23) 30-39
(24) 40-49
(25) 50-99
(26) 100-199

G	G	B	B		Oc	Lo	Lo	Lo	Lo	Lo	Lo	Lo	Lo	Lo	Ol	Ol	h	h	C	S	S	Co	Clt	Clm	Clf	Cy	Cn	Fp	Fs	Re	a1	a2	h	hx	7	Wt	Dw	S	ms	9	nO	nO	n8	n8
1	4	0	0	/	7	6	9	1	9	0	2	2	2	1	0	5	1	9	2	S	S	2	0	/	/	/	/	2	3	6	4	6	1	3	7	9	0	4	2	9	2	0	2	0
1	4	0	5	/	7	6	9	3	5	0	2	1	2	9	0	1	1	9	1	S	S	1	0	/	/	/	/	2	1	7	6	4	1	2	7	9	0	5	2	9				
1	4	1	0	/	7	6	9	5	1	0	2	0	5	4	0	0	1	8	/	S	S														7					9				
1	4	1	5	/	7	7	0	0	7	0	2	0	2	1	0	0	4	5	/	S	S														7					9				
1	4	2	0	/	7	7	0	2	1	0	1	9	4	8	0	0	4	5	/	S	S														7					9				
1	4	2	5	/	7	7	0	3	6	0	1	9	1	5	0	0	4	5	/	S	S														7					9				

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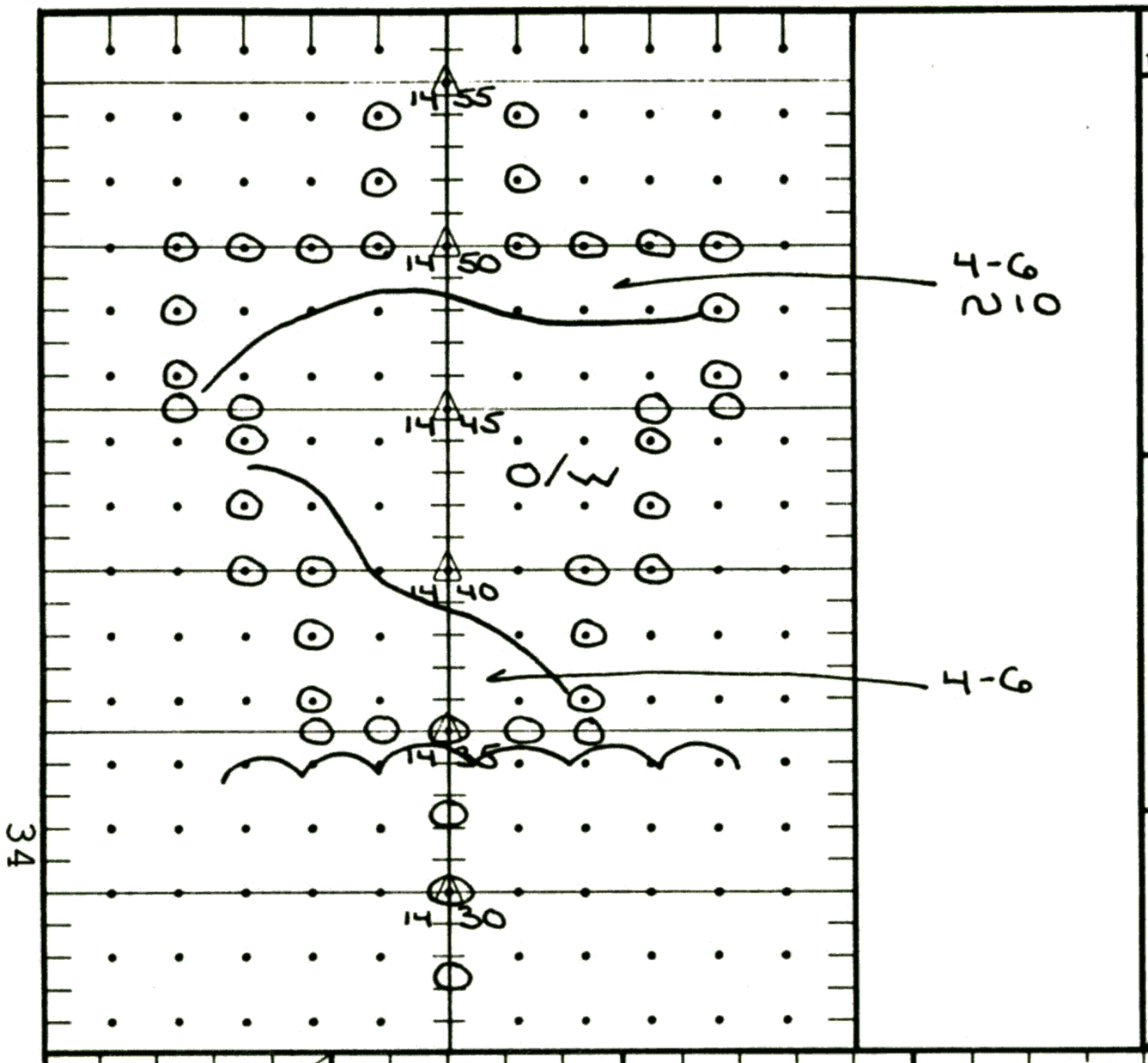
FIGURE 3-1c



TRACK FROM Keflavik TO Thule DATE 05 Aug 89 OBSERVER FIANO PAGE 4 OF 4

NOTES

1432 Descent 015
1451 Ascent 045
1458 Off Station

CONVERSION TABLE

5cm - 2in	3m - 10ft
10cm - 4in	20m - 22yds
15cm - 6in	50m - 55yds
30cm - 1ft	100m - 110yds
70cm - 2ft 4in	200m - 220yds
120cm - 3ft 11in	500m - 550yds
200cm - 6ft 8in	2km - 1.1nm
	10km - 5.4nm

TABLE 2
CONCENTRATION, EXTENT OF TOPOGRAPHY, SNOW COVER (C, Co, Cit, Clm, Cil, Cy, Cn, Ro, S)

(0) < 1/10
(1) 1/10
(2) 2/10
(3) 3/10
(4) 4/10
(5) 5/10
(6) 6/10
(7) 7/10
(8) 8/10
(9) 9/10
(A) 10/10 WITH OPENINGS
(B) 10/10 WITHOUT OPENINGS
(/) Undtr/Unk

TABLE 3 (Fp, Fs)
FORMS OF ICE

X New ice or Nilas
0 Pancake < 3m
1 Brash, Small Cake < 3m
2 Ice Cake < 20m
3 Small Floe 20-100m
4 Medium Floe 100-500m
5 Big Floe 500-2000m
6 Vast Floe 2-10km
7 Giant Floe > 10km
8 Fast Ice/Growlers or Floebergs
(/) Undtr/Unk

STAGES OF DEVELOPMENT

N - New Ice (types of New Ice) 0-10cm
NL - D.Nilas 0-5cm / L.Nilas 5-10cm
YNG - Young Ice 10-30cm
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GW - Gray White 15-30cm
FL - Thin First Year 30-70cm
FM - Medium First Year 70-120cm
FT - Thick First Year > 120cm
SY - Second Year
MY - Multi Year

TABLE 4 (a1, a2)
TOPOGRAPHY

(0) None
(1) New Ridge
(2) Weathered Ridge
(4) Aged Ridge
(6) Hummocks
(7) Rafting
(/) Undtr/Unk

TABLE 5 (Wt)
TYPE OF OPENING

(0) No Openings
(1) Crack
(2) Frctv 0-50m
(3) Frcts 50-200m
(4) Frctm 200-500m
(5) Frctl 500m
(6) Lead
(7) Polynya
(8) Recur Polynya
(9) Wtr Btwn Floe
(/) Undtr/Unk

TABLE 6 (Dw)
ORIENTATION

(0) None
(1) No Distinct
(2) Major Axis Orient
NE - SW
(3) E - W
(4) SE - NW
(5) N - S
(6) Para SH to E
(7) Para SH to S
(8) Para SH to W
(9) Para SH to N
(/) Undtr/Unk

TABLE 7 (ms)
STAGE OF MELT

(0) No Melt
(1) Few Pd
(2) Many Pd
(3) Flooded
(4) Few Th
(5) Many Th
(6) Dried
(7) Rotten
(8) Few Fzn Pd
(9) Rfzn Pd
(/) Undtr/Unk

TABLE 8
LAND ICE

ACTUAL COUNT
(00) None
(01) 1
(02) 2
(03) 3 thru 19

ESTIMATE COUNT
(20) 1-9
(21) 10-19
(22) 20-29
(23) 30-39
(24) 40-49
(25) 50-99
(26) 100-199

G	G	B	B	/	Oc	La	La	La	La	Lo	Lo	Lo	Lo	Lo	OL	OL	h	h	C	S	S	Co	Cit	Clm	Cil	Cy	Cn	Fp	Ft	Ro	a1	a2	h	hx	7	Wt	Dw	S	ms	9	nG	nG	nB	nB
1	4	3	0	/	7	7	0	5	1	0	1	8	4	0	0	0	4	5	/	S	S													7					9				
1	4	3	1		7	7	0	5	6	0	1	8	3	0	T	U	R	N	/																								
1	4	3	5	/	7	7	1	1	2	0	1	8	3	5	1	0	1	5	6	S	S	3	2	1	0	/	/	3	1	4	4	2	2	3	7	7	/	6	1	9	2	1	2	0
1	4	4	0	/	7	7	1	3	0	0	1	8	3	8	1	5	1	5	0	S	S													7					9				
1	4	4	5	/	7	7	1	4	8	0	1	8	4	3	2	0	1	5	0	S	S													7					9				
1	4	5	0	/	7	7	2	0	5	0	1	8	4	6	0	5	1	5	5	S	S	2	3	0	0	/	/	4	3	6	4	2	1	3	7	9	0	7	1	9	2	0	1	0
																																		7					9				

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FIGURE 3-1d

TRACK FROM: Sondrestrom TO: Keflavik DATE: 30 July 89

OBSERVERS: FIANO / OLSEN PAGE 1 OF 1

```
44111621206070077658073407770607453777180750577730075007773207415
77757072206100077759072506211161702772110692077214069107723506932
77239068477725506832773020684062017603007730206840773100684577315
06858773210683277334068407733706755773470674077358068027741106808
6130069900.     62306610007775107705777460773077730077456130002-04
TENTHS 60100 77642 06935 77634 07100 61000 00-02 TENTHS STRIPS/
PATCHES 06-08 TENTHS WITHIN VIS EDGE S OF 7439N AND N OF 7258N.
THREE BT'S EXPENDED. TOTAL FLT TIME ELEVEN PT. ONE. NEXT FLT KEF
TO THULE 02 AUG. ICE OBSERVERS SEND.
```

(00) (filler)
(01) Northeast of following line
(02) East of following line
(03) Southeast of following line
(04) South of following line
(05) Southwest of following line
(06) West of following line
(07) Northwest of following line
(08) North of following line
(09) Within following line
(10) Land
(11) Radar
(12) Satellite
(13) Limits of observation
(14) Limits of analysis
(15) Estimated
(16) Compacted edge
(17) Diffused edge
(18) Area of greater concentration
(19) Area of lesser concentration
(20) Analyzed
(21) Ice edge
(22) Concentration boundary
(23) Fast ice
(24) Lead
(25) Polynya
(26) Belt
(27) Patch
(28) Field
(29) Ridged ice zone
(30) Fracture zone
(31) Iceberg
(32) Scattered icebergs
(33) Group of icebergs
(34) Ice island

(35) Edge continuing visual (36) Edge continuing radar (37) Open water area (38) BT's expended
(50) Whole visually observed area (51) Visually observed outside whole pack area (99) End edge

NDW/NPOC-39308 (REV 7-86)

FIGURE 3-1e

The Ice Observer's routine procedure is as follows:

1. Take observations utilizing AERIAL ICE log forms.

2. Plot data on reconnaissance chart.

3. Check data to ensure any possible errors have been corrected.

4. Telecopy reconnaissance chart to NAVPOLAROCEANCEN (if possible), draft message, proof-read and dispatch.

5. Contact NAVPOLAROCEANCEN within 24 hours to ensure data has been received and understood.

3.3 **AERIAL ICE OBSERVATION CODE**

The complete breakdown of the Aerial Ice Observation Code is as follows:

PART I

GGgg/ QcLaLaLaLa LoLoLoLoLo O_1O_1hhC 55$C_oC_{ft}C_{fm}$ $C_{f1}C_yC_nF_pF_s$

$R_ea_1a_2hh_x$ 7$W_tD_wSm_s$ 9$n_Gn_Gn_Bn_B$

PART II

44111 6$L_iL_iL_jL_j$ 6$L_iL_iL_jL_j$ QcLaLaLaLa LoLoLoLoLo QcLaLaLaLa

$L_oL_oL_oL_oL_o$ ... etc. (C//// 55$C_oC_{ft}C_{fm}C_{f1}C_yC_nF_pF_s$ or Plain Language)

3.3.1 **SYMBOL EXPLANATION/CODE TABLES**

GG - Hour of observation in Greenwich Mean Time (GMT).
gg - Time of observation in whole minutes.
/ - After gg in Part I.
Q_c - Quadrant of the globe in which the observation is taken. See Table 3.1.
LaLaLaLa - Latitude in degrees and minutes where observation is taken.
LoLoLoLoLo - Longitude in degrees and minutes where observation is taken.
O_1O_1 - Limits of observation entered to the nearest whole nautical mile up to twenty nautical miles; 20 indicates unlimited.
hh - Altitude of aircraft to the nearest 100 feet up to 9900 feet. Example: 1100 feet would be encoded 11. For altitudes greater than 9900 encode 99.
C - Total concentration of all sea ice present. See Table 3.2.
55 - Indicator for stage of development. When encoding partial concentrations ($C_o, C_{ft}, C_{fm}, C_{f1}, C_y, C_n$) a slash (/) indicates none.
C_o - Concentration of Second-Year and/or Multi-Year ice present. See Table 3.2.
C_{ft} - Concentration of First-Year Thick ice present. See Table 3.2.
C_{fm} - Concentration of First-Year Medium ice present. See Table 3.2.
C_{f1} - Concentration of First-Year Thin ice present. See Table 3.2.
C_y - Concentration of Grey and/or Grey-White ice present. See Table 3.2.
C_n - Concentration of New Ice/Ice Rind present. See Table 3.2.
F_p - Primary form of ice present. See Table 3.3.
F_s - Secondary form of ice present. If there is only one form of ice present, repeat the figure encoded for F_p. See Table 3.3.
R_e - Total amount of all sea ice that yields topography. (In tenths) See Table 3.2.
a_1 - Primary type of topography, or the topography of the greatest extent. See Table 3.5.
a_2 - Secondary type of topography, or the topography of the second greatest extent. See Table 3.5.

h - Mean height of ridging in meters. (Plotted in decimeters). See Table 3.6.

h_x - Maximum height of ridging in meters. (Plotted in decimeters). See Table 3.6.

7 - Indicator for water features group.

W_t - Type of opening in the ice. See Table 3.7.

D_w - Orientation of water feature reported in W_t. See Table 3.8.

S - Total amount of all sea ice that is snow covered. (In tenths). See Table 3.2.

m_s - Stage of melt. Record the stage of melt that best describes the situation. In case of equal stages, use the higher code figure. See Table 3.9.

9 - Indicator for ice of land origin.

$n_G n_G$ - Growlers and bergy bits. Encode the total number of growlers and bergy bits present within the entire range of visibility. See Table 3.10.

$n_B n_B$ - Icebergs. Encode the total number of icebergs present in the entire range of visibility. See Table 3.10.

44111 - Indicator for Part II (Descriptive Ice Conditions)

6 - Indicator for data on the type of line or feature being described.

$L_i L_i L_j L_j$ - Type of line or feature being described. See Table 3.11.

TABLE 3.1

QUADRANT OF THE GLOBE (Q_c)

CODE FIGURE	LATITUDE	LONGITUDE
1	NORTH	EAST
3	SOUTH	EAST
5	SOUTH	WEST
7	NORTH	WEST

TABLE 3.2

CONCENTRATION, EXTENT OF TOPOGRAPHY, SNOW COVER
($C, C_o, C_{ft}, C_{fm}, C_{fl}, C_y, C_n, R_e, S$)

CODE FIGURE

0	Less than 1/10
1	1/10
2	2/10
3	3/10
4	4/10
5	5/10
6	6/10
7	7/10
8	8/10
9	9/10
A	10/10 - With Openings
B	10/10 - Without Openings
/	Undetermined or Unknown

1. If no sea ice is present, C will be encoded as a zero (0) with the remainder of the code deleted for that observation (see 1500Z observation, Figure 3-2).

