Basic Weather Division
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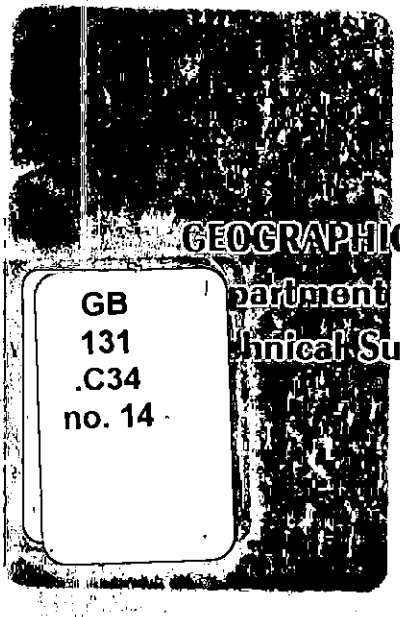
GEOGRAPHICAL PAPER No. 14

Gulf of St. Lawrence Ice Survey, Winter 1957

W. A. Black



GEOGRAPHICAL BRANCH
Department of Mines and
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EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1957

PREFACE

The Gulf of St. Lawrence, ice survey: winter 1957, is a study resulting from the second aerial ice survey in which the Canadian Ice Distribution Survey participated. During the winter of 1957 W.A. Black, a member of the Geographical Branch, carried out the ice observations for this report.

It is hoped that in publishing this report, it may bring about a clearer understanding of the nature, extent and distribution of the ice and also a clearer understanding of the problems to be faced in the winter navigation of the Gulf of St. Lawrence.

N. L. Nicholson
Director
Geographical Branch

95353—1½

GULF OF ST. LAWRENCE ICE SURVEY: WINTER 1957.

INTRODUCTION AND ACKNOWLEDGEMENTS

The aerial survey of sea ice conditions in the Gulf of St. Lawrence during February and March, 1957 is a continuation of the survey undertaken during the winter of 1956.* The primary purpose of the survey is to observe and map the coverage and distribution of the various types of ice and to observe the general movements of the ice.

The ice survey was conducted by the Geographical Branch and the Royal Canadian Air Force, and was co-ordinated by the Geophysical Research Section of the Defense Research Board. The Royal Canadian Navy and the Atlantic Oceanographic Group collaborated in the project. Specific acknowledgements are made to T.A. Harwood, Geophysical Research Section, G/C W.H. Swetman, R.C.A.F. Maritime Air Command, and L.M. Lauzier, Atlantic Oceanographic Group. The operation was planned to begin at the same time as the 1956 survey, about February 1st. Aircraft and crews were provided by the R.C.A.F. station at Summerside, the base of operations. Twelve flights were made on the following dates:- January 29; February 6, 11, 14, 19, 21, 28; and March 1, 5, 8, 11 and 13. Aircraft used in the survey were Lancasters and P_2V Neptunes and were generally flown at 1,000 feet elevation.

Aerial reconnaissance extended westward to Quebec City, eastward to Belle Isle and southward to Cabot Strait. Flight patterns were varied to permit the greatest possible observation of ice conditions and to avoid unfavourable local

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*Black, W.A. and Forward,C.N. Gulf of St. Lawrence Ice Survey: Winter, 1956. Geographical Paper No. 12. Ottawa, 1956.

weather conditions. The flight track most frequently followed paralleled the coast ten miles offshore. This flight plan permitted an observation of the behaviour of open water areas lying on the landward side of the gulf.

The ice conditions that were observed during the reconnaissance are summarized graphically in figures 1 to 12.* Each chart covers the duration of a single flight and is explained by a summary of ice conditions. The symbols and system of ice reporting used is based on that employed by the United States Navy Hydrographic Office. Certain modifications were made, however, to modify the system to meet the conditions existing in the Gulf of St. Lawrence. The modified system distinguishes both graphically and quantitatively between young and winter ice. The value of such a distinction lies in its application to sea navigation; thus, an ice coverage of 9/10 consisting of 10/10 young ice is not likely to be an obstacle to a modern steel freighter; in contrast, an ice coverage of 9/10 consisting of 10/10 winter ice can only be navigated by a powerful ice-breaker. Graphically, the pattern employed on the charts is similar to the U.S. Navy system except that an open pattern for young ice is introduced, and quantitatively, the amounts of young and winter ice are each expressed in tenths. In application, ice coverage varying from winter 5/10 and young 5/10 to winter 9/10 and young 1/10 is shown graphically in the close pattern for winter ice; ice coverage varying from winter 4/10 and young 6/10 to winter 1/10 and young 9/10 is shown graphically in the open pattern for young ice. As slush and sludge are important elements of the gulf ice, it was found necessary to show the area covered by this type of ice in tenths. A comparison of figure 1 which follows the unmodified system, with figures 2 to 12, which have been modified, will indicate the value of introducing this modification in the light of local

*The ice reconnaissance flight of January 29 was made by two Royal Canadian Navy ice observers.

conditions.

In conjunction with the ice survey a photographic survey of ice conditions was carried out using an F 24 aerial camera with a 5-inch focal lens. As the flights were made at approximately 1, 000 feet elevation the photographs have a scale of 200 $\pm$ 10 feet to one inch. Twelve photographs have been selected to illustrate various types of ice (figures 15 to 26). They are published by courtesy of the Royal Canadian Air Force. A further selection has also been made for publication. 'An Illustrated Glossary of Ice Types in the Gulf of St. Lawrence (Geographical Paper No. 11, 1957).

The route of the H.M.C.S. Labrador in the Gulf of St. Lawrence is shown in figure 13. This is the second winter that oceanographic observations have been made by the Atlantic Oceanographic Group in the gulf. The aerial reconnaissance flights provided the Group with ice coverage in order that the correlation between ice distribution and oceanographic conditions can more effectively be determined.

GENERAL WEATHER CONDITIONS

The winter of 1957 was particularly favourable for the formation of ice over the Gulf of St. Lawrence. Because of the abnormally low January temperatures, 15°F. to 18°F. below the mean of 2°F. to 6°F. in the northern part of the gulf, and 6°F. to 7°F. below the mean of 18°F. to 19°F. in the southern part, most of the gulf was ice covered. These conditions are in striking contrast to the winter of 1956 when January temperatures were 15° above normal and resulted in light ice conditions existing throughout the gulf. The mean winter temperatures of 1956 and 1957 represent two extremes and are indicative of the wide variability of mean yearly winter temperatures. Such variations are major factors in the amount and distribution of ice in the gulf.

The prevailing winds, during the winter months, generally blow from a westerly or northerly direction. In the southern part of the gulf winds from a southerly direction are also important. Most commonly the winds are from 10 to 20 m.p.h., but 20 to 30 m.p.h. winds are also frequent. Winds of less than 10 m.p.h. and strong winds exceeding 30 m.p.h. are relatively infrequent. The prevailing winds are largely responsible for the occurrence of open water areas on the leeward coasts, for the drift of ice towards Cabot Strait and for the ice congestion which develops in the southern part of the gulf. Rarely on any given date is visibility unlimited throughout the entire gulf area. In some part of the gulf snow flurries are occurring when visibility is reduced from $\frac{1}{2}$ to 3 miles or, lying to the lee side of open water areas, low-lying strato-cumulus clouds reduce visibility from 0 to 3 miles.