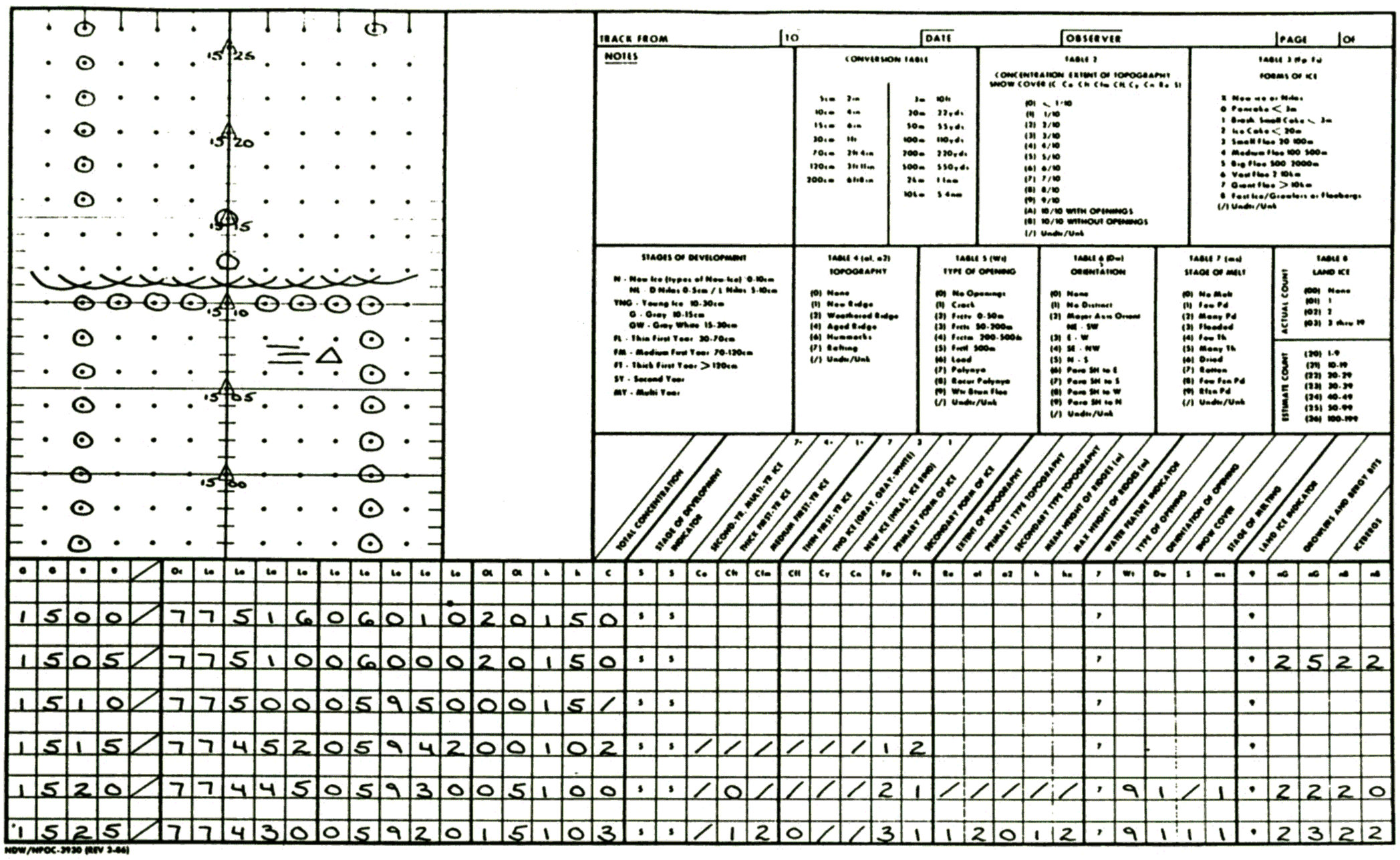
2. When no sea ice is present but ice of land origin is, C will be encoded as a zero (0) immediately followed by the $9n_Gn_Gn_Bn_B$ code group (see 1505Z observation, Figure 3-2).

3. If an observation is impossible due to undercast, darkness, etc., C will be encoded with a slash (/) with the remainder of the code deleted (see 1510Z observation, Figure 3-2).

4. If no topography is present (Example: The only stage of development is grease ice) or topography is not reportable (Example: Brash ice in low concentrations is present) the $R_ea_1a_2hh_x$ group will be deleted and followed by the $7W_tD_wSm_s$ group.

5. If no snow cover is present, S will be encoded as a zero (0).

6. If snow cover becomes impossible to determine due to very low concentrations of sea ice, S will be encoded as a slash (/) (Example: It would be extremely difficult to determine the amount of snow cover on 01/10 of sea ice)



NDW/NPOC-3930 (REV 3-66)

FIGURE 3-2

TABLE 3.3

FORMS OF ICE (F_pF_s)

CODE FIGURE		ABBREVIATION
X	New Ice	N
0	Pancake Ice	PK
1	Small Ice Cake, Brash Ice	CK/BSH
2	Ice Cake	CK
3	Small Ice Floe	SF
4	Medium Ice Floe	MF
5	Big Ice Floe	BF
6	Vast Ice Floe	VF
7	Giant Ice Floe	GF
8	Fast Ice/Growlers or Floebergs	
9	Icebergs	
/	Undetermined or Unknown	

NOTE: Symbol "8" normally indicates fast ice and is used in conjunction with many stages of development. However, when ice of land origin (Symbol) is reported, the symbol "8" indicates the presence of growlers or floebergs.

TABLE 3.4

FLOE SIZE DETERMINATION

A useful formula to estimate floe size:

1.7 (Constant) x GS (Ground speed in knots) x TIME (In seconds) = Floe size in <u>feet</u>.

EXAMPLE:

C = 1.7
GS = 220.0 Knots
TIME = 3.0 Seconds

```
   220.0
x    1.7
-------
   374.0
x    3.0
-------
  1122.0 = Medium Floe
```

TABLE 3.5

TOPOGRAPHY (a_1, a_2)

CODE FIGURE		ABBREVIATION
0	None	
1	New Ridges	NRDG
2	Weathered Ridges	WRDG
3	Very Weathered Ridges	VWRDG
4	Aged Ridges	ARDG
5	Consolidated Ridge	CRDG
6	Hummocks	HMK
7	Rafting	RFT
/	Undetermined or Unknown	

NOTE: If two types are in equal extent, report the oldest topography first.

TABLE 3.6

MAXIMUM HEIGHT OF RIDGING (h, h_x)

CODE FIGURE	
0	Level Ice
1	10 Decimeters
2	20 Decimeters
3	30 Decimeters
4	40 Decimeters
5	50 Decimeters
6	60 Decimeters
7	70 Decimeters
8	80 Decimeters
9	90 Decimeters
/	Undetermined or Unknown

TABLE 3.7

TYPE OF OPENING IN THE ICE (W_t)

CODE FIGURE	
0	No Openings
1	Crack
2	Very Small Fracture (1-50 m)
3	Small Fracture (50-200 m)
4	Medium Fracture (200-500 m)
5	Large Fracture (Greater than 500 m)
6	Lead, Shore Lead, Flaw Lead
7	Polynya, Shore Polynya, Flaw Polynya
8	Recurring Polynya
9	Water Between Floes
/	Undetermined or Unknown

TABLE 3.8

ORIENTATION (D_w)

CODE FIGURE	
0	None
1	No Distinct Orientation
2	Major Axis of Feature orientated NE-SW
3	Orientated E-W
4	Orientated SE-NW
5	Orientated N-S
6	Parallels shore to E
7	Parallels shore to S
8	Parallels shore to W
9	Parallels shore to N
/	Undetermined or Unknown

TABLE 3.9

STAGE OF MELT (m_e)

CODE FIGURE		ABBREVIATION
0	No Melt	
1	Few Puddles	FPD
2	Many Puddles	MPD
3	Flooded Ice	FLO
4	Few Thawholes	FTH
5	Many Thawholes	MTH
6	Dried Ice	DRI
7	Rotten Ice	ROT
8	Few Frozen Puddles	FFP
9	All Puddles Frozen	APF
/	Undetermined or Unknown	

TABLE 3.10

ICE OF LAND ORIGIN: GROWLERS, BERGY BITS AND ICEBERGS ($n_c n_c$, $n_b n_b$)

CODE FIGURE		CODE FIGURE	
00	None	15	15
01	1	16	16
02	2	17	17
03	3	18	18
04	4	19	19
05	5	20	1-9
06	6	21	10-19
07	7	22	20-29
08	8	23	30-39
09	9	24	40-49
10	10	25	50-99
11	11	26	100-199
12	12	27	200-499
13	13	28	500 or More
14	14	99	No Indication. Counting Has Become Impossible.

TABLE 3.11

TYPE OF LINE OR FEATURE BEING DESCRIBED (L_1L_1, L_3L_3)

CODE FIGURE		CODE FIGURE	
00	No Specification (Filler)	31	Iceberg
01	* Northeast of the following line	32	Scattered Icebergs
02	* East of the following line	33	Group of Icebergs
03	* Southeast of the following line	34	Ice island
04	* South of the following line	35	Edge continues visually
05	* Southwest of the following line	36	Edge continues by radar
06	* West of the following line	37	Open water
07	* Northwest of the following line	38	BT's expended
08	* North of the following line	50	Whole visually observed area
09	* Within following lines	51	Visually observed outside whole pack area
10	Land	99	End edge
11	Radar		
12	Satellite		
13	Limits of observation		
14	Limits of analysis		
15	Estimated		
16	Compact edge		
17	Diffused edge		
18	Area of greater concentration		
19	Area of lesser concentration		
20	Visually observed		
21	Ice edge		
22	Concentration boundary		
23	Fast ice		
24	Lead		
25	Polynya		
26	Belt		
27	Patch		
28	Field		
29	Ridged ice zone		
30	Fracture zone		

* Gives direction of the line immediately following the $6L_1L_1L_3L_3$ groups.

3.3.2 **PART I INSTRUCTIONS**

Part I of the NAVPOLAROCEANCEN Suitland aerial ice code relates to the area surrounding the observation. This area should cover one kilometer in all directions from the point directly below the aircraft. Use the illustration area on the Part I form to describe areas outside the one kilometer range.

For conformity and to avoid confusion when plotting ice messages, it will be understood that the limits of observation, reported in each 5 minute observation, will not change until modified by a subsequent observation or otherwise indicated in Part II of the message.

In order for the plotter to establish the true limits of observation for a track, the message must provide observations with the aircraft coordinates and the limits of observation: (1) at five minute intervals, (2) at all turn points, (3) at all bathythermograph drops along the track and (4) at the points where observations begin and terminate. Ice groups are not required at turn points or on bathythermograph drop observations unless a radical change in ice conditions has occurred since the last five minute observation. Unusual or irregular limits of observation may be reported in Part II of the message if considered significant.

If sea ice is observed outside the observation area (one kilometer in all directions from the point directly below the aircraft), report it in Part II of the message.

3.3.3 **SPECIAL OBSERVATIONS**

Special observations should be reported when:

a. Undercast begins (Report all information possible in the observation).

b. Undercast ends (Complete observation).

c. Turns. Reporting procedure:
GGgg/ QcLaLaLaLa LoLoLoLoLo $0_1 0_1$hhC TURN/

Note: Turns do not have to be reported if they occur within 30 seconds either side of observation time.

d. Bathythermograph expenditures. Reporting procedure: GGgg/ QcLaLaLaLa LoLoLoLoLo $0_1 0_1$hhC BTnnn $tmp#

BTnnn - Number in order of drop
(Example: BT001)
$tmp# - Temperature group
$ - Zero (0) is for positive temperatures
One (1) is for negative temperatures
tmp - Temperature in tens, units and tenths
- (C) is for reports in celsius
(F) is for reports in fahrenheit

Example: BT002 0335F - Bathythermograph drop number 2 reported a temperature of positive 33.5 degrees fahrenheit.

NOTE: If a bathythermograph fails, encode DUD// in place of the temperature group.

3.3.4 **PART II INSTRUCTIONS**

Part II of the ice reconnaissance message delineates large scale features as obtained from radar and the illustration area on the Part I form. Part II may or may not include areas reflected in Part I observations.

When all data (from Part I and radar forms) have been plotted on the reconnaissance chart, a paragraph is formulated using the $6L_iL_iL_jL_j$ group. It is important to have a good working knowledge of NPOC's ice message drafting techniques, for they are the principal user of your aerial ice reconnaissance messages. Communication of data with as little confusion as possible is needed for timely incorporation of your data into daily or weekly messages and sea ice products. In addition to the "6" group, plain language can be used if you feel it is needed or if there are no codes on Table 3.11 to adequately describe the line or feature being reported. Remember, the more information you can give Suitland, the better.

d. Bathythermograph expenditures. Reporting procedure: GGgg/ QcLaLaLaLa LoLoLoLoLo $0_1 0_1$hhC BTnnn $tmp#

BTnnn - Number in order of drop
(Example: BT001)
$tmp# - Temperature group
$ - Zero (0) is for positive temperatures
One (1) is for negative temperatures
tmp - Temperature in tens, units and tenths
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3.3.4 **PART II INSTRUCTIONS**

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The lines and features in Part II are reported in the following order:

a. Limits of observation. Limits of observation will not be reported in Part II if adequately described in Part I Part I observations.

b. Ice edge

c. Fast ice

d. Concentration boundaries. Areas of differing concentrations considered significant enough to be reported in Part II will be within the following categories.

1) Less than 1 tenth
2) 1 - 3 tenths
3) 4 - 6 tenths
4) 7 - 9 tenths
5) 10 tenths with openings
6) 10 tenths without openings

e. Water features. At the observers discretion, water features may be described through the use of the appropriate code figure in Table 3.11.

Notes on Part II:

a. As many $6L_iL_iL_jL_j$ groups as needed may be reported to describe a line or feature. Code figures (Table 3.10) may appear in any order that best describes the line or feature being reported. If only one code figure in the $6L_iL_iL_jL_j$ group is used, L_jL_j will be encoded as 00. If only one $6L_iL_iL_jL_j$ group will supply enough information, drop the second $6L_iL_iL_jL_j$ group.

Example: 62111 60600 indicates an ice edge (21) by radar (11) with the ice to the west of the following line (06). Filler (00) is used to complete the group.

b. The code figure for land (10) will be reported in a $6L_iL_iL_jL_j$ group immediately preceding the QcLaLaLaLa LoLoLoLoLo coordinates for a line point which begins and/or ends on land.

Example: 62111 60110 77435 05715 77515 05930 77550 06300 61000 77555 06620 indicates an ice edge (21) by radar (11) with the ice to the north-east of the following line (01) from land (10) at 7435N 05715W to 7515N 05930W, 7550N 06300W, to land (10) at 7555N 06620W.

c. Code figures (01) - (09), which describe direction, need not be used when the concentration within the boundary being described is evident from the ice observations reported in Part I.

d. When encoding an ice edge, code figures (35) (edge continues visually) and/or (36) (edge continues by radar) will be used to reflect the change in the means by which the data was obtained.

Example: 62111 60600 77435 05715 77515 05930 63500 77550 06300 indicates an ice edge (21) by radar (11) with the ice to the west of the following line (06) from 7435N 05715W to 7515N 05930W changing from a radar edge to a visual edge at 7515N 05930W and continuing to 7550N 06300W.

e. Latitude/Longitude pairs need not be repeated when changing from radar ice edge to visual ice edge (or vice versa) as long as the change is preceded with code figure 35 (edge continues visually) or code figure 36 (edge continues by radar).

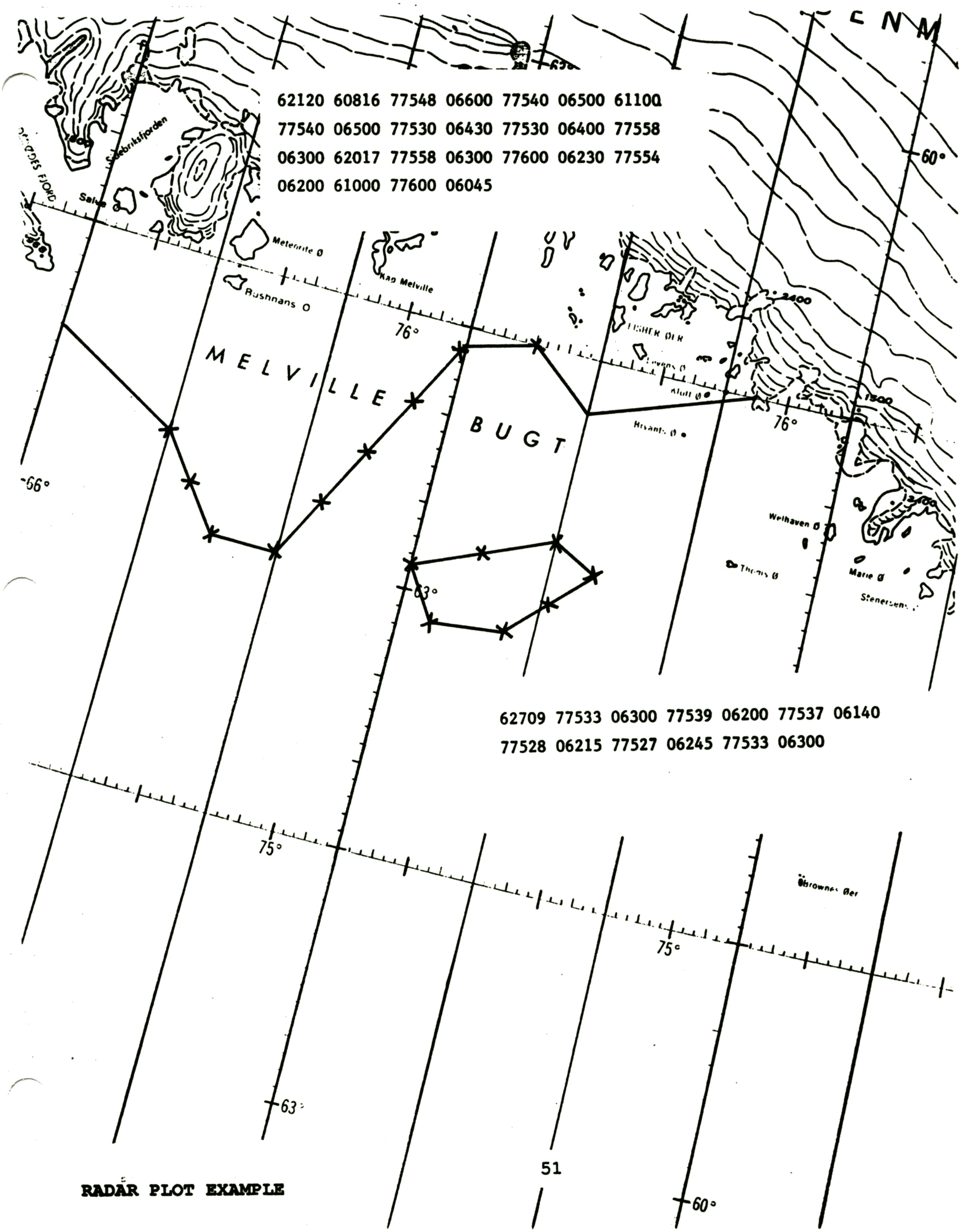
f. End edge (69900) will be used immediately following the last QcLaLaLaLa LoLoLoLoLo group for each ice edge.

g. When code figure (15) (estimated) is used to describe the line or feature being reported, it ensures that the data will not be archived but will be available to the ice analysts for evaluation.

h. Concentration, partial concentrations and forms of ice need not be reported after the line or feature being described, provided the conditions within the feature are evident from ice observations reported in Part I.

In rare cases, a plain language message may need to be transmitted from the ice observer on deployment to the group or groups they are supporting. Use as many abbreviations as possible while still keeping the the basic data intact. A sample plain language message follows:

P 131800Z OCT 89
FM NAVPOLAROCEANCEN DET THREE
TO MV GREENWAVE
INFO NAVOCEANCOMFAC KEFLAVIK IC
BT
UNCLAS //N03140//
SUBJ: AERIAL ICE RECONNAISSANCE 13 OCT 89
1. 130610Z TO 131247Z OCT 1989. TOTAL FLT TIME SIX PT SIX HRS. ALL LATS NORTH/ALL LONGS WEST. TRK: THULE 79/10 78/05 75/15 7030/16 67/25 TO KEF. OB LMT 10NM 7030/16 TO 67/25. EDGE 79/1010 7830/12 78/15 76/0710 74/7430 7040/15 6810/22 67/25. N OF LN FM EDGE 78/15 TO 7730/12. 5MY3FT2N MP CK. RDG TWO, HMK ONE, RFT ONE, MEAN RDG TWO, MAX RDG THREE, SNO SEVEN, FPD TWO, BRG FOUR, BRGY EIGHT, RMNDR THRUT EXC WHERE NOTED. 9FT, RDG ONE, SNO THREE, FPD ONE, FEW BRGY, OBS QUESTIONABLE N OF 79N DUE TO DARKNESS. THULE OBS ICE THKNS 54 IN. NXT FLT 14 OCT 89. OLSEN/FIANO SEND.



RADAR PLOT EXAMPLE

JOINT MESSAGEFORM						SECURITY CLASSIFICATION: UNCLASSIFIED				
PAGE	DTG/RELEASER TIME			PRECEDENCE		CLASS	SPECAT	LMF	CIC	ORIG/MSG IDENT
	DATE-TIME	MONTH	YR	ACT	INFO					
01 OF 01	021530Z	APR	89	PP	RR	UUUU				NPOC 021130
BOOK	MESSAGE HANDLING INSTRUCTIONS									

FROM: NAVPOLAROCEANCEN DET THREE

TO: NAVPOLAROCEANCEN SUITLAND MD

INFO NAVOCEANCOMFAC KEFLAVIK IC

ISCOMGREENLAND

COMICEDEFOR KEFLAVIK IC

COMICEASWGRU KEFLAVIK IC

DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA

ICE CENTRAL OTTAWA CAN

UNCLAS //N03140//

SUBJ: AERIAL ICE RECONNAISSANCE 02 APR 1989

1010/ 76516 03200 15500

1011/ 76519 03146 15480 TURN/

1015/ 76538 03125 10350

1018/ 76540 03115 10250 BT001 0010C

1020/ 76557 03108 10200

1025/ 76616 03052 20104 55112 ///34 44223 79052 90101

1030/ 76636 03036 20108 55422 ///45 62424 76254 90201

1035/ 76654 03018 3010A 5542/ /4/54 76413 71171 90702

44111 61121 60800 76602 03326 76558 03300 76603 03133 61300 76603

03133 76602 03123 76604 03115 76602 03100 76605 03050 76603 03037

6 5 4 3 2 1 0

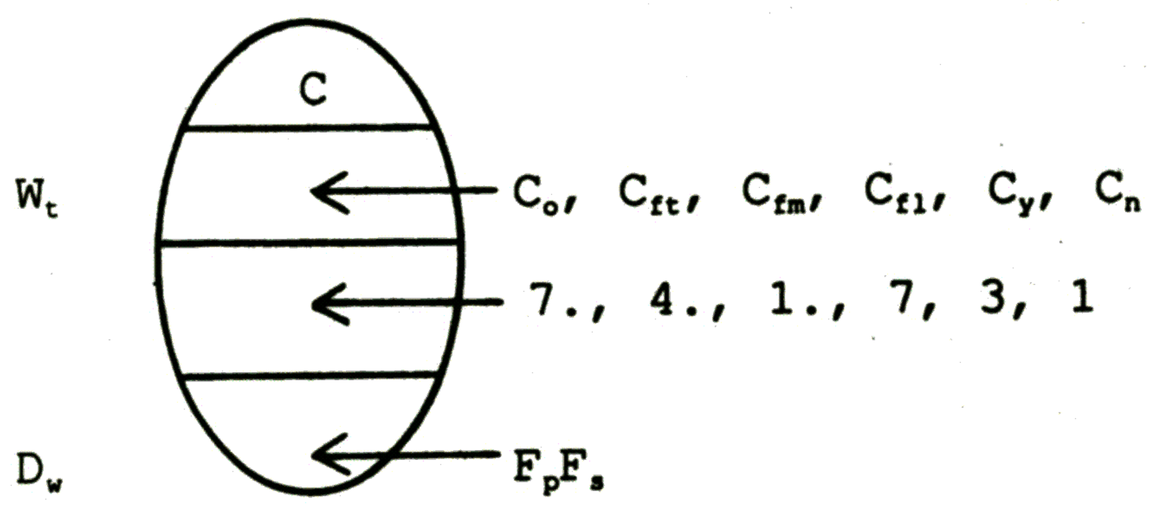
DISTR:

AG2 D. OLSEN USN 3276

DRAFTER TYPED NAME, TITLE, OFFICE SYMBOL, PHONE	SPECIAL INSTRUCTIONS	
AG2 D. OLSEN USN 3276		
RELEASER: TYPED NAME, TITLE, OFFICE SYMBOL AND PHONE		
SIGNATURE	SECURITY CLASSIFICATION: UNCLASSIFIED	DATE TIME GROUP

SAMPLE ICE RECONNAISSANCE MESSAGE FORMAT

3.3.6 **SAMPLE ICE OBSERVATION PLOT**



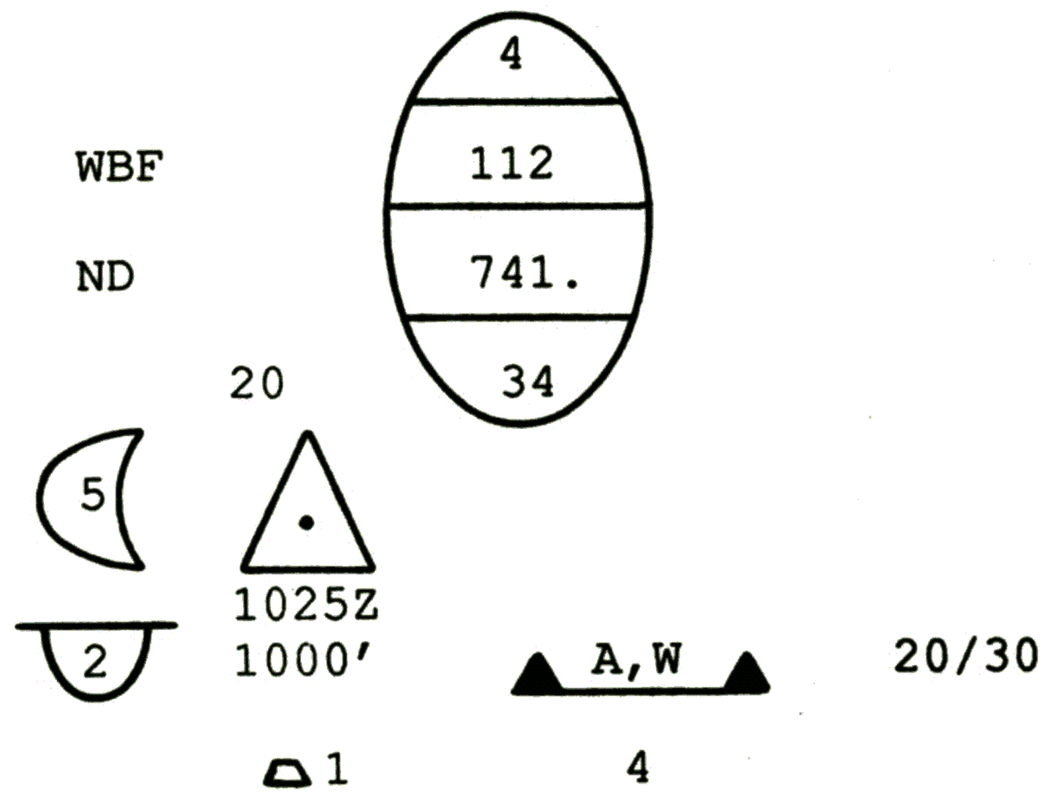
0_10_1

S GGgg a_1a_1
hh
h/h_x

m_s n_Cn_C R_e

n_Bn_B

IIHH 890611 1025/ 76616 03052 20104 55112 ///34 44223 79152 90101



CHAPTER 4

SEA ICE SUPPORT AND OBSERVATIONS

4.1 TAILORED SEA ICE SUPPORT

Tailored sea ice support is provided by the Naval Polar Oceanography Center to ships and other units operating in and near the ice on a three times weekly basis in the Arctic and twice weekly in the Antarctic. This support is usually supplied to the ships in message format rather than in chart format. Facsimile charts are also available upon request.

4.1.1 MESSAGE FORMAT

Sea ice analyses and forecasts are transmitted as alpha-numeric messages. These plain language descriptions are a combination of latitude/longitude points which describe ice concentrations, the location of the ice edge and other ice and water features. Figure 4-1 is a sample sea ice analysis. It is important to remember that not all features of the ice edge or inner-pack concentration boundaries can be described with latitude/longitude points and still retain a reasonable message length. There are a number of abbreviations that are used in sea ice support messages. A listing of these abbreviations and their meanings are found in Appendix 6.

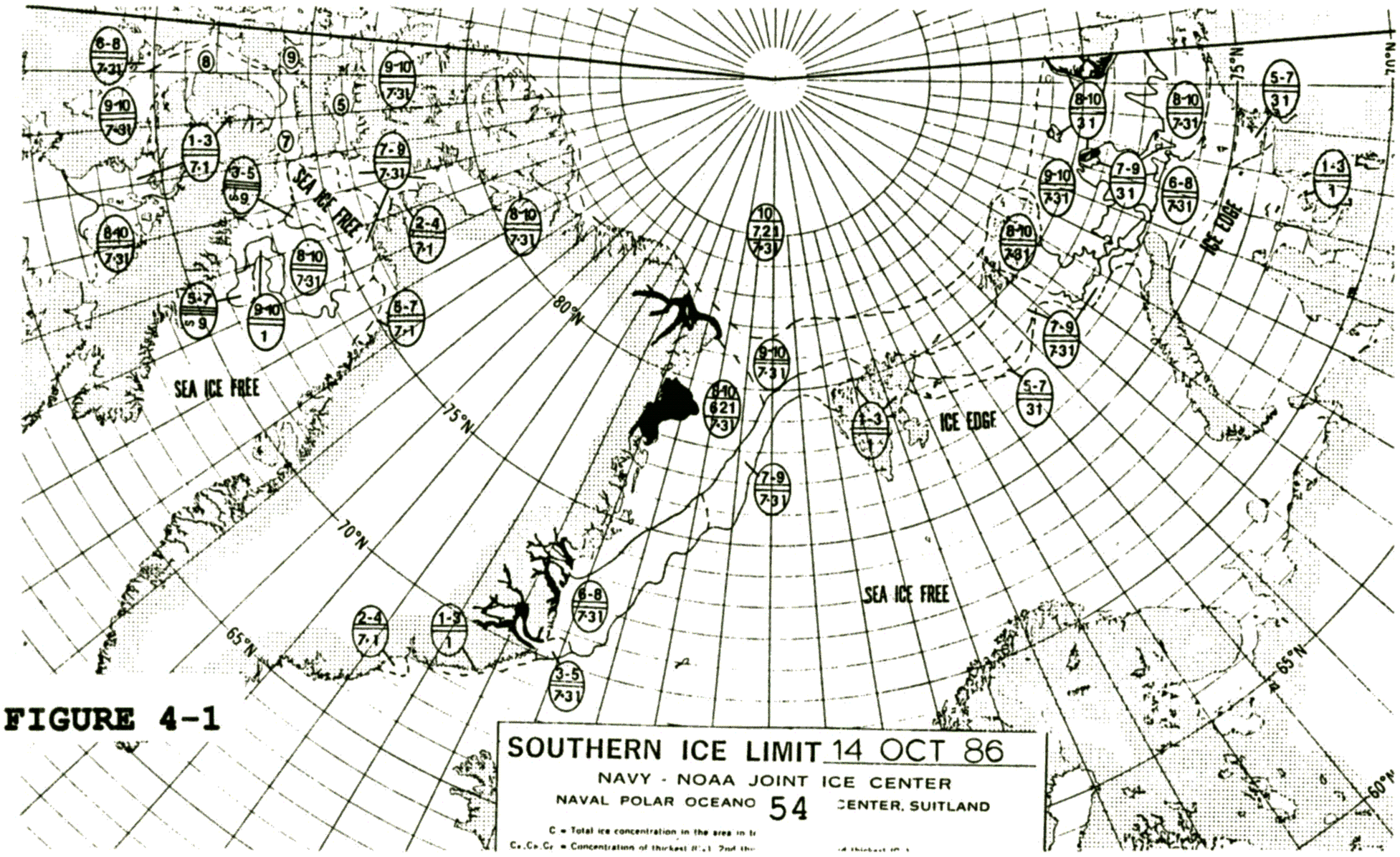


FIGURE 4-1

4.1.2 **MESSAGE CONTENT**

There are two basic types of ship support messages:

1. EDGE ONLY - This message contains only the position of the ice edge which is defined as the demarcation at any given time between the open sea and sea ice of any kind. It is designed for ships concerned only with ice avoidance and those not intending to operate within the ice.

2. ICE EDGE WITH INNER PACK CONDITIONS - This message consists of the location of the ice edge, inner-pack concentrations and ages.

4.1.3 **REQUESTING SERVICES AND COMMUNICATIONS**

DEPARTMENT OF DEFENSE AND U.S. COAST GUARD - These users should request sea ice support by letter to the Naval Polar Oceanography Center or by Autodin message addressed to NAVPOLAROCEANCEN SUITLAND MD. Support will be forwarded via Autodin message.

ALL OTHERS - All other users should request sea ice support by letter or telex to the Naval Polar Oceanography Center. The Naval Polar Oceanography Center does not have its own telex capability, but does have access to the telex connections of the National Weather Service. The following circuits may be utilized:

CIRCUIT	ANSWERBACK
RCA 248376	248376 OBSW UR
TRT 197683	197683 KWBC UT
WU 89406	NW OBS MHTS

The Naval Polar Oceanography Center does not have funding for commercial telex support. Consequently, users desiring to receive support via commercial telex must contact the Naval Polar Oceanography Center to arrange appropriate communications.

4.2 SHIP AND SHORE ICE OBSERVATIONS

Systematic sea ice observations from ships operating in or near sea ice are extremely valuable to the Naval Polar Oceanography Center. They serve not only as one of the few ground truth data sources, but they also serve to verify the sea ice analyses derived from satellite. Shipboard observers can provide more accurate data on the height of ridges, thickness of the ice and snow cover than can be provided by an aerial ice observer. Shipboard observations should be made at least every six hours (preferably 00Z, 06Z, 12Z and 18Z), even if the ship is hove-to or beset in ice. If overall ice conditions change rapidly, observations should be made more frequently. There are two basic formats for reporting sea ice observations. The first is the ICE group that is appended to the WMO ship synoptic weather observation. The second format is the more detailed Ship-Shore Ice Observation Code.