GENERAL ICE CONDITIONS

Ice conditions experienced throughout the gulf were heavy, i.e. ice of 9/10 to 10/10 concentration predominated, particularly in the southern and eastern parts of the gulf. Much of this ice consisted of large floes and fields. Pancake ice, and small to medium floes were most commonly observed in Cabot Strait, Northumberland Strait and off the west coast of Newfoundland. In these parts of the gulf winter ice was predominant. Landfast winter ice occupied the bays and harbours observed along the flight track. The principal areas of young ice were along the New Brunswick coast, the St. Lawrence estuary and the north shore of the gulf. The ice charts and the accompanying reports afford specific details of the ice conditions that were observed during each flight.

A characteristic feature of the gulf and one frequently accompanied by low-lying strato-cumulus clouds is the open water areas which lie to the leeward of the land. These generalized areas are indicated in Figure 14. The open

water areas which lie off the lee side of the gulf coasts result principally from the blowing of the ice seaward by the prevailing winds. In effect the lightest ice parallels the areas of open water or more generally the western part of the gulf, and the heaviest or winter ice lies on the windward side of the land or more generally the south and eastern part of the gulf. Open water areas however, do occur off the windward coasts in the eastern part of the gulf. A current which enters Cabot Strait off Cape Ray and follows the Newfoundland coast northward is largely responsible for the occurrence of the open water area off the west coast of Newfoundland. A period of southerly winds results in open water occurring off the southern and eastern gulf coasts. Canso Causeway has resulted in Chedabucto Bay and the southern part of Canso Strait becoming open water areas. Prior to the construction of the Causeway, gulf ice passed from George Bay into Chedabucto Bay. Depending principally upon wind, currents, and temperature conditions the local areas of open water are constantly expanding and contracting, but the actual extent of the gulf ice during any particular winter is intimately related to the climatic and oceanographic influences prior to the beginning of winter.*

Ice begins to form along the shores of the Gulf of St. Lawrence in November; it reaches its maximum extent in February and disappears from the gulf in May. In mid-winter the gulf is not covered by a solid ice sheet but by masses of ice which drift with the currents and tides. Throughout the winter months the ice moves from various parts of the gulf to Cabot Strait. The St. Lawrence winter river ice was observed to follow the Gaspé coast, either to drift southeastward to the Magdalen Islands or in lesser amounts to parallel the New Brunswick coast southward.

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*Lauzier, L.M. A preliminary report of the winter oceanographic survey in the Gulf of St. Lawrence, 1956. Atlantic Oceanographic Group, St. Andrews, N.B. December 1956.

This river ice is rough and dark in outline. Ice from the St. Lawrence estuary drifts southeastward on both the north and south side of Anticosti Island. Labrador ice that enters the gulf through the Strait of Belle Isle drifts southward through Cabot Strait. This ice can readily be distinguished from the gulf ice as it appears massive and its surface is rough and whiter than the surrounding winter ice. It is readily observed in Cabot Strait. Ice found in Northumberland Strait and off the coasts of Prince Edward Island has a reddish surface cast. This ice has been observed eastward of St. Paul Island. Ice found to the east of the New Brunswick coast often incorporates dark material and thus has been identified drifting eastward off the north coast of Prince Edward Island as well as southward into Northumberland Strait. These movements of the ice are related to the circulation of the gulf and to the prevailing winds.

Ice conditions experienced throughout the gulf were heavy; ice of 9/10 to 10/10 concentration predominated, particularly in southern, central, eastern and northeastern areas. Most of this ice consisted of winter forms, mainly floes and fields. Pancake ice was commonly observed in Cabot Strait, Northumberland Strait and in the eastern parts of the gulf. Landfast ice occupied the bays and harbours observed along the flight track. The principal areas of young ice occurred along the New Brunswick coast, the St. Lawrence estuary and the north shore of the gulf. This ice, together with slush and sludge, was generally associated with open or recently open water areas.

To consider temperatures as an ice-forming factor, the period from January 29 to March 13 indicates that air conditions were favourable for ice consolidation. The following table (A) gives the mean temperature variations from 30.0°F. which is accepted as the freezing point of gulf water. The weekly intervals show a gradual gradation in ice-forming conditions from most favourable at the beginning of the

survey to least favourable at the end of the survey. There is also a significant gradation in ice-forming conditions from the north shore to the south shore. The number of degree-days of frost at Summerside were in most instances half or less

(A) Average Daily Degree-Days of Frost, January 29 to March 13, 1957*

PLACE	Jan. 29 to Feb. 4	Feb. 5 to Feb. 11	Feb. 12 to Feb. 18	Feb. 19 to Feb. 25	Feb. 26 to Mar. 4	Mar. 5 to Mar. 11	Mar. 12 to Mar. 13	Av.
Seven Islands	36.4	24.8	13.7	11.9	16.3	3.86	3.50	15.8
Natashquan	36.7	23.8	12.7	8.78	14.5	0.07	-2.5	13.7
Stephenville	23.1	19.4	2.14	8.29	10.5	0.14	-7.0	8.09
Grindstone	23.2	14.7	9.72	9.22	10.3	2.36	-3.0	9.50
Summerside	16.8	11.0	11.3	6.64	4.86	0.71	-3.75	6.78

(B) Number of flights by weekly intervals

Total Number of Flights.	1	2	1	2	2	3	1	Total 12

than half of the number of days of frost at Seven Islands or Natashquan. A degree-day of frost is defined as a day with a mean temperature one Fahrenheit degree below 30.0°F. Considering temperatures alone then ice formation should be far more rapid at Seven Islands. The warm period between February 12 and February 25 covered the entire gulf except for the southern part, indicating a lull in ice consolidation. A resumption of seasonal temperatures from February 26 to March 4 made the conditions for formation more favourable. The interval from March 5 to March 13 ended with thawing conditions which prevailed over most of the gulf.

The effectiveness of the aerial survey depends primarily upon visibility conditions and scheduling of the flights. Poor visibility limits the range of

*The average is calculated on one week's temperature data except for the last two columns. The data used in the calculations were the minimum and maximum daily temperatures for each of the places listed.

observation; the scheduling of flights at regular intervals makes possible a comparison between large changes in ice coverage between flights. These changes are in part related to air temperatures, (Table A) and are described in the following summary.

SUMMARY OF ICE CONDITIONS

January 29 to February 4

The flight of January 29 revealed that ice of 9/10 to 10/10 concentrations covered most of the gulf. Winter ice of 10/10 coverage was predominant in the estuary; elsewhere in the gulf concentrations consisted of young and winter forms. No open water areas were visible.

These conditions appeared to be related to the low air temperatures that existed at the end of January.

February 5 to February 11

The flight of February 4 showed an ice coverage of 10/10 extending over the southern, central and northwestern parts of the gulf, 9/10 coverage in adjacent areas and 7/10 to 8/10 coverage in Cabot Strait. In these areas winter ice concentration varied from 5/10 to 10/10. Extensive areas of young ice with concentration of 6/10 to 10/10 lay off the east coast of Cape Breton Island, the east coast of New Brunswick, the south coast of Anticosti Island, the north shore and the St. Lawrence estuary. Open water areas were limited to the mouth of the Saguenay.

The flight of February 11 showed an ice coverage of 9/10 to 10/10 extending over the southern, eastern and northern areas of the gulf. In these areas winter ice concentrations varied from 6/10 to 10/10, whereas young ice paralleled the coast of the St. Lawrence estuary. Essentially the gulf was ice-covered except for the open water areas that lay off the north shore and occupied the St. Lawrence River

in the vicinity of the Saguenay.

There were 24.8 degree-days of frost in the northern gulf region and 11.0 degree-days in the southern, conditions favourable for ice consolidation.

February 12 to February 18

On the flight of February 14, ice coverage was 9/10 with winter ice predominating in the central and southern gulf. Winter concentrations were reduced to 5/10 in the estuary. Extensive areas of young ice concentrations (10/10) extended eastward from the river to parallel the north shore. Open water in the St. Lawrence River continued downstream to Pointe des Monts.

Temperatures were 20 degrees higher on the north shore than on January 29. This seemed to reduce the winter ice coverage and increase the open water and young ice areas in the St. Lawrence estuary and along the north shore.

February 19 to February 25

On the flight of February 19, ice coverage in the central and eastern gulf area was 8/10, in the southern gulf 9/10 and in the northeast arm 9/10 to 10/10. Winter ice coverage varied from 6/10 to 10/10. Young ice with coverage of 9/10 to 10/10 extended over much of Jacques Cartier Passage, the southern entrance to the St. Lawrence River, the southwestern part of Northumberland Strait and the north coast of Prince Edward Island. Open water extended eastwards to occupy much of the St. Lawrence estuary.

The flight of February 21 indicated that ice coverage in the central and western gulf region varied from 8/10 to 9/10, and in Cabot Strait 3/10 to 9/10. Winter ice in these areas varied from 7/10 to 10/10. In the St. Lawrence estuary ice coverage varied from 5/10 to 9/10 consisting principally of young ice. The open water area in the St. Lawrence estuary was considerably reduced in extent, but an expanding area of open water lay off the south coast of Anticosti Island.

Lower air temperatures towards the end of the period had resulted in an extention of ice coverage in the St. Lawrence estuary from the previous flight,

February 26 to March 4

On the flight of February 28 ice coverage in the central and southern gulf region was 9/10 with winter ice varying from 7/10 to 10/10. In the north-central gulf and the St. Lawrence estuary ice coverage varied from 8/10 to 9/10 with young ice occupying from 7/10 to 10/10 of the surface. From the Saguenay River to Quebec City ice concentration varied from 3/10 to 8/10 consisting principally of young ice. There was a notable extension of the ice surface from the estuary to the mouth of the Saguenay.

On the flight of March 1 ice coverage was 9/10 over the central, southern, and eastern parts of the gulf and the estuary. In these areas winter forms composed 7/10 to 10/10 of the ice. Extensive areas of young ice with concentration of 8/10 to 9/10 lay off the west coast of New Brunswick and off the south coast of Anticosti Island. No areas of open water were visible.

The return to normal winter temperatures was undoubtedly responsible for the extension of the ice into the St. Lawrence estuary and for the elimination of the open water areas along the gulf coast.

March 5 to March 11

On the flight of March 5 ice coverage in the eastern and central parts of the gulf was 9/10, varying from 6/10 to 10/10 winter ice. Young ice concentrations of 7/10 to 10/10 extended over the western and north-central gulf area. Open water areas paralleled the west coast of New Brunswick, the south coast of Anticosti Island, and on March 6, the north coast of Chaleur Bay.

The flight of March 8 indicated ice coverage of 8/10 to 9/10 with winter ice concentrations varying from 9/10 to 10/10 occupying the central, southern and

eastern parts of the gulf. Young ice with concentrations varying from 7/10 to 10/10 covered the western and northern parts of the gulf including the St. Lawrence estuary. The main areas of open water lay off the south coast of Anticosti Island, the south shore, and occupied the western part of the estuary.

The flight of March 11, showed ice coverage extending over the west, central and eastern parts of the gulf. Winter ice in these areas varied from 7/10 to 10/10. Young ice concentration of 7/10 to 10/10 covered the eastern end of Jacques Cartier Passage and Northumberland Strait. The main areas of open water occurred in the St. Lawrence estuary and extended from the Gaspé coast to parallel the south coast of Anticosti Island. Other areas of open water occurred off the south coast of Prince Edward Island, the east coast of New Brunswick, the west coast of Cape Breton Island and off the north shore.

Thawing conditions prevailed over most of the gulf area and appeared to have resulted in extensive areas of open water.

March 12 to March 13

The flight of March 15 indicated an ice coverage of 8/10 to 9/10 over the eastern half of the gulf, and 10/10 in the Strait of Belle Isle. In these areas winter ice varied from 7/10 to 10/10 concentration. Two large areas of young ice with concentrations varying from 7/10 to 10/10 lay between Anticosti Island and the Newfoundland coast. An extensive area of open water paralleled the west coast of Newfoundland. Other areas of open water lay off the west coast of Cape Breton Island, the south coast of Prince Edward Island, and on March 15, off the east coast of New Brunswick.

Thawing conditions continued and appeared to contribute to the development of these open water areas.

EXPLANATION OF TERMS

Block: A fragment of sea ice ranging in size from 6 to 30 feet across.

Brash: Fragments of floating ice, less than 6 feet across, resulting from the wreckage of other forms of ice.

Consolidated ice: Ice of different sizes that is compacted into larger ice forms.

Floe: A piece of sea ice. A small floe is from 30 to 600 feet across; a medium floe is 600 to 3,000 feet; a large, or giant floe is 3,000 feet to 5 miles, and an ice-field is an area of sea ice greater than 5 miles across.

Ice concentration: The ratio of the areal extent of ice present to the total extent of the ice and water surface. Concentration is usually measured in tenths; for example, $\frac{9}{621}$ concentration indicates 6/10 brash and block, 2/10 small to medium floes and 1/10 giant floes and field; total surface of ice coverage 9/10.

Landfast ice: Any type of ice attached to the shore, beached, stranded in shoal water, or attached to the bottom of shoal areas.

Pressure ridge: A ridge of ice. Wherever a substantial area of the ice is in the form of pressure ridges, coverage may be expressed in tenths; for example, $\frac{PR}{3}$ denotes 3/10 of the area of the ice surface is in the form of pressure ridges.

Rafting: In this study, rafting denotes the overriding of one floe by another floe of winter ice.

Shelving: Shelving refers to the rectangular pattern of interfingerings of young ice.

Sludge: An accumulation of small pieces of soft ice mixed with slush. The surface of the sludge is usually hardened into an ice crust.

Slush: An accumulation of ice crystals such as would result from snow that has fallen into water at approximately freezing temperature. Slush forms a

thick soupy mass in the water. The coverage of slush and sludge may be expressed in tenths; thus $\frac{S}{5}$ - 5/10 of slush and sludge.

Very young ice: Ice that is recently formed in calm water. Coverage is expressed in tenths; thus, $\frac{VY}{6}$ - 6/10 of very young ice.

Winter ice: Ice produced during the current winter, usually ridged and capable of maintaining a snow cover without the snow becoming grey from water seepage through the ice. Coverage is expressed in tenths; thus, $\frac{W}{5}$ - 5/10 of winter ice.

Young ice: Newly formed ice that is generally transparent; if it includes slush or sludge it is usually grey in appearance. Coverage is expressed in tenths; thus, $\frac{Y}{7}$ - 7/10 of young ice.