4.2.1 SHIP SYNOPTIC WEATHER CODE ICE GROUP

The ICE group of the ship synoptic weather code is located at the end of section 2 of the code and has the following format:

$$\text{ICE} + \begin{cases} \text{plain language} \\ \text{or} \\ c_i S_i b_i D_i z_i \end{cases}$$

Explanation of symbols:

c_i - Concentration or arrangement of sea ice.
S_i - Stage of development.
b_i - Ice of lsnd origin.
D_i - Bearing of principal ice edge.
z_i - Present ice situation and trend of conditions over preceding 3 hours.

The $c_i S_i b_i D_i z_i$ group will be reported whenever sea ice and/or ice of land origin is observed from the ships position at the time of the synoptic weather observation, unless the ship is required to report ice conditions by means of a special sea-ice code.

When an ice edge is crossed or sighted between observation hours, it will be reported as a plain language addition to the ship synoptic weather code as follows: ICE EDGE Latitude/Longitude. The latitude/longitude point will be reported in degrees and minutes.

If the ship is in the open sea when reporting the ice edge, the concentration c_i and the stage of development S_i will be reported only if the ship is in close proximity to the ice (within 0.5 nautical mile).

If the ship is in an open lead more than 1.0 nautical mile wide, c_i (concentration) will be coded as a 1 and D_i (bearing of principal ice edge) will be coded as a 0. If the situation arises in which the ship is in fast ice, with the ice boundary beyond the limit of visibility (one kilometer radius of the observer), c_i will be coded as a 1 and D_i will be coded as a 9.

If no sea ice is visible, and the code group is used to report ice of land origin only, the ICE group will be coded as $0/b_i/0$;

Code breakdown:

c_i is 0: No sea ice in sight.
S_i is /: Unable to report because ship is more than 0.5 nautical mile away from ice edge.
b_i is 2: 6-10 icebergs in sight, no growlers or bergy bits.
D_i is /: Unable to report because only ice of land origin is visible.
z_i is 0: Ship in open water with floating ice in sight.

0/2/0 would mean 6-10 icebergs in sight, but no sea ice.

In coding concentration or arrangement of sea ice (c_i), the condition will be reported which is of the most navigational significance.

TABLE 4.1

c_i — *Concentration or arrangement of sea ice*

Code figure			
0	No sea ice in sight		
1	Ship in open lead more than 1.0 nautical mile wide, or ship in fast ice with boundary beyond limit of visibility		
2	Sea ice present in concentrations less than 3/10 (3/8), open water or very open pack ice	Sea ice concentration is uniform in the observation area	Ship in ice or within 0.5 nautical mile of ice edge
3	4/10 to 6/10 (3/8 to less than 6/8), open pack ice		
4	7/10 to 8/10 (6/8 to less than 7/8), close pack ice		
5	9/10 or more, but not 10/10 (7/8 to less than 8/8), very close pack ice		
6	Strips and patches of pack ice with open water between	Sea ice concentration is not uniform in the observation area	
7	Strips and patches of close or very close pack ice with areas of lesser concentration between		
8	Fast ice with open water, very open or open pack ice to seaward of the ice boundary		
9	Fast ice with close or very close pack ice to seaward of the ice boundary		
/	Unable to report, because of darkness, lack of visibility, or because ship is more than 0.5 nautical mile away from ice edge		

The purpose of code figure 0 (no sea ice in sight) is to establish its relationship to code z_i, figure 0 (ship in open water with floating ice in sight). These code figures report that the floating ice that is visible is ice of land origin.

The possible variations in sea-ice concentration and arrangement within an area of observation or "spot" are almost infinite. However, the field of reasonably accurate observation from a ships bridge is limited. For this reason, and also because minor variations are of temporary significance, the choice of concentrations and arrangements has been restricted, for reporting purposes, to those representing significantly different conditions from a navigational point of view. Code figures 2-9 have been divided into two sections depending on:

a. Whether sea-ice concentrations within the area of observation are more or less uniform (code figures 2-5) or

b. Whether there are marked contrasts in concentrations or arrangement (code figures 6-9).

TABLE 4.2

S_i — *Stage of development*

Code figure	
0	New ice only (frazil ice, grease ice, slush, shuga)
1	Nilas or ice rind, less than 10 cm thick
2	Young ice (grey ice, grey-white ice), 10–30 cm thick
3	Predominantly new and/or young ice with some first-year ice
4	Predominantly thin first-year ice with some new and/or young ice
5	All thin first-year ice (30–70 cm thick)
6	Predominantly medium first-year ice (70–120 cm thick) and thick first-year ice (> 120 cm thick) with some thinner (younger) first-year ice
7	All medium and thick first-year ice
8	Predominantly medium and thick first-year ice with some old ice (usually more than 2 metres thick)
9	Predominantly old ice
/	Unable to report, because of darkness, lack of visibility or because only ice of land origin is visible or because ship is more than 0.5 nautical mile away from ice edge

This table represents a series of increasing navigational difficulties for any given concentration; for example, if the average concentration is 8 tenths, then new ice would hardly have any effect on navigation. Predominately old ice would provide difficult conditions requiring reductions in speed and frequent course alterations.

The correlation between the stage of development of sea ice and its thickness is explained in the Guide to Meteorological Instrument and Observing Practices.

TABLE 4.3

b_i — *Ice of land origin*

Code figure	
0	No ice of land origin
1	1–5 icebergs, no growlers or bergy bits
2	6–10 icebergs, no growlers or bergy bits
3	11–20 icebergs, no growlers or bergy bits
4	Up to and including 10 growlers and bergy bits — no icebergs
5	More than 10 growlers and bergy bits — no icebergs
6	1–5 icebergs with growlers and bergy bits
7	6–10 icebergs with growlers and bergy bits
8	11–20 icebergs with growlers and bergy bits
9	More than 20 icebergs with growlers and bergy bits — a major hazard to navigation
/	Unable to report, because of darkness, lack of visibility or because only sea ice is visible

This table represents a series of inceasing navigational difficulties, but unlike Table 4.2 (stage of development), it represents ice of land origin.

Growlers and/or bergy bits are much smaller and lower in the water than icebergs, and therefore are more difficult to see either by eye or radar. This is especially so if there is a heavy sea running. For this reason, code figures 4 and 5 (growlers and bergy bits - no icebergs) represent more hazardous conditions than code figures 1 through 3 (icebergs - no growlers or bergy bits).

TABLE 4.4

D_i — *Bearing of principal ice edge*

Code figure	
0	Ship in shore or flaw lead
1	Principal ice edge towards NE
2	Principal ice edge towards E
3	Principal ice edge towards SE
4	Principal ice edge towards S
5	Principal ice edge towards SW
6	Principal ice edge towards W
7	Principal ice edge towards NW
8	Principal ice edge towards N
9	Not determined (ship in ice)
/	Unable to report, because of darkness, lack of visibility or because only ice of land origin is visible

There is no provision in this code for the reporting of distance from the ice edge. It will be assumed by those receiving the report that the bearing has been given to the closest part of the ice edge. From the reported code figures for concentration and stage of development, it will be clear whether the ship is in ice or more than 0.5 nautical mile from the ice edge. The ice edge will be assumed to be aligned at right angles to the bearing which is reported.

TABLE 4.5

z_i — *Present ice situation and trend of conditions over preceding 3 hours*

Code figure			
0	Ship in open water with floating ice in sight		
1	Ship in easily penetrable ice; conditions improving		Ship in ice
2	Ship in easily penetrable ice; conditions not changing		
3	Ship in easily penetrable ice; conditions worsening		
4	Ship in ice difficult to penetrate; conditions improving		
5	Ship in ice difficult to penetrate; conditions not changing		
6	Ice forming and floes freezing together	Ship in ice difficult to penetrate and conditions worsening	
7	Ice under slight pressure		
8	Ice under moderate or severe pressure		
9	Ship beset		
/	Unable to report — because of darkness or lack of visibility		

The purpose of this element is to establish:

a. Whether the ship is in pack ice or is viewing floating ice (sea ice and/or ice of land origin) from the open sea.

b. A qualitative estimate, dependent upon the sea ice navigation capabilities of the reporting ship, of the penetrability of the sea ice and the recent trend in conditions.

The reporting of sea ice conditions, represented by code figures 1-9, can be used to help in the interpretation of reports from code tables 4.1 (concentration, c_i) and 4.2 (stage of development, S_i).

NOTE: Usage of the term "open water" adjacent to code figure 0 (ship in open water with floating ice in sight), indicates the ship is located in sea ice free water.

4.2.2 **SHIP - SHORE SEA ICE LOG**

The ship-shore sea ice log contains a detailed sea ice observing and reporting code. Since each sea ice observation can make a valuable contribution to the analysis and forecast of sea ice conditions, it should be made carefully and thoroughly. Only those conditions present at the time of observation will be reported. Mandatory and supplemental ice groups will be reported within a one kilometer radius of the observer, (see Figure A). Be sure to fill in all pertinent information on the form. (See Figure 4-2).

TRANSMISSION OF REPORTS - Observations should be transmitted to the Naval Polar Oceanography Center as soon as possible after the time of observation. For those units with access to military AUTODIN circuits, the observations should be addressed to:

NAVPOLAROCEANCEN SUITLAND MD

For those units who do not have access to AUTODIN, the reports can be transmitted via commercial telex addressed to the Naval Polar Oceanography Center on one of the following circuits:

CIRCUIT	ANSWERBACK
RCA 248376	248376 OBSW UR
TRT 197683	197683 KBWC UT
WU 89406	NW OBS MHTS

Mandatory groups will always be transmitted. Supplemental groups will be transmitted when those features are observed.

Feature groups will be transmitted only if indicated phenomena outside the one kilometer radius can be observed. As many of these groups should be sent as necessary to describe the ice.

Ship helicopter observations will be transmitted when the helicopter returns to the ship. These observations will be considered special observations and will be followed by the letters HLCPTR in the transmitted report.

DISPOSITION OF RECORDS - Completed log sheets should be mailed monthly to:

U.S. NAVAL OCEANOGRAPHIC OFFICE
CODE 712B
NSTL STATION
BAY ST LOUIS, MS 39522

REQUISITION OF FORMS - Ship-Shore Ice Log forms may be requisitioned from the Naval Polar Oceanography Center via letter, message or telephone call. The commercial telephone numbers are (301) 763-2000 or (301) 763-7310. The AUTOVON telephone number is 293-2000.

SHIP OBSERVATIONS I I S S

VESSEL NAME _____

HULL TYPE AND NUMBER _____

VOYAGE FROM _____

TO _____

U.S. NAVAL POLAR OCEANOGRAPHY CENTER
SUITLAND,MD.
SHIP-SHORE ICE LOG

SHEET NO _____

MONTH _____

YEAR _____

SHORE OBSERVATIONS I I L L

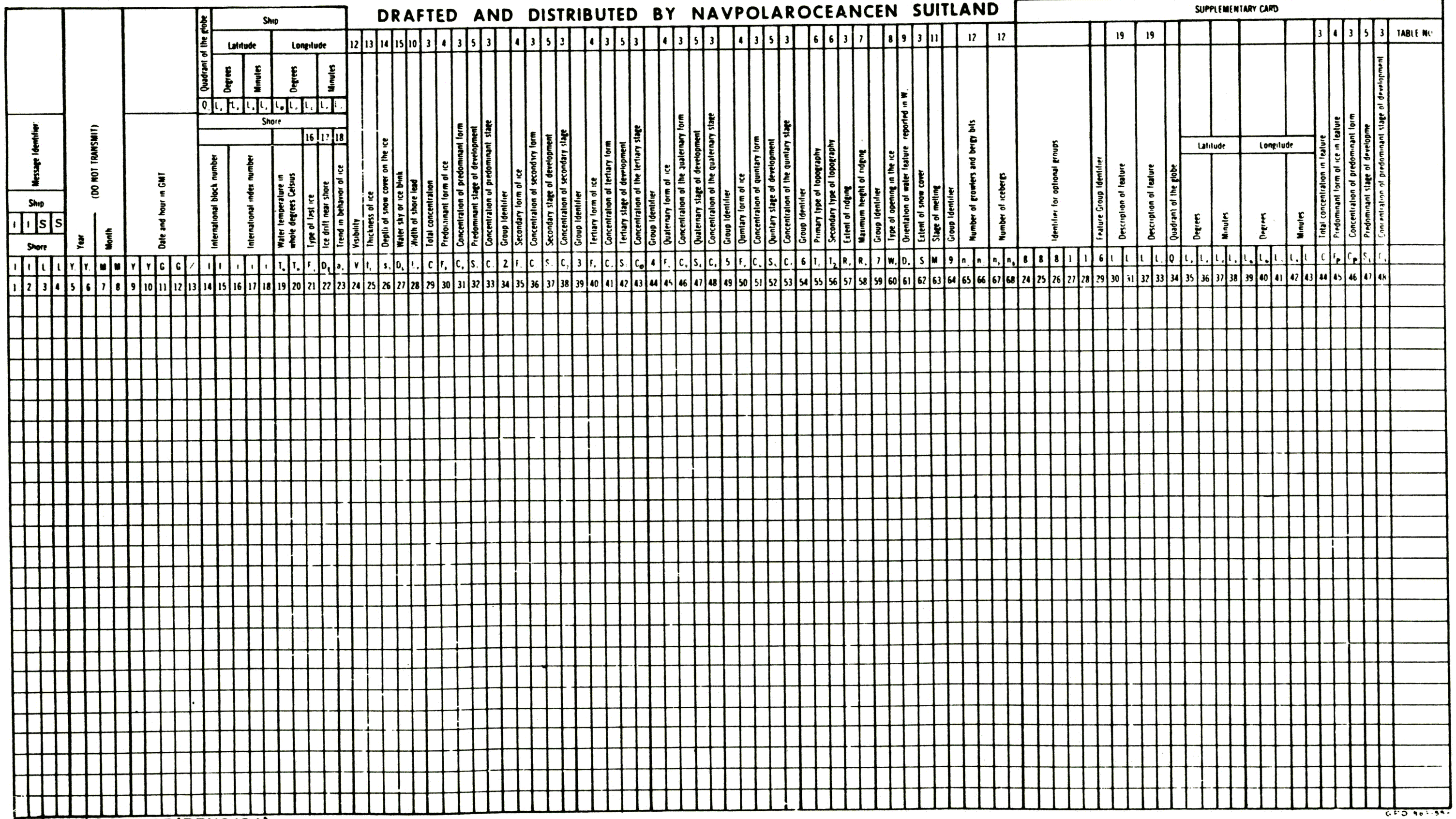
STATION NAME _____

INTERNATIONAL INDEX NUMBER _____

SITE NUMBER _____

LOCATION _____

DRAFTED AND DISTRIBUTED BY NAVPOLAROCEANCEN SUITLAND



NOW/NPOC 3167(REV8/81)

FIGURE 4-2

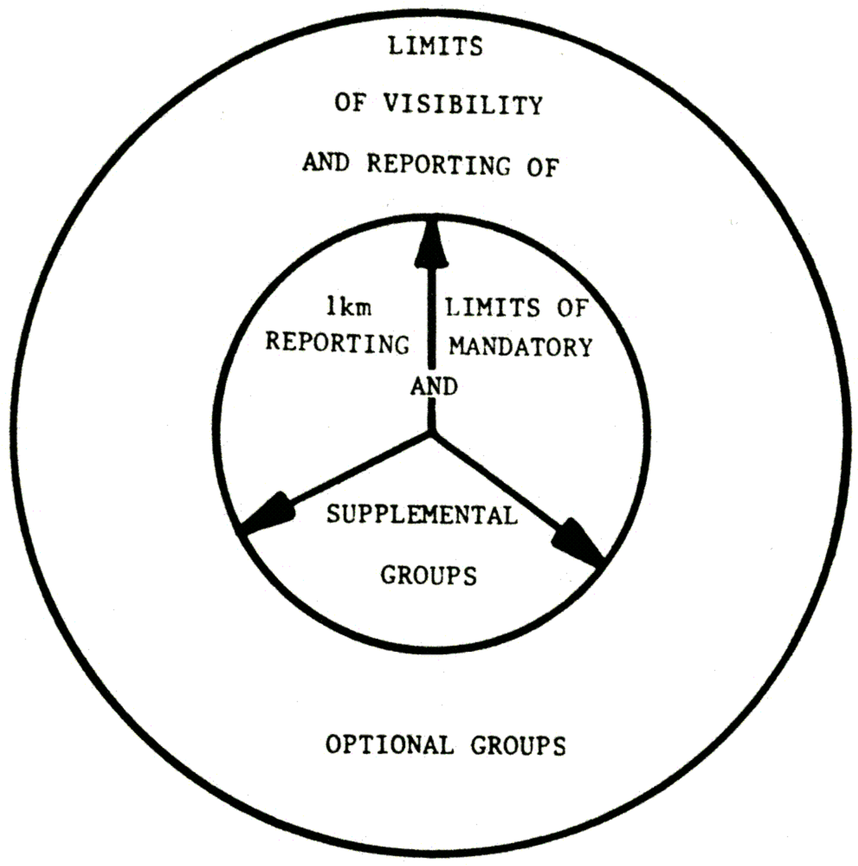


FIGURE A

How to report
average visibility:

4+2+2+2 / 4 = 2.5 km

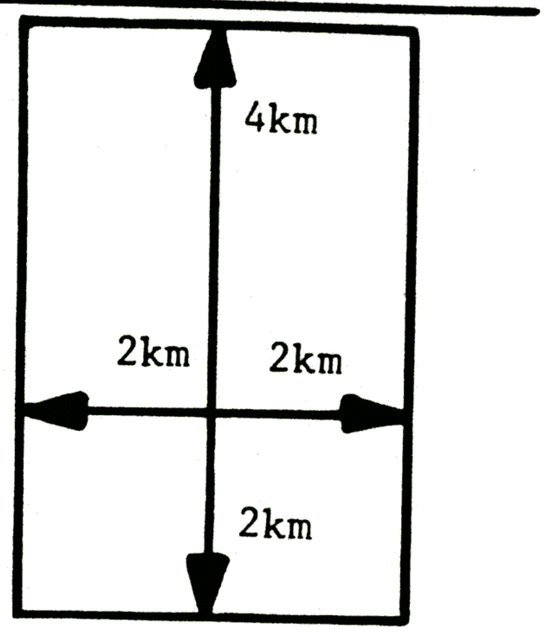
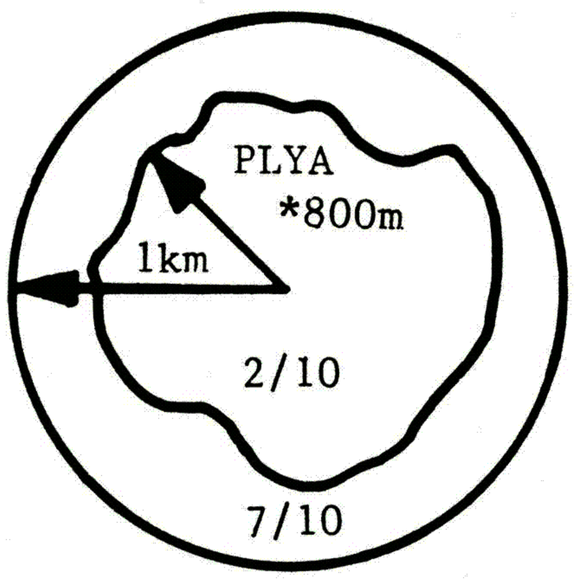


FIGURE B

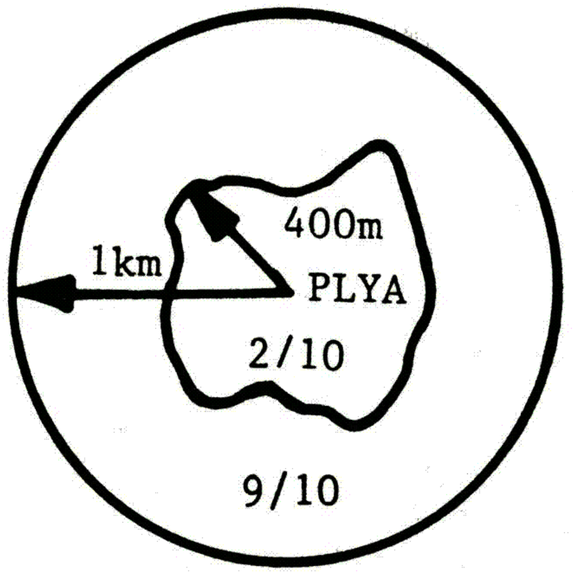
The observer will report any feature seen within the limits of visibility using the appropriate feature groups (see Figure A). Visibility is defined as the horizontal distance at which prominent objects can be seen and positively identified by the unaided eye (see figure B).

If the observer is located in a lead or polynya in which the nearest ice boundary is greater than the distance of 700 meters, report the total concentration (C) of the ice within the lead or polynya (see Figure C). If the nearest ice boundary is at a distance of less than 700 meters, report the total concentration within the one kilometer radius (see Figure D). In both instances, report the polynya or lead using feature groups.



Concentration = 2/10

FIGURE C



Concentration = 6/10

FIGURE D

Use as many feature groups as required to accurately describe all ice conditions. Features near the horizon cannot be accurately estimated and should be ignored. When located in ice free water, but within the visible limits of an ice edge or a boundary, report feature groups as necessary to describe the edge or boundary. If it is necessary to use more than one set of feature groups, continue on to the next line directly below the one being used, making sure to use the appropriate columns.

If radar is available, use radar bearings and distances to determine the position of the ice edge whenever possible. Radar observations are especially valuable if darkness or visibility restrictions make visual observations difficult or impossible.

Latitude and longitude will be reported only by ship stations or operating locations without index numbers. International index and block numbers will be reported only by shore stations.

If no ice is observed within the one kilometer radius, the identifier and location groups will be sent followed by the $CF_pC_pS_1C_1$ group on the ship-shore ice log will be coded as 0 (no sea ice). Any remaining groups will be describing the ice features outside of the one kilometer area. If no ice is observed because of darkness or poor visibility, the $CF_pC_pS_1C_1$ group will be coded as a slash (/). In both cases, if radar is available, feature groups based on radarscope interpretation can be sent.

These codes were designed to be used separately from meteorological observations. If, however, it is desired to append the ice data to a meteorological observation of any kind, the appropriate identifier group - IISS or IILL - should follow the weather report, followed immediately by the ice data, but omitting the time and location groups.

a. **Ship Station**

Shipboard observers will make an ice observation at the time the ice edge is first seen; subsequently, an ice observation will be taken four (4) times daily at 00Z, 06Z, 12Z and 18Z while operating in the ice or in view of the ice boundary. One vessel from each convoy will make the ice observation. Additionally, any ship or group of ships separated from the convoy, or any ship navigating the ice alone, will initiate an observing program. While at sea, the ice observations will be made at the scheduled times regardless of the headway being made. Helicopter reports will be considered as a special shipboard observation. The latitude and longitude of a helicopter observation are particularly important.

b. **Shore Station**

Shore station observers will make an observation once each day during the navigation season unless otherwise indicated for specific stations. Observations will be made once a week during the remainder of the year. Latitude and longitude will not be reported by shore stations except when reporting from an operating location which has not been assigned an international index number. These stations will be treated as ships.

c. **Special Observations - Ship and Shore**

An additional observation will be made when any of the following changes occur:

1. A change of 3/10 in total concentration.
2. A change in Table 4-2 from any one of the following groups to another:

   a. Code 0, 1, 2
   b. Code 3, 4, 5
   c. Code 6
   d. Code 7, 8
   e. Code 9
   f. Code A, B

These codes were designed to be used separately from meteorological observations. If, however, it is desired to append the ice data to a meteorological observation of any kind, the appropriate identifier group - IISS or IILL - should follow the weather report, followed immediately by the ice data, but omitting the time and location groups.

a. **Ship Station**

Shipboard observers will make an ice observation at the time the ice edge is first seen; subsequently, an ice observation will be taken four (4) times daily at 00Z, 06Z, 12Z and 18Z while operating in the ice or in view of the ice boundary. One vessel from each convoy will make the ice observation. Additionally, any ship or group of ships separated from the convoy, or any ship navigating the ice alone, will initiate an observing program. While at sea, the ice observations will be made at the scheduled times regardless of the headway being made. Helicopter reports will be considered as a special shipboard observation. The latitude and longitude of a helicopter observation are particularly important.

b. **Shore Station**

Shore station observers will make an observation once each day during the navigation season unless otherwise indicated for specific stations. Observations will be made once a week during the remainder of the year. Latitude and longitude will not be reported by shore stations except when reporting from an operating location which has not been assigned an international index number. These stations will be treated as ships.

c. **Special Observations - Ship and Shore**

An additional observation will be made when any of the following changes occur:

1. A change of 3/10 in total concentration.
2. A change in Table 4-2 from any one of the following groups to another:

   a. Code 0, 1, 2
   b. Code 3, 4, 5
   c. Code 6
   d. Code 7, 8
   e. Code 9
   f. Code A, B

SHIP - SHORE ICE OBSERVATION CODE

Section 1

(SHIP) IISS Y_rY_rMM YYGG/ $QcLaLaLaLa$ $LoLoLoLoLo$

(SHORE) IILL Y_rY_rMM YYGG/ IIiii $T_wT_wE_tD_Ea_i$

Section 2

$Vt_Es_2D_bL_e$ $CF_pC_pS_1C_1$ $2F_sC_sS_2C_2$ $3F_eC_eS_3C_3$ $4F_qC_qS_4C_4$

$5F_uC_uS_5C_5$ $6T_1T_2R_eR_h$ $7W_tD_WSm_s$ $9n_Gn_Gn_Gn_G$

Section 3

88811 $6L_iL_iL_iL_i$ $QcLaLaLaLa$ $LoLoLoLoLo$ $CF_pC_pS_1C_1$

SYMBOL EXPLANATION FOR SHIP-SHORE ICE LOG

IISS - Message Identifier (ship).
IILL - Message Identifier (shore).
Y_rY_r - Year.
MM - Month.
YYGG/ - Date and hour in GMT.
IIiii - International block and index number (shore stations only).
Qc - Quadrant of the globe (ships only). See Table 4.6.
LaLaLaLa - Latitude in degrees and minutes (ships only).
LoLoLoLoLo - Longitude in degrees and minutes (ships only).
T_wT_w - Water temperature in whole degrees Celsius. Add 50 to temperatures below 0 Celsius (shore stations only).
E_t - Type of fast ice (shore stations only). See Table 4.7.
D_E - Ice drift near shore (shore stations only). See Table 4.8.
a_i - Trend in behavior of ice (shore stations only). See Table 4.9.
V - Visibility (horizontal). When the visibility is irregular or spotty, report the average visibility over the defined area. See Table 4.10.
t_E - Thickness of ice. If ice is of varying thickness, report the thickness of the predominant form of ice. Do not include snow depth. See Table 4.11.
s_2 - Depth of snow cover on the ice. See Table 4.12.
D_b - Direction into which water sky or ice blink is observed. See Table 4.13.
L_e - Width of shore lead if the horizontal visibility permits. See Table 4.14.
C - Total sea ice concentration. See Table 4.15.
F_p - Predominate form of ice. If two or more forms of ice have the same concentration, selection of the predominate form will be made in a decreasing size sequence. See Table 4.16.
C_p - Concentration of predominant form of ice. See Table 4.15.
S_1 - Predominate stage of development. If two or more stages of development are of the same concentration, older stages of development will have precedence over younger stages. See Table 4.17.
C_1 - Concentration of the predominant stage of development. See Table 4.15.
2 - Indicator.
F_s - Secondary form of ice. See Table 4.16.
C_s - Concentration of secondary form of ice. See Table 4.15.
S_2 - Secondary stage of development. See Table 4.17.
C_2 - Concentration of the secondary stage of development. See Table 4.15.
3 - Indicator.
F_e - Tertiary form of ice. See Table 4.16.

C_e - Concentration of the tertiary form of ice. See Table 4.17.
S_3 - Tertiary stage of development. See Table 4.17.
C_3 - Concentration of the tertiary stage of development. See Table 4.15.
4 - Indicator.
F_q - Quaternary form of ice. See Table 4.17.
C_q - Concentration of quaternary form of ice. See Table 4.15.
S_4 - Quaternary stage of development. See Table 4.17.
C_4 - Concentration of quaternary stage of development. See Table 4.15.
5 - Indicator.
F_u - Quintary form of ice. See Table 4.16.
C_u - Concentration of quintary form of ice. See Table 4.15.
S_5 - Quintary stage of development. See Table 4.17.
C_5 - Concentration of quintary stage of development. See Table 4.15.
6 - Indicator.
T_1 - Primary type of topography. Report topography of the greatest extent. If two types are of equal extent, report the higher code number first. See Table 4.18.
T_2 - Secondary type of topography. Topography of the second greatest extent. See Table 4.18.
R_e - Extent of all ridging. See Table 4.15.
R_h - Maximum height of all ridging. See Table 4.19.
7 - Indicator.
W_t - Type of opening in the ice. If the ice concentration is greater than 08 tenths, report the presence of the largest type of opening within the defined area. If less than 08 tenths concentration exists, continue to report the largest type of openings other than polynyas. See Table 4.20.
D_W - Orientation of feature reported in W_t. See Table 4.21.
S - Extent of snow cover. See Table 4.15.
m_s - Stage of melt. Record the stage of melt that best describes the existing situation. In the case of equal stages, use the higher code figure. See Table 4.22.
9 - Indicator.
n_Gn_G - Number of growlers and bergy bits within the limits of visibility. See Table 4.23.
n_Bn_B - Number of icebergs within the limits of visibility. See Table 4.23.
88811 - Indicator.
6 - Indicator.
L_iL_i - Type of line or feature being described. See Table 4.24.
L_jL_j - Type of line or feature being described. See Table 4.24.

CODE TABLES FOR SHIP-SHORE ICE LOG

TABLE 4.6

QUADRANT OF THE GLOBE (Qc)

CODE FIGURE	LATITUDE	LONGITUDE
1	NORTH	EAST
3	SOUTH	EAST
5	SOUTH	WEST
7	NORTH	WEST

TABLE 4.7

TYPE OF FAST ICE (E_t)

CODE FIGURE	
0	No Fast Ice
1	Young Coastal Ice
2	Young Fast Ice
3	First Year Fast Ice
4	Second Year Fast Ice
5	Multi Year Fast Ice
6	Icefoot
7	Grounded Ice
8	Stranded Ice
9	Grounded Hummock
/	Undetermined or Unknown

TABLE 4.8

ICE DRIFT NEAR SHORE (D_z)

CODE FIGURE

0	No Net Ice Drift
1	Ice Drift to NE
2	Ice Drift to E
3	Ice Drift to SE
4	Ice Drift to S
5	Ice Drift to SW
6	Ice Drift to W
7	Ice Drift to NW
8	Ice Drift to N
9	All Ice is Motionless
/	Undetermined or Unknown

TABLE 4.9

TREND IN BEHAVIOR OF ICE (a_i)

CODE FIGURE

0	No Change
1	Ice Situation Improving (For navigation)
2	Ice Situation Deteriorating (For navigation)
3	Ice Breaking-Up
4	Ice Opening or Drifting Away
5	Ice Increasing
6	Ice Freezing Together
7	Ice Drifting In
8	Ice Under Pressure
9	Ice Hummocking or Screwing
/	Undetermined or Unknown

TABLE 4.10

VISIBILITY (V)

CODE FIGURE

0	< 50 Meters
1	50 - 200 Meters
2	200 - 500 Meters
3	500 - 1000 Meters
4	1 - 2 Kilometers
5	2 - 4 Kilometers
6	4 - 10 Kilometers
7	10 - 20 Kilometers
8	20 - 50 Kilometers
9	50 Kilometers or more

TABLE 4.11

THICKNESS OF THE ICE (t_e)

CODE FIGURE

0	< 5 Centimeters
1	5 - < 10 Centimeters
2	10 - < 20 Centimeters
3	20 - < 30 Centimeters
4	30 - < 40 Centimeters
5	40 - < 60 Centimeters
6	60 - < 90 Centimeters
7	90 - < 1.5 Meters
8	1.5 - < 2.5 Meters
9	2.5 Meters or Greater
/	Undetermined or Unknown

TABLE 4.12

DEPTH OF SNOW COVER (S_2)

CODE FIGURE

0	No Snow
1	Up to 5 cm
2	Up to 10 cm
3	Up to 20 cm
4	Up to 30 cm
5	Up to 50 cm
6	Up to 75 cm
7	Up to 100 cm
8	Greater than 100 cm
/	Undetermined or Unknown

TABLE 4.13

DIRECTION INTO WHICH WATER SKY OR ICE BLINK IS OBSERVED (D_b)

CODE FIGURE

0	Not Present
1	Ice Blink to East
2	Ice Blink to South
3	Ice Blink to West
4	Ice Blink to North
5	Water Sky to East
6	Water Sky to South
7	Water Sky to West
8	Water Sky to North
9	Frost Smoke
/	Undetermined or Unknown

TABLE 4.14

WIDTH OF SHORE LEAD IF HORIZONTAL VISIBILITY PERMITS (L_z)

CODE FIGURE

0	Not Present
1	Less than 100 meters
2	100 meters - Less than 1 kilometer
3	1 kilometer - Less than 2 kilometers
4	2 kilometers - Less than 5 kilometers
5	5 kilometers - Less than 10 kilometers
6	10 kilometers - Less than 30 kilometers
7	30 kilometers - Less than 50 kilometers
8	50 kilometers - Less than 100 kilometers
9	100 or more kilometers
/	Undetermined or Unknown

TABLE 4.15

TOTAL CONCENTRATION ($C, C_p, C_s, C_o, C_q, C_u, C_1, C_2, C_3, C_4, C_5$)

CODE FIGURE

0	< 1/10
1	1/10
2	2/10
3	3/10
4	4/10
5	5/10
6	6/10
7	7/10
8	8/10
9	9/10
10	10/10

TABLE 4.16

PREDOMINATE FORM OF ICE (F_p, F_s, F_o, F_q, F_u)

CODE FIGURE

X	New Ice
0	Pancake Ice
1	Small Ice Cake, Brash Ice
2	Ice Cake
3	Small Ice Floe
4	Medium Ice Floe
5	Big Ice Floe
6	Vast Ice Floe
7	Giant Ice Floe
8	Fast Ice/ Growlers of Floebergs
9	Icebergs
/	Undetermined of Unknown

NOTE: Symbol "8" normally indicates fast ice and is used in conjunction with many stages of development (S). However, when ice of land origin (Symbol) is reported, the symbol "8" indicates the presence of growlers or floebergs.