CONCLUSION

The aerial ice survey during the winter of 1957 revealed abnormal ice conditions extending over most of the gulf. As the shipping track was generally filled with winter ice formations the gulf presented special problems in navigation. Navigation by steel freighters would have been impossible except for ships with re-enforced hulls or of the icebreaker type. This winter was in striking contrast to the winter of 1956 when the shipping track was largely ice-free and therefore presented no unusual problem to the passage of steel freighters.

The open water areas that parallel the northern and western coasts of the gulf, the south coast of Anticosti Island and the west coast of Newfoundland are of interest to navigation. Between these open areas ice bridges occurred that would require the assistance of an icebreaker to permit through passage for a freighter.

The harbours on the coasts paralleled by areas of open water are usually blocked by landfast ice, including those on the lower St. Lawrence River. Any consideration of winter navigation is not only linked to economic considerations of winter passage but also to the ice conditions that exist in harbours.

Figure 1 (Janaury 29/57)

Weather conditions. The abnormally low January temperatures of 16.5°F. below normal in the northern part of the gulf, and 6.5° below normal in the southern part were favourable for ice formation. By January 29, the date of the first ice reconnaissance flight, ice appeared to have covered most of the gulf.

Ice distribution. Ice concentration of 10/10 coverage consisting of 0010 extended north of Prince Edward Island from the Magdalen Islands to Cape Gaspé. It occupied the St. Lawrence River estuary west of Anticosti Island and the eastern entrance to Jacques Cartier Passage. Ice of 8/10 to 9/10 coverage occupied the southeastern entrance of the St. Lawrence estuary, and the eastern part of the gulf. The ice consisted principally of young and winter ice, with winter ice predominant in the St. Lawrence estuary and young ice predominant in Jacques Cartier Passage.

Open water. Large areas of open water were visible in the eastern part of the gulf.

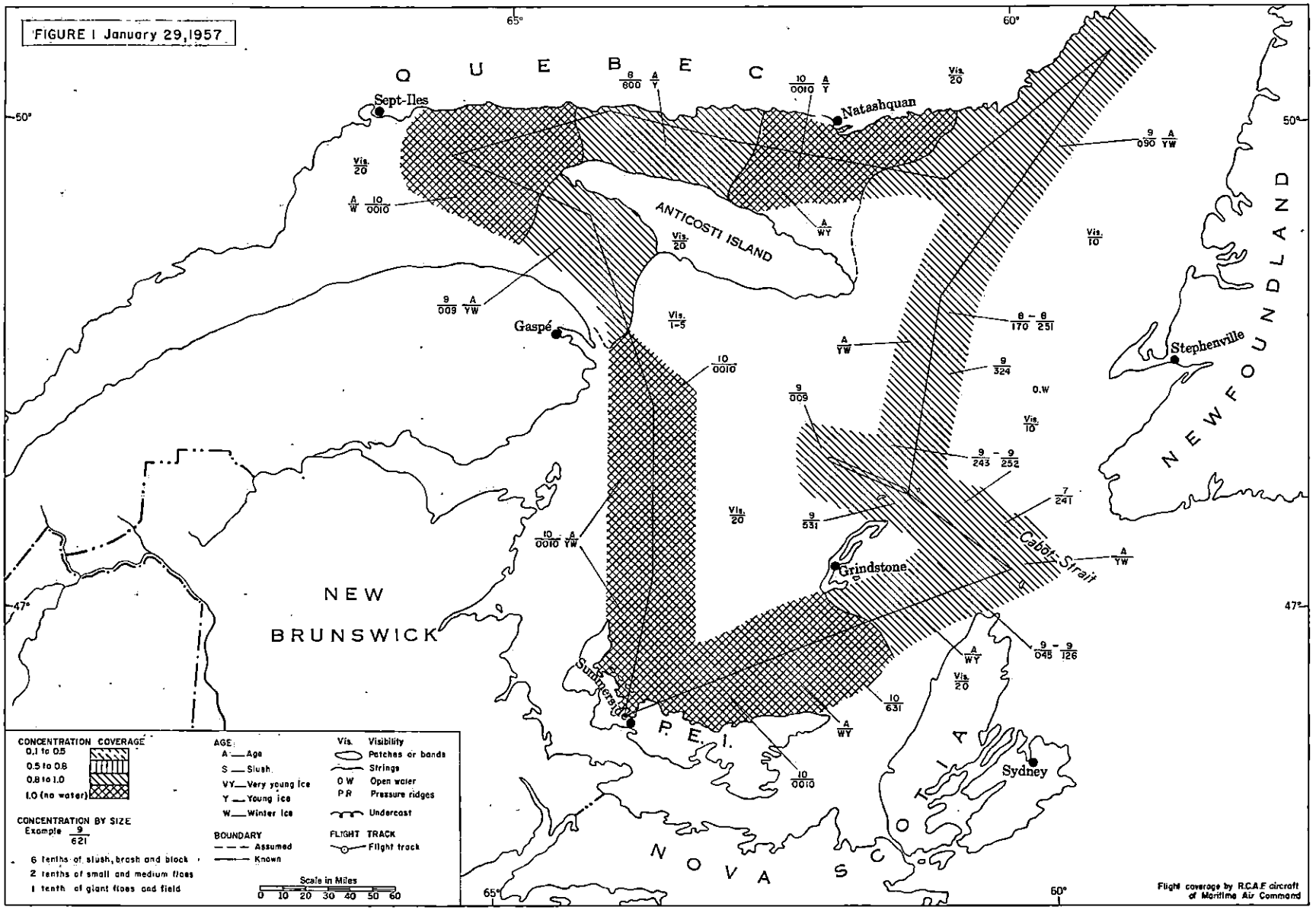
FIGURE I January 29,1957
65°
60°
50°
47°
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
N O V A S C O T I A
P. E. I.
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Summerside
Sydney
Cabot Strait
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE:
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
O W Open water
P R Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F aircraft of Maritime Air Command

Figure 2 (February 6/57)

Weather conditions. From January 29 to February 6, high pressure air masses dominated the region, with westerly winds flowing at speeds from 10 to 30 m.p.h. Throughout this period the St. Lawrence estuary and the north shore experienced particularly low temperatures. The north shore average minimum and maximum temperatures were -12.8°F. and 1.8°F. respectively. Temperatures were higher toward the southwestern part of the gulf with average minimum and maximum temperatures 0°F. and 12.2°F. Such conditions were favourable for ice formation.

Changes in ice distribution. The main change from the flight of February 29, was the increase in the concentration of ice to 9/10 or 10/10 in the eastern part of the gulf and in the southern entrance of the St. Lawrence estuary. Elsewhere ice distribution remained similar.

Ice distribution. Ice of 009 to 0010 concentration covered much of the gulf. Localized areas of lesser concentration occurred in the St. Lawrence River estuary and in Cabot Strait and consisted of brash and block, small, medium and giant floes. Ice was 2/10 winter and 8/10 young in the southwest, but in the remainder of the gulf winter ice occupied 7/10 to 9/10 of the surface. Areas of young ice were chiefly located off the east coast of Cape Breton Island, the northwest coast of Prince Edward Island, off the north shore, and in the estuary of the St. Lawrence River. In the St. Lawrence estuary there were extensive areas of slush and sludge.

Open water. There were two principal areas of open water: in Cabot Strait to the east of the ice edge; and in the estuary eastwards from the Saguenay River to the vicinity of Father Point.

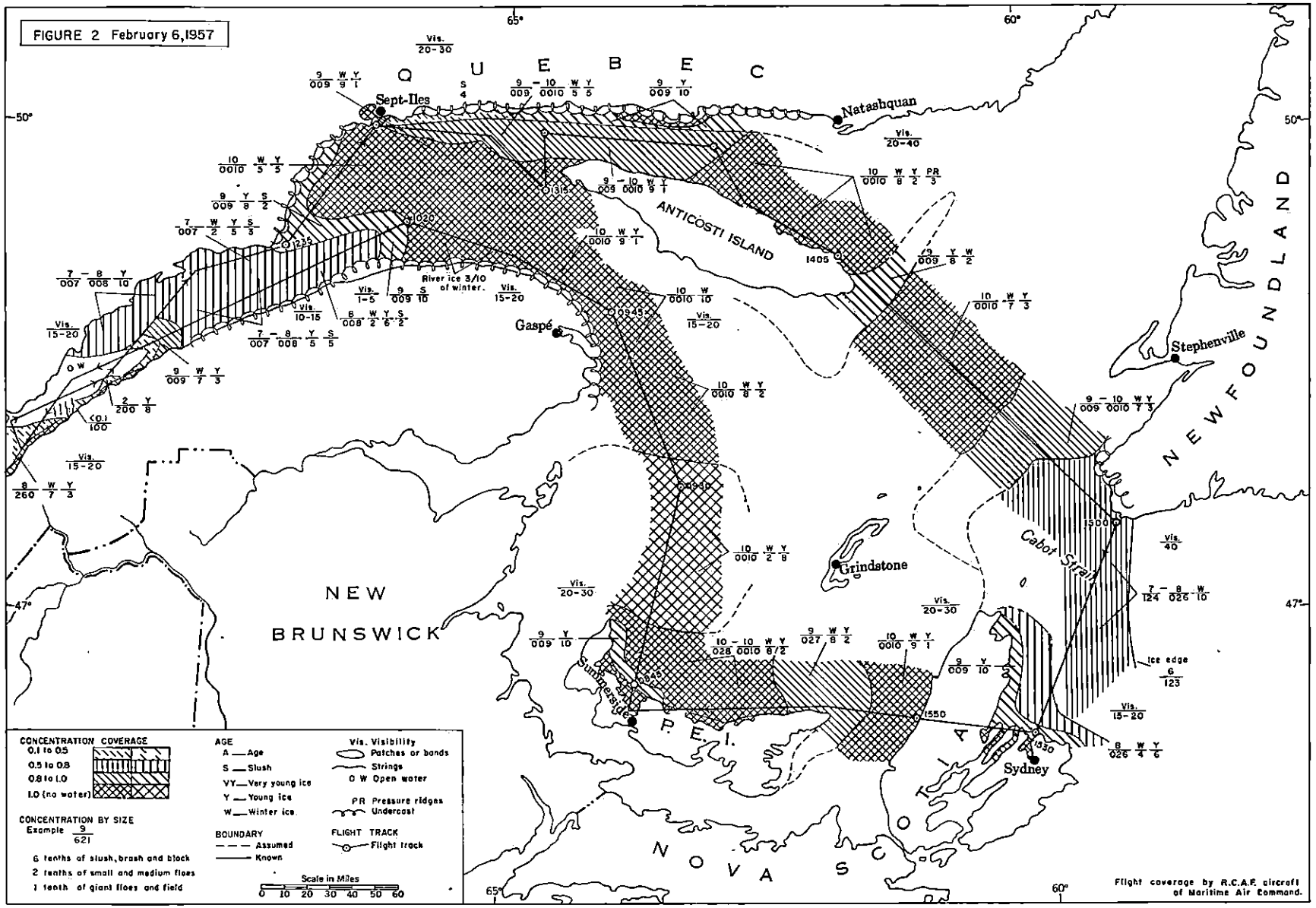
FIGURE 2 February 6, 1957
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
NEWFOUNDLAND
P.E.I.
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Summerside
Sydney
ANTICOSTI ISLAND
Cabot Strait
River ice 3/10 of winter.
Ice edge
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
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Vis. Visibility
Patches or bands
Strings
O W Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command.

Figure 3 (Feburary 11/57)

Weather conditions. Favourable temperatures for ice formation continued from the previous period through to February 11. Low pressure air masses dominated the region and winds were predominantly from the west with speeds varying from 15 to 30 m.p.h., and on one day with speeds of 50-60 m.p.h. Though temperatures were considerably higher than previously they were still well below freezing. Sub-zero temperatures continued in the St. Lawrence estuary and on the north shore where average minimum and maximum temperatures were -0.4°F. and 12.4°F. In the southern part of the gulf temperatures were 7.7°F. and 22.9°F. respectively.

Changes in ice distribution. The most important changes were the increase in the water area in the St. Lawrence River, the occurrence of a belt of open water from 2 to 10 miles wide along the north shore of the gulf, and a belt of open water along the Cape Breton coast.

Ice distribution. Ice with a concentration of 009 to 0010 dominated the gulf. Localized areas of lesser concentration occurred along the north shore, the St. Lawrence estuary, Cabot Strait and the entrance to Chaleur Bay. Winter ice was predominant. Young ice concentrations were extensive in the St. Lawrence estuary, along the north shore, the east coast of Cape Breton Island, and the eastern and southern shores of Prince Edward Island. River ice appeared scattered among the winter ice off the Gaspé coast. About 3/10 of the ice surface north of Anticosti Island consisted of pressure ridges. The surface of the winter ice of the central and eastern gulf area was snow covered, whereas to the north and west it was snow-free.

Open water. The areas of open water included the St. Lawrence River, the north shore of the gulf, the narrow belts off Prince Edward Island and a belt paralleling the east coast of Cape Breton Island.