TABLE 4.17

STAGES OF DEVELOPMENT (S_1, S_2, S_3, S_4, S_5)

CODE FIGURE

0	New Ice Only (Frazil, Grease, Slush, Shuga).
1	Nilas or Ice Rind, Less than 10 cm thick.
2	Young Ice (Grey, Grey-White), 10-30 cm thick.
3	Predominantly New and/or Young Ice with some First-Year Ice.
4	Predominantly Thin First-Year Ice with some New and/or Young Ice.
5	All Thin First-Year Ice, 30-70 cm thick.
6	Predominantly Medium First-Year Ice (70-120 cm thick) and Thick First-Year Ice (>120 cm thick) with some younger First-Year Ice.
7	All Medium and Thick First-Year Ice.
8	Predominantly Medium and Thick First-Year Ice with some Old Ice (Usually more than 2 meters thick).
9	Predominantly Old Ice.
/	Unable to report because of darkness, lack of visibility, only ice of land origin is visible or because ship is more than 0.5 nautical mile away from the edge.

TABLE 4.18

TOPOGRAPHY (T_1, T_2)

CODE FIGURE

1	New Ridges
2	Weathered Ridges
3	Very Weathered Ridges
4	Aged Ridges
5	Consolidated Ridge
6	Hummocks
7	Rafted
/	Undetermined or Unknown

TABLE 4.19

MAXIMUM HEIGHT OF ALL RIDGING (R_n)

CODE FIGURE

0	Level Ice
1	10 Decimeters
2	20 Decimeters
3	30 Decimeters
4	40 Decimeters
5	50 Decimeters
6	60 Decimeters
7	70 Decimeters
8	80 Decimeters
9	90 Decimeters
/	Undetermined or Unknown

TABLE 4.20

TYPE OF OPENING IN THE ICE (W_t)

CODE FIGURE

0	No Openings
1	Crack
2	Very Small Fracture (1-5 m)
3	Small Fracture (50-200 m)
4	Medium Fracture (200-500 m)
5	Large Fracture (Greater than 500 m)
6	Lead, Shore Lead, Flaw Lead
7	Polynya, Shore Polynya, Flaw Polynya
8	Recurring Polynya
9	Water Between Floes
/	Undetermined or Unknown

TABLE 4.21

ORIENTATION OF WATER FEATURE REPORTED IN W_t (D_w)

CODE FIGURE

0	None
1	No Distinct Orientation
2	Major Axis of Feature orientated NE-SW
3	Orientated E-W
4	Orientated SE-NW
5	Orientated N-S
6	Parallels shore to E
7	Parallels shore to S
8	Parallels shore to W
9	Parallels shore to N
/	Undetermined or Unknown

TABLE 4.22

STAGE OF MELT (m_s)

CODE FIGURE

0	No Melt
1	Few Puddles
2	Many Puddles
3	Flooded Ice
4	Few Thawholes
5	Many Thawholes
6	Dried Ice
7	Rotten Ice
8	Few Frozen Puddles
9	All Puddles Frozen
/	Undetermined or Unknown

TABLE 4.23

ICE OF LAND ORIGIN: GROWLERS, BERGY BITS AND ICEBERGS ($n_c n_c, n_s n_s$)

CODE FIGURE		CODE FIGURE	
00	None	15	15
01	1	16	16
02	2	17	17
03	3	18	18
04	4	19	19
05	5	20	1-9
06	6	21	10-19
07	7	22	20-29
08	8	23	30-39
09	9	24	40-49
10	10	25	50-99
11	11	26	100-199
12	12	27	200-499
13	13	28	500 or More
14	14	99	No Indication. Counting Has Become Impossible.

TABLE 4.24

TYPE OF LINE OR FEATURE BEING DESCRIBED (L_iL_i, L_jL_j)

CODE FIGURE		CODE FIGURE	
00	No Specification (Filler)	31	Iceberg
01	* Northeast of the following line	32	Scattered Icebergs
02	* East of the following line	33	Group of Icebergs
03	* Southeast of the following line	34	Ice island
04	* South of the following line	35	Edge continues visually
05	* Southwest of the following line	36	Edge continues by radar
06	* West of the following line	37	Open water
07	* Northwest of the following line	38	BT's expended
08	* North of the following line	50	Whole visually observed area
09	* Within following lines	51	Visually observed outside whole pack area
10	Land	99	End edge
11	Radar		
12	Satellite		
13	Limits of observation		
14	Limits of analysis		
15	Estimated		
16	Compact edge		
17	Diffused edge		
18	Area of greater concentration		
19	Area of lesser concentration		
20	Visually observed		
21	Ice edge		
22	Concentration boundary		
23	Fast ice		
24	Lead		
25	Polynya		
26	Belt		
27	Patch		
28	Field		
29	Ridged ice zone		
30	Fracture zone		

* Gives direction of the line immediately following the $6L_iL_iL_jL_j$ groups.

Note: If only one set of code figure L_iL_i is used, L_jL_j shall be coded as 00. If only one group will provide enough information, drop the second 6 group.

APPENDIX 1

WMO SEA ICE NOMENCLATURE

AGED RIDGE: Ridge which has undergone considerable weathering. These ridges are best described as undulations.

ANCHOR ICE: Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.

AREA OF WEAKNESS: A satellite observed area in which either the ice concentration or the ice thickness is significantly less than that in the surrounding areas. Because the condition is satellite observed, a precise quantitative analysis is not always possible, but navigation conditions are significantly easier than in surrounding areas.

BARE ICE: Ice without snow cover.

BELT: A large feature of drift ice arrangement; longer than it is wide; from 1 km to more than 100 km in width.

BERGY WATER: A large piece of floating glacier ice, generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 sq. m in area.

BERGY WATER: An area of freely navigable water in which ice of land origin is present in concentrations of less than 1/10. There may be sea ice present, although the total concentration of all ice shall not exceed 1/10.

BESET: Situation of a vessel surrounded by ice and unable to move.

BIG FLOE: Any relatively flat piece of sea ice 500 m - 2 km across.

BIGHT: An extensive crescent-shaped indentation in the ice edge, formed by either wind or current.

BRASH ICE: Accumulations of floating ice made up of fragments not more than 2 m across, the wreckage of other forms of ice.

BUMMOCK: From the point of view from a submariner, a downward projection from the underside of the ice canopy.

CALVING: The breaking away of a mass of ice from an ice wall, ice front or iceberg.

CLOSE ICE: Floating ice in which the concentration is 7/10 to 8/10, composed of floes mostly in contact.

COMPACTED ICE EDGE: Close, clear-cut ice edge compacted by wind or current; usually on the windward side of an area of ice.

COMPACTING: Pieces of floating ice are said to be compacting when they are subject to a converging motion, which increases ice concentration and/or produces stresses which may result in ice deformation.

COMPACT ICE: Floating ice in which the concentration is 10/10 and no water is visible.

CONCENTRATION: The ratio in tenths describing the amount of the sea surface covered by ice as a fraction of the whole area being considered. Total concentration includes all stages of development that are present. Partial concentration may refer to the amount of a particular stage or of a particular form of ice and represents only a part of the total.

CONCENTRATION BOUNDARY: A line approximating the transition between two areas of drift ice with distinctly different concentrations.

CONSOLIDATED ICE: Floating ice which the concentration of 10/10 and the floes are frozen together.

CONSOLIDATED RIDGE: A ridge in which the base has frozen together.

CRACK: Any fracture which has not parted more than 1 meter.

DARK NILAS: Nilas which is under 5 cm in thickness and is very dark in color.

DEFORMED ICE: A general term for ice which has been squeezed together and in places forced upwards and/or downwards. Subdivisions are rafted ice, ridged ice and hummocked ice.

DIFFICULT AREA: A general qualitative expression to indicate that the severity of ice conditions prevailing in an area is such that navigation in it is difficult.

DIFFUSE ICE EDGE: Poorly defined ice edge limiting an area of dispersed ice; usually on the leeward side of an area of ice.

DIVERGING: Ice fields or floes in an area are subjected to diverging or dispersive motion, thus reducing ice concentration and/or relieving stresses in the ice.

DRIED ICE: Sea ice from the surface of which melt-water has disappeared after the formation of cracks and thaw holes. During the period of drying, the surface whitens.

DRIFT ICE* / PACK ICE: 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 dispersed. When concentrations are high, i.e. 7/10 or more, drift ice may be replaced by the term Pack Ice.

* Previously the term Pack Ice was used for all ranges of concentration.

EASY AREA: A general qualitative expression to indicate that ice conditions prevailing in an area are such that navigation in it is not difficult.

FAST ICE: Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an ice wall, to an ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of floating ice of any age to the shore, where it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (Old, Second-Year, or Multi-Year). If it is thicker than about 2 m above sea-level it is called an ice shelf.

FAST-ICE BOUNDARY: The ice boundary at any given time between fast ice and drift ice.

FAST-ICE EDGE: The demarcation at any given time between fast ice and open water.

FINGER RAFTING: Type of rafting whereby interlocking thrusts are formed, each floe thrusting "fingers" alternately over and under the other. Common in nilas and grey ice.

FIRN: Old snow which has recrystallized into a dense material. Unlike ordinary snow, the particles are to some extent joined together but, unlike ice, the air spaces in it still connect with each other.

FIRST-YEAR ICE: Sea ice of not more than one winter's growth, developing from young ice; thickness 30 cm - 2 m. May be subdivided into thin first-year ice/white ice, medium first-year ice and thick first-year ice.

FLAW: A narrow separation zone between drift ice and fast ice, where the pieces of ice are in chaotic state; it forms when drift ice shears under the effect of a strong wind or current along the fast ice boundary.

FLAW LEAD: A passage-way between drift ice and fast ice which is navigable by surface vessels.

FLAW POLYNYA: A polynya between drift ice and fast ice.

FLOATING ICE: Any form of ice found floating in water. The principal kinds of floating ice are lake ice, river ice, and sea ice, which form by the freezing of water at the surface, and glacier ice (ice of land origin) formed on land or in an ice shelf. The concept includes ice that is stranded or grounded.

FLOE: Any relatively flat piece of sea ice 20 m across. Floes are subdivided according to horizontal extent as follows:

GIANT:	Over 10 km across.
VAST:	2-10 km across.
BIG:	500 m - 2 km across.
MEDIUM:	100-500 m across.
SMALL:	20-100 m across.

FLOEBERG: A massive piece of sea ice composed of a hummock or a group of hummocks, frozen together and separated from any ice surroundings. It may typically protrude up to 5 m above sea-level.

FLOEBIT: A relatively small piece of sea ice, normally not more than 10 m across composed of a hummock(s) or part of a ridge(s) frozen together and separated from any surroundings. It typically protrudes up to 2 m above sea level.

FLOODED ICE: Sea ice which has been flooded by melt-water or river water and is heavily loaded by water and wet snow.

FRACTURE: Any break or rupture through very close ice, compact ice, fast ice or a single floe resulting from deformation processes. Fractures may contain brash ice and/or be covered with nilas and/or young ice. Length may vary from a few meters to many kilometers.

FRACTURE ZONE: An area which has a great number of fractures.

FRACTURING: Pressure process whereby ice is permanently deformed, and rupture occurs. Most commonly used to describe breaking across very close ice, compact ice and consolidated ice.

FRAZIL ICE: Fine spicules or plates of ice suspended in water.

FRIENDLY ICE: From the point of view of the submariner, an ice canopy containing many large skylights or other features which permit a submariner to surface. There must be more than ten such features per 30 nautical miles along the submarines track.

FROST SMOKE: Fog-like clouds due to contact of cold air with relatively warm water, which can appear over openings in the ice or leeward of the ice edge, and which may persist while ice is forming.

GIANT FLOE: Any relatively flat piece of sea ice over 10 km across.

GLACIER: A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are: Inland Ice Sheet, Ice Shelves, Ice Streams, Ice Caps, Ice Piedmonts, Cirque Glaciers and various types of mountain (valley) glaciers.

GLACIER ICE: Ice in or originating from a glacier, whether on land or floating on the sea as an iceberg, bergy bits or growlers.

GLACIER TONGUE: Projecting seaward extension of a glacier usually afloat. In the Antarctic, glacier tongues may extend over many tens of kilometers.

GREASE ICE: A later stage of freezing than frazil ice, when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.

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 raft.

GROUNDED HUMMOCK: Hummocked grounded ice formation. There are single grounded hummocks and lines (or chains) of grounded hummocks.

GROUNDED ICE: Floating ice which is aground in shoal water.

GROWLER: Smaller piece of ice than a bergy bit or floeberg, often transparent but appearing green or almost black in color, extending less than 1 m above the sea surface and normally occupying an area of about 20 sq. m.

HOSTILE ICE: From the point of view of the submariner, an ice canopy containing no large skylights or other features which permit a submarine to surface.

HUMMOCK: A hillock of broken ice which has been forced upwards by pressure. May be fresh or weathered.

HUMMOCKED ICE: Sea ice piled haphazardly one piece over another to form an uneven surface. When weathered, has the appearance of smooth hillocks.

HUMMOCKING: The pressure process by which sea ice is forced into hummocks. When the floes rotate in the process it is termed screwing.

ICEBERG: A massive piece of ice of greatly varying shape, more than 5 m above sea-level, which has broken away from a glacier and which may be afloat or aground. Icebergs may be described as tabular, dome-shaped, sloping, pinnacled, weathered or glacier bergs.

ICEBERG TONGUE: A major accumulation of icebergs projecting from the coast, held in place by grounding and joined together by fast ice.

ICE BLINK: A whitish glare on low clouds above an accumulation of distant ice.

ICE-BOUND: A harbour, inlet, etc., is said to be ice-bound when navigation by ships is prevented on account of ice, except possibly with the assistance of an ice breaker.

ICE BOUNDARY: The demarcation at any given time between fast ice and drift ice or between areas of drift ice of different concentrations.

ICE BRECCIA: Ice pieces of different age frozen together.

ICE CAKE: Any relatively flat piece of sea ice less than 20 m across.

ICE CANOPY: Drift ice from the point of view of the submariner.

ICE COVER: The ratio of an area of ice of any concentration to the total area of sea surface within some large geographic local; this local may be global, hemispheric or prescribed by a specific oceanographic entity such as Baffin Bay or the Barents Sea.

ICE EDGE: The demarcation at any given time between the open sea and sea ice of any kind. It may be termed compact or diffuse.

ICE FIELD: Area of floating ice consisting of any size of floes, which is greater than 10 km across.

ICEFOOT: A narrow fringe of ice attached to the coast; unmoved by tides and remaining after the fast ice has moved away.

ICE FREE: No ice present. If ice of any kind is present this term should not be used.

ICE FRONT: The vertical cliff forming the seaward face of an ice shelf or other floating glacier varying in height from 2-50 m or more above sea-level.

ICE ISLAND: A large piece of floating ice about 5 m above sea-level which has broken away from an Arctic ice shelf, having a thickness of 30-50 m and an area of from a few thousand square meters to 500 sq. km or more and usually characterized by a regularly undulating surface which gives it a ribbed appearance from the air.

ICE ISTHMUS: A narrow connection between two ice areas of very close or compact pack ice. It may be difficult to pass, sometimes being part of a recommended route.

ICE JAM: An accumulation of broken river ice or sea ice caught in a narrow channel.

ICE KEEL: From the point of view of the submariner, a downward projecting ridge on the underside of the ice canopy. Ice keels may extend as much as 50 m below sea-level.

ICE LIMIT: Climatological term referring to the extreme minimum or extreme maximum extent of the ice edge in any given month or period based on observations over a number of years. Term should be preceded by minimum or maximum.

ICE MASSIF: A concentration of close or very close sea ice covering hundreds of square kilometers, which is found in the same region every summer.

ICE OF LAND ORIGIN: Ice formed on land or in an ice shelf, found floating in water. The concept includes ice that is stranded or grounded.

ICE PATCH: An area of floating ice less than 10 km across.

ICE PORT: An embayment in an ice front, often of a temporary nature where ships can moor alongside and unload directly onto the ice shelf.

ICE RIND: A brittle shiny crust of ice formed on a quiet surface by direct freezing or from grease ice, usually in water of low salinity. Thickness to about 5 cm. Easily broken by wind or swell, commonly breaking in rectangular pieces.

ICE SHELF: A floating ice sheet of considerable thickness showing 2-50 m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land glaciers. Limited areas may be aground. The seaward edge is termed an ice front.

ICE STREAM: Part of an island ice sheet in which the ice flows more rapidly and not necessarily in the same direction as the surrounding ice. The margins are sometimes clearly marked by a change in direction of the surface slope but may be indistinct.

ICE UNDER PRESSURE: Ice in which deformation processes are actively occurring and hence a potential impediment or danger to shipping.