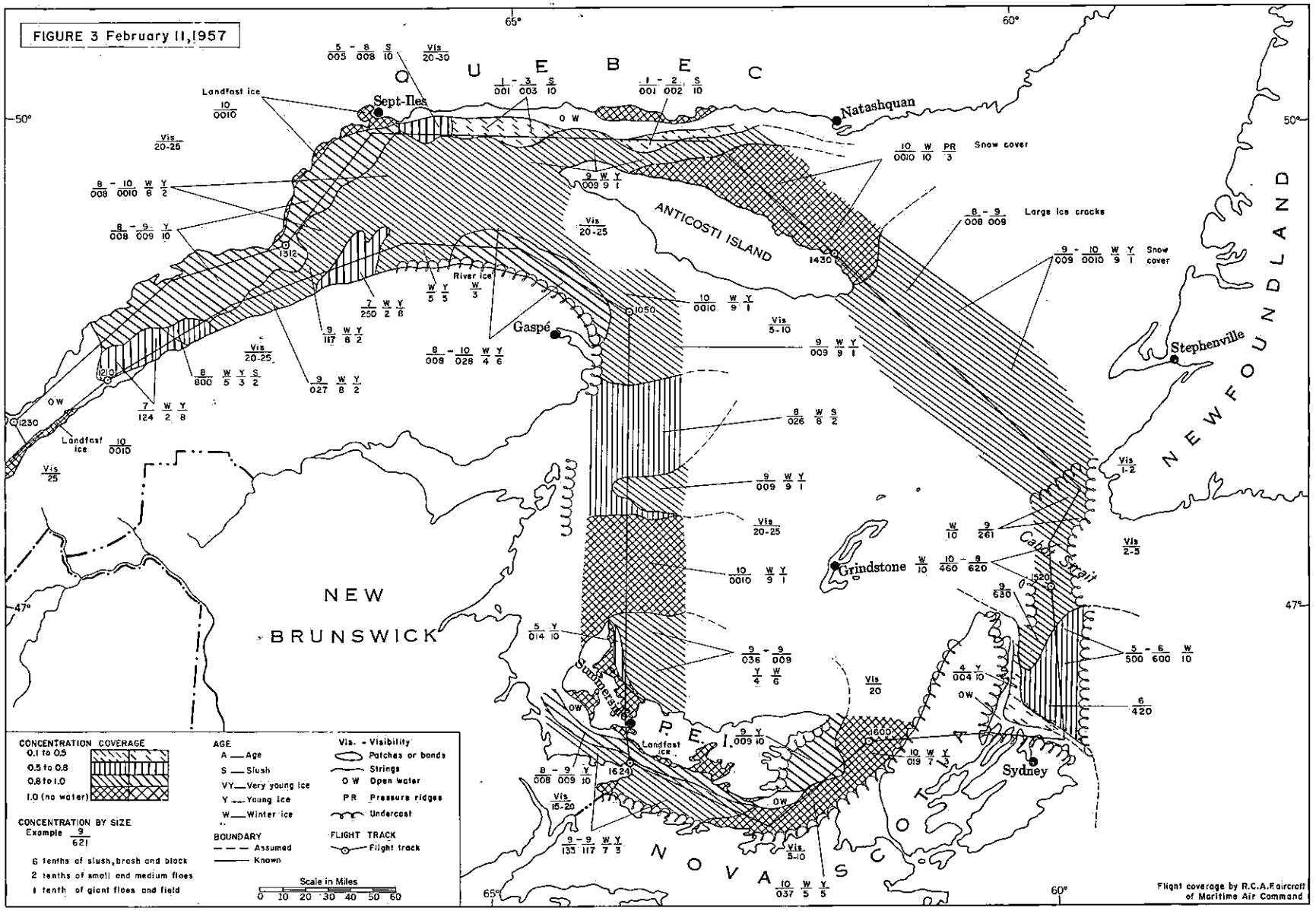
FIGURE 3 February 11, 1957
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
NEWFOUNDLAND
P.E.I.
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Grindstone
Stephenville
Sydney
Summerside
Cabot Strait
Landfast ice
River ice
Large ice cracks
Snow cover
Open water
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. - Visibility
Patches or bands
Strings
O W Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F aircraft of Maritime Air Command

Figure 4 (February 14/57)

Weather conditions. Low temperatures continued through February 12 to February 14; winds were chiefly from the east with speeds varying from 10 to 35 m.p.h. The high pressure ridge that extended southward from Labrador resulted in sub-zero temperatures over the western and northwestern gulf area and produced average minimum and maximum temperatures of 0.6°F. and 14.2°F., and contributed to the increase of young ice in the St. Lawrence estuary and along the north coast. In the southeastern parts average minimum and maximum temperatures were 9.3°F. and 19.6°F. respectively.

Changes in ice distribution. Open water in the St. Lawrence River, and young ice in the estuary and on the north shore continued to expand.

Ice distribution. Ice with a concentration of 009 to 0010, consisting primarily of 9/10 winter and 1/10 young, covered the gulf. In Cabot Strait, brash, block and small to medium floes composed the ice fields; in the southern part of the strait strings of brash and block from 1 to 3 miles wide bordered the Cape Breton coast. Heavy floe ice was visible in the strings. In the St. Lawrence River and estuary, winter ice, of which 5/10 was of river origin, bordered the Gaspé coast. Landfast ice from the southern shore of the St. Lawrence was also moving into the river. In the southern two-thirds of the gulf the ice surface was snow-covered but was relatively snow-free in the northern third.

Open water. The areas of open water included the St. Lawrence River in a belt 4 to 10 miles wide bordering the Gaspé coast as far as Fame Point; the north shore of Prince Edward Island; Canso Strait south of the causeway; and Cabot Strait, extending eastward from the ice edge.

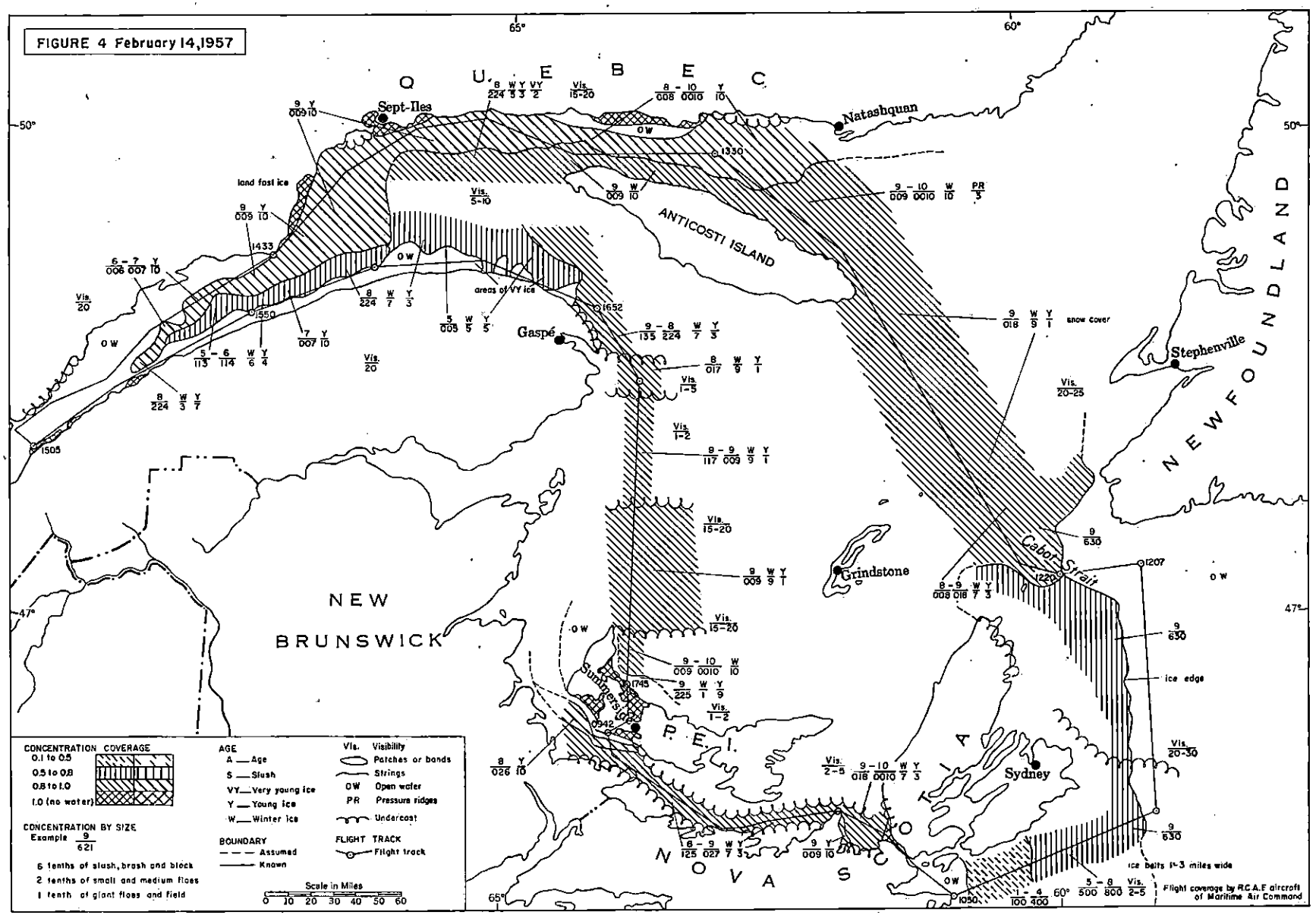
FIGURE 4 February 14,1957
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
P.E.I.
NEWFOUNDLAND
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Grindstone
Sydney
Stephenville
Summerside
Cabot Strait
land fast ice
areas of VY ice
snow cover
ice edge
ice belts 1-3 miles wide
Flight coverage by R.C.A.F. aircraft of Maritime Air Command
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
65°
60°
50°
47°

Figure 5 (February 19/57)

Weather conditions. From February 15 to 19, a succession of low pressure air masses passed over the gulf; winds were easterly, except towards the end of the period when westerly winds were predominant with speeds of 15 to 30 m.p.h. During the passage of lows, 21 inches of snow fell on the southern gulf, decreasing to 15 inches on the north shore. Temperatures were substantially higher and were relatively uniform except in the southeastern part of the gulf. Average minimum and maximum temperatures were 21.3°F. and 27.6°F., and for the southeastern part were 26.8°F. and 33.6°F. respectively. Maximum temperatures exceeded 30°F. in the southeastern gulf for 4 days.

Changes in ice distribution. The main change resulting from the passage of the lows was the reduction of 009-0010 ice concentration over much of the gulf to brash and block, and to small and medium floes. The water area in the St. Lawrence estuary continued to expand eastward. Young ice extended over the shipping track south of Anticosti Island and continued to expand in Jacques Cartier Passage.

Ice distribution. In Cabot Strait and off the west coast of Newfoundland ice of 5/10 coverage consisted of belts of brash and block alternating with small, medium or large floes. In the northeast arm of the gulf concentration consisted of 350 to 550 winter ice, with 6/10 in pressure ridges. In the western gulf, ice concentration varied from 018 to 234 and from 10/10 winter to 5/10 young ice. In the southern part of the estuary ice concentration varied from 216 to 224, and from 6/10 winter to 4/10 young ice. Snow drifts covered the winter ice throughout and were heavy in the northeast arm. Growlers and arctic ice were visible off Cape Breton and the Newfoundland coast.

Open water. The areas of open water included the northeast arm, the St. Lawrence estuary, the north coast of Prince Edward Island and a narrow belt in Northumberland Strait. The ice edge extended southward off Scatari Island and southeastward from Cape Ray.

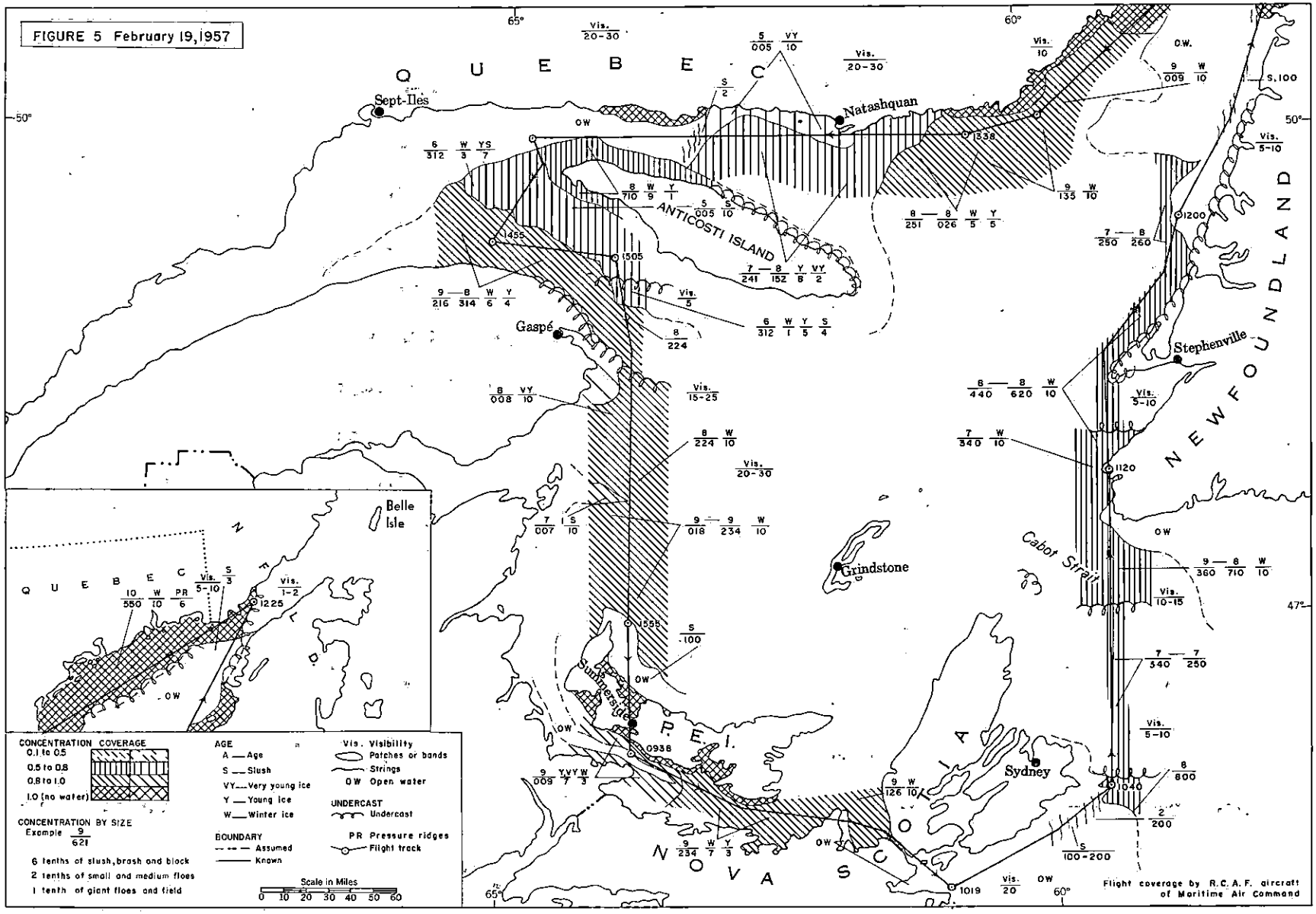
FIGURE 5 February 19, 1957
Q U E B E C
Sept-Îles
Natashquan
ANTICOSTI ISLAND
Gaspé
Belle Isle
Grindstone
Stephenville
NEWFOUNDLAND
Cabot Strait
Summerside
P.E.I.
Sydney
N O V A S C O T I A
Flight coverage by R.C.A.F. aircraft of Maritime Air Command
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
UNDERCAST
Undercast
PR Pressure ridges
Flight track
Scale in Miles
0 10 20 30 40 50 60

Figure 6 (February 21/57)

Weather conditions. Low pressure air masses continued to move eastward, followed by NW winds at 10 to 20 m.p.h. Temperatures were uniform, but the minimum fell substantially (minimum 15.1°F., maximum 28.3°F). These temperatures aided the formation of young ice but were not sufficient for winter ice formation.