ICE WALL: An ice cliff forming the seaward margin of a glacier which is not afloat. An ice wall is aground with the rock basement being at or below sea-level.

JAMMED BRASH BARRIER: A strip or narrow belt of new, young or brash ice (usually 100-5000 m wide) formed at the edge of either pack or fast ice or at the shore. It is heavily compacted mostly due to wind action and may extend 2-20 m below the surface, but does not have appreciable topography.

LAKE ICE: Ice formed on a lake, regardless of observed location.

LARGE FRACTURE: More than 500 m wide.

LARGE ICE FIELD: An ice field over 20 km across.

LEAD: Any fracture or passage-way through sea ice which is navigable by surface vessels.

LEVEL ICE: Sea ice which is unaffected by deformation.

LIGHT NILAS: Nilas which is more than 5 cm in thickness and rather lighter in color than dark nilas.

MEAN ICE EDGE: Average position of the ice edge in any given month or period based on observations over a number of years. Other terms which may be used are mean maximum ice edge and mean minimum ice edge.

MEDIUM FIRST-YEAR ICE: First-year ice 70-120 cm in thickness.

MEDIUM FLOE: Any relatively flat piece of sea ice 100-500 m across.

MEDIUM FRACTURE: 200-500 m wide.

MEDIUM ICE FIELD: An ice field 15-20 km across.

MULTI-YEAR ICE: Old ice greater than 2 m or more thick which has survived at least two summer's melt. Hummocks even smoother than in second-year ice, and the ice is almost salt free. Color where bare is usually blue. Melt pattern consists of large interconnecting irregular puddles and a well developed drainage system.

NEW ICE: A general term for recently formed ice which includes frazil ice, grease ice, slush and shuga. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

NEW RIDGE: Ridge newly formed with sharp peaks and slope of sides usually 40 degrees. Fragments are visible from the air at low altitude.

NILAS: A thin elastic crust of ice easily bending on waves and swell, under pressure thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt appearance and is up to 10 cm in thickness. May be subdivided into dark nilas and light nilas.

NIP: Ice is said to nip when it forcibly presses against a ship. A vessel so caught, though undamaged, is said to have been nipped.

OLD ICE: Sea ice which has survived at least one summer's melt. most topographic features are smoother than on first-year ice. May be subdivided into second-year and multi-year ice.

OPEN ICE: Floating ice in which the concentration is 4/10 to 6/10 with many leads and polynyas and the floes are generally not in contact with one another.

OPEN WATER: A large area of freely navigable water in which sea ice is present in concentrations less than 1/10. No ice of land origin is present.

PACK ICE: Term used to describe heavily concentrated drift ice. (i.e. 7/10 concentration or more).

PANCAKE ICE: Predominately circular pieces of ice from 30 cm - 3 m in diameter and up to 10 cm in thickness with raised rims due to the pieces striking against one another. It may be formed on a slight swell from grease ice, shuga or slush or as a result of the breaking of ice rind, nilas or under severe conditions the result of swell, waves, or grey ice. It also sometimes forms at some depth, at an interface between water bodies of different physical characteristics from where it floats to the surface; its appearance may rapidly cover wide areas of water.

POLYNYA: Any non-linear shaped opening in the ice. Polynyas may contain brash ice and/or be covered with new ice, nilas or young ice; submariners refer to these as skylights. Sometimes the polynya is limited on one side by the coast and is called a shore polynya. If it recurs in the same position every year it is called a recurring polynya.

PUDDLE: An accumulation on ice of melt water, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

RAFTED ICE: Type of deformed ice formed by one piece of ice overriding another.

RAFTING: Pressure processes whereby one piece of ice overrides another. Most common in new and young ice.

RAM: An underwater ice projection from an ice wall, ice front, iceberg or floe. Its formation is usually due to a more intensive melting and erosion of the unsubmerged part.

RECURRING POLYNYA: A polynya which recurs in the same position every year.

RIDGE: A line or wall of broken ice forced up by pressure. May be fresh or weathered. The submerged volume of broken ice under a ridge, forced downwards by pressure, is termed an ice keel.

RIDGED ICE: Ice piled haphazardly one piece over another in the form of ridges or walls. Usually found in first-year ice.

RIDGED ICE ZONE: An area in which much ridged ice with similar characteristics has formed.

RIDGING: The pressure process by which sea ice is forced into ridges.

RIVER ICE: Ice formed on a river regardless of observed location.

ROTTEN ICE: Sea ice which has become honeycombed and which is in an advanced stage of disintegration.

RUBBLE FIELD: An area of extremely deformed sea ice of unusual thickness formed during the winter by the motion of pack ice against or around a protruding rock, islet or other obstructions.

SASTRUGI: Sharp, irregular ridges formed on a snow surface by wind erosion and deposition. On drift ice the ridges are parallel to the direction of the prevailing wind at the time they were formed.

SEA ICE: Any form of ice found at sea which has originated from the freezing of sea water.

SECOND-YEAR ICE: Old ice which has survived only one summer's melt. Because it is thicker and less dense than first-year ice, it stands higher out of the water. In contact to multi-year ice, summer melting produces a regular pattern of numerous small puddles. Bare patches and puddles are usually greenish-blue.

SHEAR RIDGE: An ice ridge formation which develops when one ice feature is grinding past another. This type of ridge is more linear than those caused by pressure alone.

SHEAR RIDGE FIELD: Many shear ridges side by side.

SHEARING: An area of ice is subject to shear when the ice motion varies significantly from the direction normal to the motion, subjecting the ice to rotational forces. These forces may result in phenomena similar to a flaw.

SHORE LEAD: A lead between drift ice and the shore or between drift ice and an ice front.

SHORE ICE RIDE-UP: A process by which ice is pushed ashore as a slab.

SHORE POLYNYA: A polynya between drift ice and the coast or between drift ice and an ice front.

SHORE MELT: Open water between the shore and the fast ice, formed by melting and/or due to river discharge.

SHUGA: An accumulation of spongy white lumps a few centimeters across; they are formed from grease ice or slush and sometimes from anchor ice rising to the surface.

SKYLIGHT: From the point of view from the submariner, thin places in the ice canopy, usually less than 1 m thick and appearing from below as relatively light, translucent patches in dark surroundings. The undersurface of a skylight is normally flat. Skylights are called large if big enough for a submarine to surface through them (120 m) or small if not.

SLUSH: Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

SMALL FLOE: Any relatively flat piece of sea ice 20-100 m across.

SMALL FRACTURE: 50-200 m wide.

SMALL ICE CAKE: An ice cake less than 2 m across.

SMALL ICE FIELD: An ice field 10-15 km across.

SNOW COVERED ICE: Ice covered with ice.

SNOWDRIFT: An accumulation of wind-blown snow deposited in the lee of obstructions or heaped by wind eddies. A crescent-shaped snowdrift with ends pointing down-wind is known as snow barchan.

STANDING FLOE: A separate floe standing vertically or inclined and enclosed by rather smooth ice.

STRANDED ICE: Ice which had been floating and has been deposited on the land by retreating high water.

STRIP: Long narrow area of floating ice about 1 km or less in width, usually composed of small fragments detached from the main mass of ice and run together under the influence of wind, swell or current.

TABULAR BERG: A flat-topped iceberg. Most tabular bergs form by calving from an ice shelf and show horizontal banding.

THAW HOLES: Vertical holes in sea ice formed when surface puddles melt through to the underlying water.

THICK FIRST-YEAR ICE: First-year ice over 120 cm thick.

THIN FIRST-YEAR ICE/WHITE ICE: First-year ice 30-70 cm thick.

THIN FIRST-YEAR ICE/WHITE ICE first stage: 30-50 cm thick.

THIN FIRST-YEAR ICE/WHITE ICE second stage: 50-70 cm thick.

TIDE CRACK: Crack at the line of junction between an immovable ice foot or ice wall and fast ice, the latter subject to rise and fall of the tide.

TONGUE: A projection of the edge up to several kilometers in length caused by wind or current.

VAST FLOE: Any relatively flat piece of sea ice 2-10 km across.

VERY CLOSE ICE: Floating ice which the concentration is 9/10 to less than 10/10.

VERY OPEN ICE: Floating ice in which the concentration is 1/10 to 3/10 and water preponderates over ice.

VERY SMALL FRACTURE: 0 to 50 m wide.

VERY WEATHERED RIDGE: Ridge with tops very rounded, slope of sides usually 20 to 30 degrees.

WATER SKY: Dark streaks on the underside of low clouds, indicating the presence of water features in the vicinity of sea ice.

WEATHERED RIDGE: Ridge with peaks slightly rounded and slope of the sides usually 30 to 40 degrees. Individual fragments are not discernable.

WEATHERING: Processes of ablation and accumulation which gradually eliminate irregularities in an ice surface.

WHITE ICE: First-year ice 30-70 cm thick.

YOUNG COASTAL ICE: The initial stage of fast ice formation consisting of nilas or young ice, its width varying from a few meters up to 100-200 m from the shoreline.

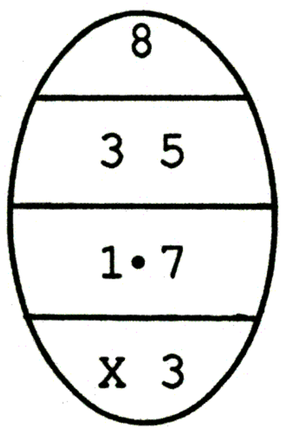
YOUNG ICE: Ice in the transition stage between nilas and first-year ice, 10-30 cm in thickness. May be subdivided into grey and grey-white ice.

APPENDIX 2

EXAMPLES OF WMO SYMBOLOGY

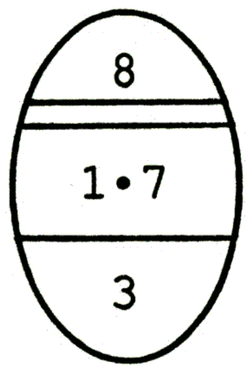
EXAMPLES OF THE USE OF THE "EGG" SYMBOL

Example 1



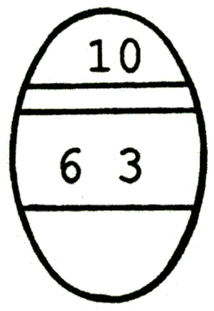
8 tenths of ice; 3 tenths of medium and 5 tenths of thin first-year ice; floe size of medium first-year ice is not known; the floe size of the thin first-year ice is small floe.

Example 2



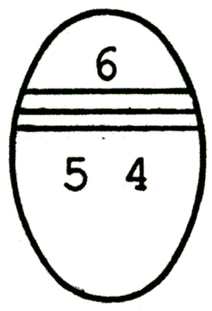
8 tenths of ice; medium and thin first-year ice of which the partial concentrations are not given; predominant floe size is small floe.

Example 3



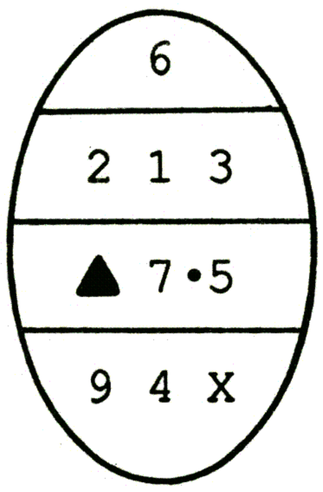
10 tenths of ice; first-year and young ice of which the partial concentrations are not given; no information on form of ice (This example applies particularly to satellite data).

Example 4



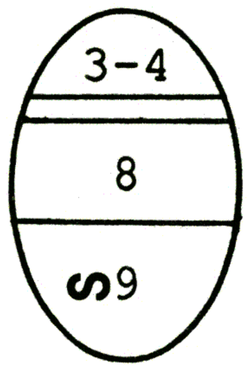
6 tenths of ice in big and medium floes; stages of development are not given and therefore there are no partial concentrations.

Example 5



6 tenths of ice; 2 tenths concentration of icebergs, one tenth of old ice and 3 tenths of grey-white ice; the floe size of old ice is medium floe.

Example 6

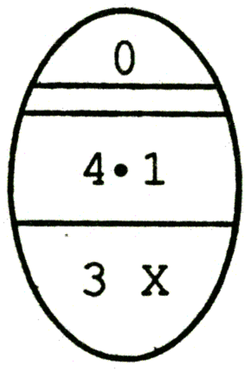


3 to 4 tenths of ice; all thin first-year ice is of 30-50 cm thickness; in strips and patches the concentration is 9 tenths. (With one stage of development, indication of partial concentration is not needed).

Example 7

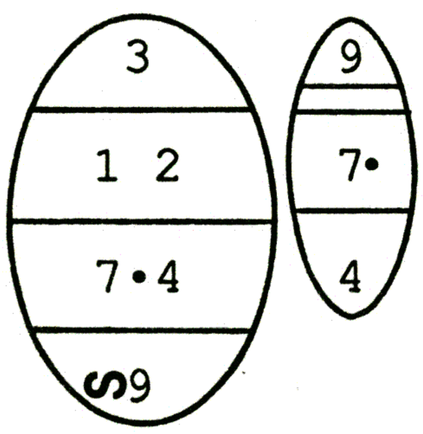
6 tenths of ice; no other details.

Example 8



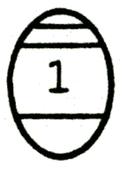
Less than 1 tenth of ice; some thick first-year ice in small floes is present; some new ice, but total concentration is less than 1 tenth.

Example 9



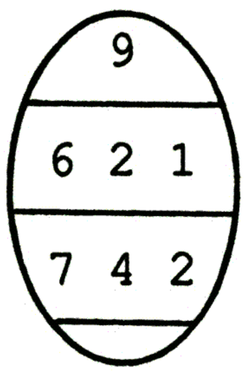
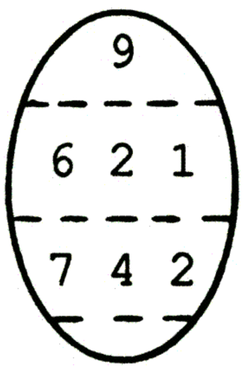
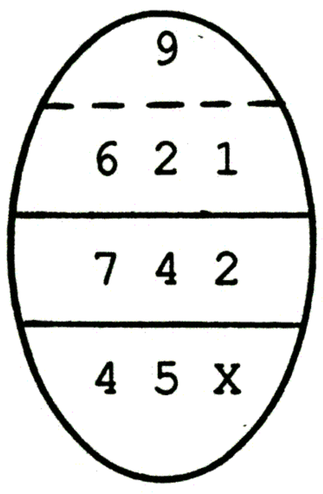
Total concentration is 3 tenths; 1 tenth is multi-year ice and 2 tenths is grey ice. The ice is partly distributed in strips and patches within which the concentration is 9 tenths of multi-year ice in medium floes.

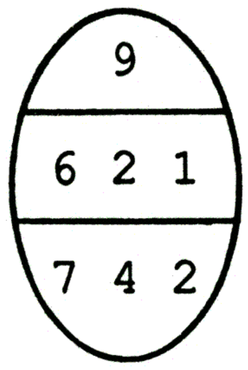
Example 10



New ice, no concentration or floe size indicated.

In general, throughout the symbology, solid lines are used for observed data and dashed lines for estimates. For indicating estimates in the "egg", see the following examples:

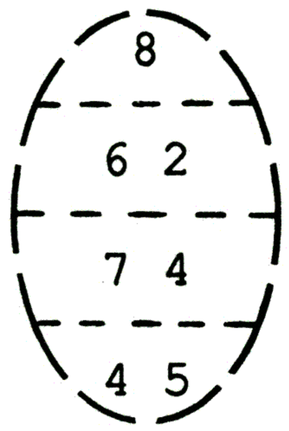
Symbol	Known Data	Estimated Data	Missing Data
	Concentration, partial concentrations and stage of development		Floe size
	Concentration	Partial concentrations and stage of development	Floe size
	Concentration, stage of development and floe size	Partial concentrations	



Concentration and partial concentrations

Stage of development

Floe size



All Data

APPENDIX 3

CONVERSION TABLE

1 Inch	=	25.4	Millimeters
		2.54	Centimeters
1 Foot	=	30.48	Centimeters
		3.048	Decimeters
		0.3048	Meters
1 Yard	=	0.9144	Meters
1 Statute Mile	=	1609.3	Meters
		1.6039	Kilometers
1 Nautical Mile	=	1852.0	Meters
		1.852	Kilometers
1 Millimeter	=	0.03937	Inches
1 Centimeter	=	0.3937	Inches
1 Decimeter	=	3.937	Inches
1 Meter	=	39.37	Inches
		3.2808	Feet
		1.0936	Yards
1 Kilometer	=	3208.8	Feet
		1093.6	Yards
		0.62137	Nautical Miles
		0.54	Nautical Miles

Fahrenheit to Centigrade: C = (F-32) / 1.8

Centigrade to Fahrenheit: F = 1.8 x C + 32

APPENDIX 4

STANDARD NAVAL MESSAGE FORMAT

The Standard Naval Message is the primary means of passing sea ice information to the operational user from NAVPOLAROCEANCEN Suitland, MD. and for passing time critical data from deployed observers to NPOC sea ice analysts for use in operational support. The accuracy of the message and the correct drafting format in accordance with current requirements is essential to effective use of the communication system. Due to the millions of messages transmitted daily, brevity is a major concern. Authorized abbreviations and contractions can be used in composition wherever possible. The following format requirements will aid the drafter in correct message preparation.

4.1 PRECEDENCE. The precedence assigned to an ice message indicates the required speed of delivery, in addition to the speed in which it will be acted upon by the addressee(s). The precedence indicators are shown below along with their meanings. Long range planning or administrative messages will be designated Routine. Standard ice observation and analysis messages are normally designated Priority. Immediate precedence may be used if conditions warrant or if the observer has been specifically instructed to do so.

INDICATOR	PRECEDENCE	SUBJECT MATTER
Z	Flash	Emergency warnings only
O	Immediate	Dangerous storm conditions, ship diversions, etc.
P	Priority	Normal weather conditions, ship movements and administrative matters requiring immediate attention.
R	Routine	Matters whose urgency does not justify a higher precedence, but should nonetheless be handled without delay.

4.2 DATE/ TIME GROUP OF MESSAGE. The date/ time group of the message indicates the origination date and time of the message. It is expressed in six digits where: the first two digits indicate the day of the month, the third and fourth indicate the hour and the fifth and sixth indicate the minutes. If the day of the month is the 9th or earlier, a zero will be used as the first digit in order to complete the six digit group. The six digits are followed by the letter "Z" to indicate Greenwich Mean Time (GMT).

EXAMPLE:

071454Z = The seventh day of the month at 1454Z.

The six digit date/ time group is preceded with the precedence indicator and is followed by the month and year.

P 071454Z JAN 89

4.3 ORIGINATOR. The originator of the message will be the ice observers on deployment, utilizing the Plain Language Address given for that particular detachment, except in Antarctica where - COMNAVSUPPFORANTARCTICA AY - may be used. Shore station addresses must be followed by the geographical location of the base. Ship addresses simply consist of the name of the ship.

EXAMPLES:

FM: COMNAVSUPPFORANTARCTICA AY

FM: NAVPOLAROCEANCEN DET THREE

FM: USS SARATOGA

FM: NAVPOLAROCEANCEN SUITLAND MD

FM: USCGC POLAR SEA

4.4 ACTION ADDRESS(S). The activities which are expected to take some action upon receipt of the message are considered action addees. If more than one activity is to take action, place them in the message header in order of precedence.

EXAMPLE:

TO: NAVPOLAROCEANCEN SUITLAND MD
NAVOCEANCOMFAC KEFLAVIK IC
ICE CENTRAL OTTAWA CAN

4.5 INFORMATION ADDRESS(S). The activities which require knowledge of the message contents, but no action is required of their command.

EXAMPLE:

INFO: ISCOMGREENLAND
NAVOCEANCOMFAC KEFLAVIK IC
ICE CENTRAL OTTAWA CAN

4.6 ACCOUNTING DATA. Accounting data is only required at the communication center in McMurdo Antarctica. It provides for billing of costs within their communication system. It is placed directly beneath the addresses.

EXAMPLE:

ACCT NSOPP NS-WCAB

4.7 CLASSIFICATION. The security classification of a message is based upon the message content. Most ice messages are of an unclassified nature and should be so designated. Specific instructions will be provided if a higher level of classification is required. A classification indicator is required of each paragraph, designating the classification of the material discussed within that paragraph. Unclassified messages do not require paragraph classification indicators. All classified messages require a declassification (DECL) date or Originator Authorization for Declassification Required (OADR), to be placed at the last line of the message.

EXAMPLE MESSAGE:

```
P 131200Z JAN 89
FM NAVPOLAROCEANCEN SUITLAND MD
TO USCGC POLAR SEA
INFO NAVOCEANCOMFAC KEFLAVIK IC
ICE CENTRAL OTTAWA CAN
ISCOMGREENLAND
BT
C O N F I D E N T I A L //N03140//
SUBJ: ICE EDGE (U)
1. (C) ICE EDGE ANALYZED FM 7415N7 06310W0 TO 7555N2
06245W7 7520N4 06330W2.
2. (U) LITTLE CHANGE EXPECTED WITHIN THE NEXT 24 HOURS.
DECL: OADR
BT
```

4.8 STANDARD SUBJECT IDENTIFICATION CODE (SSIC). The message SSIC number categorizes a message by content. All ice related message traffic will be assigned the number 3140.

EXAMPLE:

```
//N03140//
```

4.9 PASSING INSTRUCTIONS. Naval communication systems, for the most part, transmit data based upon flagwords, codewords, subject lines and incoming/ outgoing message references. When written properly, these elements assist in the automatic internal routing of message traffic. Passing instructions, placed below the classification line and consisting of office codes, symbols and names, will not be used by NAVY, Marine Corps and Coast Guard activities except under the following circumstance:

1) Messages are addressed to non - NAVY/ Coast Guard activities (ex. U.S. ARMY, U.S. Air Force, DOD, etc.) which contain office symbols as described below: (See examples a - d).

Office symbols, code numbers and other subordinate or internal activity designators will not be used in plain language address lines of NAVY, Marine Corps and Coast Guard messages, however, these commands are permitted their use when addressing outside services, agencies or joint commands. Office symbols, when used, will be placed immediately following the plain language address of the addressee, and will be enclosed within double slants. (ex. //DACSA/DACDB//). In cases where the use of office symbols result in the addressee line extending beyond the 69 character limit of the line, they will be continued on the subsequent line by indenting five spaces.

EXAMPLES:

a) FM NAVPOLAROCEANCEN SUITLAND MD
TO COMNAVSUPPFORANTARCTICA AY
BT
UNCLAS //N03140//
* PASS TO MARBLE POINT
SUBJ: SEA ICE CONDITIONS 55E - 115E

b) FM NAVPOLAROCEANCEN SUITLAND MD
TO SCRIPPS INSTITUTE OF OCEANOGRAPHY LA JOLLA CA
BT
UNCLAS //N03140//
PASS TO PROF W. SMITH; R/V MELVILLE
SUBJ: SEA ICE CONDITIONS 80W - 20E

c) FM NAVPOLAROCEANCEN SUITLAND MD
TO 30WS SEOUL KOREA//DO//
BT
UNCLAS //N03140//
SUBJ: SEA ICE CONDITIONS 90W - 20W

d) FM NAVPOLAROCEANCEN SUITLAND MD
TO COMNAVSUPPFORANTARCTICA AY
BT
UNCLAS //N03140//
PASS TO NAVPOLAROCEANCEN ICE OBSERVER; WX OFFICE
SUBJ: SEA ICE CONDITIONS 160E - 160W

* If more than one action addressee, identify which command to pass instructions.

EXAMPLE:

COMNAVSUPPFORANTARCTICA PASS TO NAVPOLAROCEANCEN
ICE OBSERVER.

4.10 SUBJECT. The subject identifies the text subject matter.

EXAMPLE:

SUBJ: SEA ICE CONDITIONS 130E - 150E

SUBJ: ICE RECONNAISSANCE 14 JULY 1989

4.11 REFERENCES. References are used when addressing a subject in the message which has been previously addressed via message or phone conversation.

EXAMPLE:

A. PHONCON BTWN LCDR GORE (VXN-8)/ AG1 RONAN
(NAVPOLAROCEANCEN) OF 17 MAR 89.

NOTAL is used after the reference if only some of the addressees received the reference message.

EXAMPLE:

COMNAVSUPPFORANTARCTICA 190230Z NOV 88 (NOTAL)

4.12 TEXT. The text of the message will vary dependent on subject matter. The text relative to this handbook will be the plain language ice observation format.

4.13 FREQUENTLY USED MESSAGE HEADERS:

EAST GREENLAND

FM NAVPOLAROCEANCEN DET ****
TO NAVPOLAROCEANCEN SUITLAND MD
INFO NAVOCEANCOMFAC KEFLAVIK IC
ISCOMGREENLAND
COMICEDEFOR KEFLAVIK IC
COMICEASWGRU KEFLAVIK IC
DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA
ICE CENTRAL OTTAWA CAN
ACCT NA-CNRF
BT

WEST GREENLAND

FM NAVPOLAROCEANCEN DET ****
TO NAVPOLAROCEANCEN SUITLAND MD
INFO NAVOCEANCOMFAC KEFLAVIK IC
ISCOMGREENLAND
ICE CENTRAL OTTAWA CAN
BT

WEST ARCTIC

FM NAVPOLAROCEANCEN DET ****
TO NAVPOLAROCEANCEN SUITLAND MD
INFO ICE CENTRAL OTTAWA CAN
BT

ANTARCTICA

FM COMNAVSUPPFORANTARCTICA AY
TO ZEN/CASEY STATION ANTARCTICA
INFO RULKSKD/NAVPOLAROCEANCEN SUITLAND MD
ACCT NSOPP NS-WCAB
BT

**** = Detachment numbers are sequential and will be assigned to observers prior to deployment.

Messages sent from NPOC ice observers deployed to McMurdo may use - COMNAVSUPPFORANTARCTICA AY - as they are acting under CNSFA.

ADDITIONAL ROUTING CODES

RULKSKD/NAVPOLAROCEANCEN SUITLAND MD
RUDISDI/NAVOCEANCOMFAC KEFLAVIK IC
RUDISAB/COMICEDEFOR KEFLAVIK IC
RUDISDP/COMICEASWGRU KEFLAVIK IC
RYCACAA/ISCOMGREENLAND
RCCTSAB/ICE CENTRAL OTTAWA CA
RDFJ/DANISH METEOROLOGICAL INSTITUTE COPENHAGEN DA

* Routing codes should be checked prior to each deployment.

APPENDIX 5

GLOBAL/ REGIONAL SEA ICE DISTRIBUTION AND BEHAVIOR

ICE DISTRIBUTION IN THE NORTHERN HEMISPHERE

The general configuration of the Arctic Ocean in the northern hemisphere is largely that of an ocean bounded by continental land masses. As a result, the variation in ice cover is limited by geography than by thermodynamics. In the polar basin, the variation in ice cover is largely limited to the relatively shallow nearshore areas. The greatest variation in ice cover occurs in the marginal seas: the Chuckchi and Bering Seas and Sea of Okhotsk on the Pacific side and the Greenland and Norwegian Seas and Baffin Bay on the Atlantic side.

ATLANTIC SECTOR

Sea ice is generally greatest in March-April and least in September-October. The actual ice configuration at any time results from a combination of oceanic currents and climatological conditions; the variations that occur continue to reflect these conditions. For instance, the Warm Atlantic Current continuously transports heat into the Norwegian Sea. As a result, the ice edge in the eastern Atlantic sector is indented poleward during all seasons. Comparing April and September climatology maps shows that the statistical ice edges all remain in the vicinity of Svalbard (Spitsbergen) throughout the year. In the Barents Sea to the east, where the effect of the Atlantic Current dies out, the sea ice extent varies significantly between summer and winter.

On the western side of Svalbard and along the eastern coast of Greenland, the sea ice extent remains nearly constant throughout the year. This is largely due to the southerly Greenland Current which advects ice south throughout the year.

On the western side of Greenland, in the Baffin Bay-Davis Strait region, the Greenland Current swings northward around the southern tip of Greenland before joining the Labrador Current southward along the Newfoundland coast. Note that this current effectively limits maximum ice extent in this region while the minimum ice extent extends as far northward as Ellesmere Island.

DISCUSSION OF VARIATIONS OF ICE EXTENT IN THE SOUTHERN HEMISPHERE

Ice extent in the southern hemisphere is at a minimum at the end of the antarctic summer (February-March) and at a maximum at the end of the antarctic winter (October-November). At a minimum, the ice extent is close to the coast or ice shelf everywhere except in the Weddell Sea off the Ronne Ice Shelf. While at a maximum, the ice has expanded to 6000S latitude in most locations and to 5500S latitude in the Atlantic sector.

Antarctica has two large embayments, the Ross Sea and the Weddell Sea. Both embayments are partially filled with glacial-fed ice sheets: the Ross Ice Shelf and the Ronne Ice Shelf). During summer the ice edge recedes toward these ice shelves, creating the most southerly open water in the Antarctic. When winter arrives, these areas freeze earliest to bring the average ice edge out to an approximate uniform perimeter around the continent. As a result, the absolute amount of ice growth is greatest in these two areas.

As winter advances, the statistical ice extent advances more or less uniformly around the continent except in the regions seaward of the Ross and Weddell Seas. Here the ice advance is statistically greater as the ice covered areas expand under the influence of currents and winds.

This effect is most pronounced in the Weddell Sea area where the ice advances through the South Orkney Islands and into the Scotia Sea. Here the average ice limit becomes greatest, approaching 5500S.

Although its causes are not well understood, a large polynya is often formed in the center of the Weddell Sea. Looking down on a polar projection map, ice development in the Weddell Sea expands in a clockwise fashion as winter advances. As the ice advances clockwise in the direction of the current pattern, a polynya is frequently left in the center of this circular ice advance. This polynya has persisted throughout the winter season for several years.

APPENDIX 6

COMMON MESSAGE ABBREVIATIONS

The below listed endings may be attached to the list of word abbreviations when required to clarify statement interpreation.

al: L

ally, erly, ly: LY

ance, ence: NC

der: DR

ed, ied: D

ening: NG

er, ier, or: R

ern: RN

ically: CLY

iest, est: ST

iness, ness: NS

ing: G

ity: TY

ment: MT

ous: US

s, es, ies: S

tion, ation: N

ward: WD

WORD ABBREVIATIONS

About: ABT

Across: ACRS

Adjacent: ADJ

Advise: ADV

Again: AGN

Aged Ridge: ARDG

Along: ALG

Amend: AMD

Amount: AMT

Analysis: ANLYS

Area of Weakness: AOW

Around: ARND

Avaliable: AVBL

Average: AVG

Become: BCM

Belt: BLT

Bergy Bit: BRGY

Bergy Water: B/W

Between: BTWN

Big Floe: BF

Boundary: BDRY

Brash Ice: BSH

Break: BRK

Broken: BKN

Bummock: BMK

Change: CHG

Clear: CLR

Close Ice: CL

Cloud: CLD

Coast: CST

Compact Ice: CT

Concentration: CONC

Consolidated Ice: CSLD

Consolidated Ridge: CRDG

Continue: CONT

Cover: CVR

Crack: CRK

Dark Nilas: DNL

Decrease: DCR

Degree: DEG

Deteriorate: DTRT

Difficult Area: DIFF

Diffuse Ice Edge: EDGD

Diminish: DMSH

Distance: DIST

Distant: DSNT

Diverging: DIV

Dried Ice: DRI

Easy Ice: ESY

Elsewhere: ELSW

Ending: ENDG

Entire: ENTR

Estimate: EST

Except: EXC

Expansion: EXPN

Expect: EXP

Extend: EXT

Extensive: EXTSV

Farther: FTHR

Fast Ice: FAST

Fast Ice Boundary: FAST BDRY

Fast Ice Edge: FEDG

Finger Rafted Ice: FRFT

First Year Ice: FY

Flaw: FLW

Flaw Lead: FLW LD

Flaw Polynya: FLY PLYA

Flooded Ice: FLO

Form: FRM

Fracture Zone: FRCTZ

Freezing: FZ

Froozen: FRZN

General: GEN

Glacier: GB

Grey Ice: G

Growler: GRWL

However: HWVR

Ice Berg: BRG

Ice Free: IF

Increase: INCR

Information: INFO

Knots: KTS

Latitude: LAT

Light Nilas: LNL

Line: LN

Little Change: LTLCG

Medium First Year Ice: FM

Miles: MI

Move: MOV

Nautical Miles: NM

Floe Berg: FB

Forecast: FCST

Fracture: FRCT

Frazil Ice: FZL

From: FM

Further: FTHR

Giant Floe: GF

Grease Ice: GRS

Grey White Ice: GW

Heavy: HVY

Hummock: HMK

Ice Cake: CK

Ice Rind: RND

Indicate: INDC

Isolated: ISOLD

Large Fracture: LFRCT

Level Ice: LVL

Limit: LMT

Longitude: LONG

Mainly: MNLY

Medium Floe: MF

Mostly: MSTLY

Mulit Year Ice: MY

Near: NR

New Ice: N

Next: NXT

No Change: NC

Number: NBR

Observation: OB

On Request: O/R

Open Water: O/W

Pancake Ice: PK

Polynya: PLYA

Possible: PSBL

Prevail: PVL

Rafted Ice: RFT

Recession: RECN

Remark: RMK

Ridge Zone: RDGZ

Scattered: SCTD

Several: SVRL

Significant: SGFNT

Small Floe: SF

Small Ice Cake: SK

Stationary: STNRY

Thick: THK

Thin: THN

Through: THRU

New Ridge: NRDG

Nilas: NL

Normal: NRML

Numerous: NMRS

Occasional: OCNL

Open Ice: OP

Otherwise: OTRW

Plus: PS

Position: PSN

Predominant: PDMT

Puddle: PD

Rapid: RPD

Remain: RMN

Ridge: RDG

Rotten Ice: ROT

Second Year Ice: SY

Shuga: SG

Slush: SL

Small Fracture: SFRCT

Snow: SN

Thaw Hole: TH

Thick First Year Ice: FT

Thin First Year Ice: FL

Throughout: THRUT