Changes in ice distribution. The most important changes were the almost complete disappearance of winter ice in the estuary, the withdrawal of the ice field south of Anticosti Island, and the continuing movement of the ice-field eastward in Cabot Strait.

Ice distribution. The extension of young and very young ice areas were associated with recent open water areas off the north and south coasts of Prince Edward Island, the east coast of New Brunswick, Chaleur Bay and the St. Lawrence estuary westward of a line joining Fame Point and Southwest Point. The most extensive area of winter ice lay in the southwestern part of the gulf with a concentration of 036 and 10/10 winter ice. In the eastern part, ice coverage varied from 026 to 144 and from 7/10 to 10/10 winter ice; a thick layer of snow covered the ice. In Cabot Strait ice occurred in belts with a concentration of 252 alternating with ice of 400. The belts varied in width from 1/2 to 8 miles and generally extended in a north - south direction. Towards the southeastern end of Cape Breton Island the belts consisted of sludge, brash and block, and small floes. In the St. Lawrence River, ice with a concentration of 120 extended upstream from Seal Island to become 230 in the south channel and 130 in the river above Quebec and Lévis. This ice consisted of 5/10 winter and 5/10 young ice.

Open water. Extensive areas of open water occurred south of Anticosti Island, in the St. Lawrence estuary and extended northeastward from Pointe des Monts parallel to the shore. Except for a narrow band of ice bordering the south shore of the river, the St. Lawrence was almost ice-free to Seal Island.

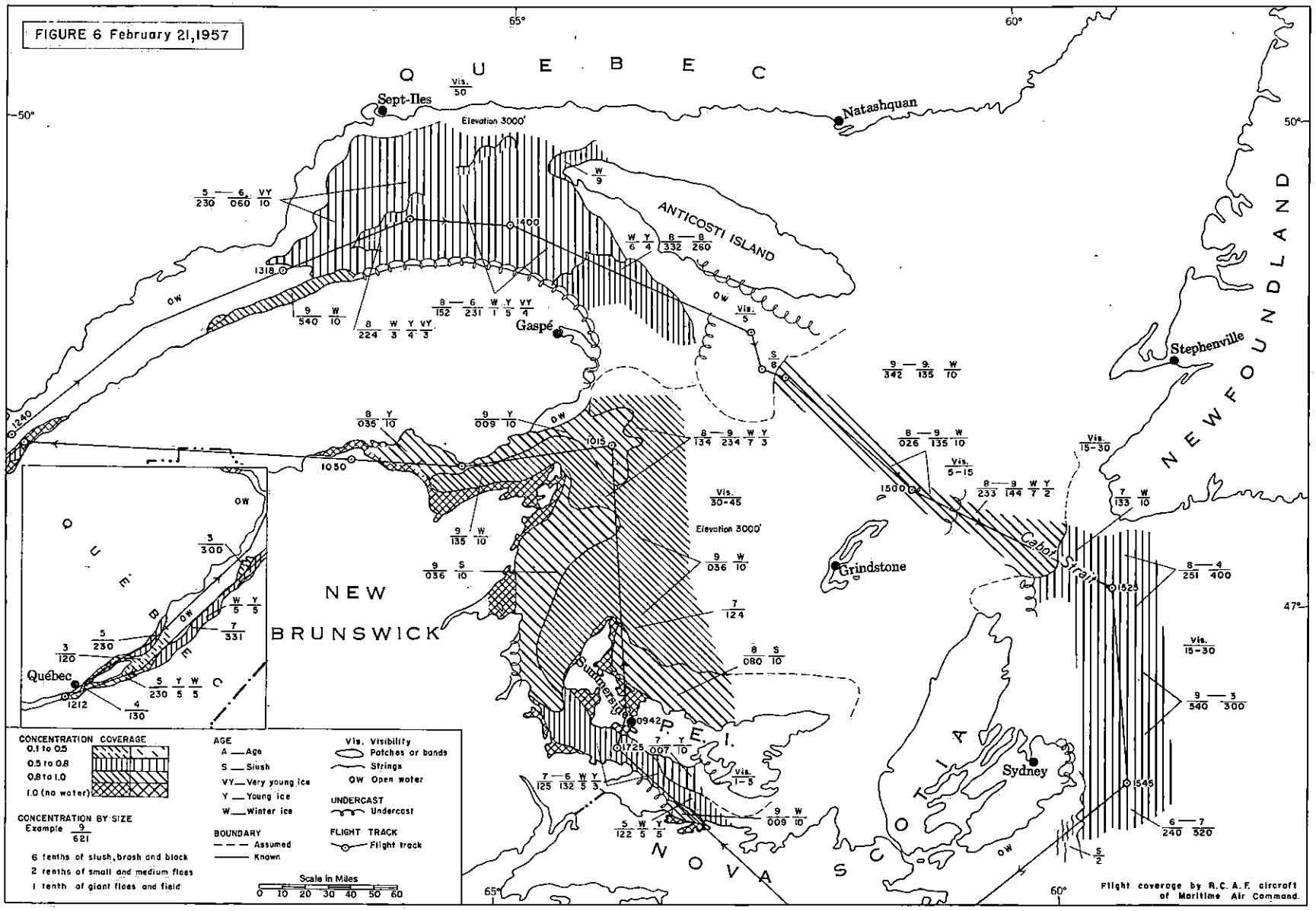
FIGURE 6 February 21,1957
Q U E B E C
NEWFOUNDLAND
NEW BRUNSWICK
N O V A S C O T I A
P.E.I.
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Sydney
Québec
Summerside
ANTICOSTI ISLAND
Cabot Strait
Elevation 3000'
Vis. Visibility
Patches or bands
Strings
OW Open water
UNDERCAST
Undercast
FLIGHT TRACK
Flight track
BOUNDARY
Assumed
Known
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and black
2 tenths of small and medium floes
1 tenth of giant floes and field
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command.

Figure 7 (February 28/57)

Weather conditions. From February 22 to 28 the gulf region was crossed successively by a number of low and high pressure air masses. Winds were chiefly from a north to northwesterly direction with speeds varying from 10 - 25 m.p.h. Temperatures fluctuated from sub-zero minimums in the St. Lawrence estuary to above-freezing maximums in the southern parts of the gulf. The average minimum and maximum temperatures in the estuary were 5.7°F. and 18.8°F., and resulted in the formation of young ice in the St. Lawrence River. Elsewhere in the gulf average minimum and maximum temperatures were 14.2°F. and 26.3°F.

Changes in ice distribution. The most notable change consisted of the appearance of young ice formations in the St. Lawrence River and a compact area of ice situated west of the Magdalen Islands which appeared to be the only massive winter ice in the gulf.

Ice distribution. Young ice of varying concentrations dominated the St. Lawrence River, extended eastward into the gulf south of Anticosti Island, and southward to join with the young ice of Chaleur Bay. Approximately 3/4 of this ice consisted of slush and sludge, the remainder consisted of clear young ice. With the exception of the massive winter ice in the neighbourhood of the Magdalen Islands, the remainder consisted of 8/10 to 9/10 coverage. The ice was level and smooth and its surface glazed as a result of a thaw followed by freezing conditions.

Open water. Though open water areas bordered the north shore of Prince Edward Island, the most extensive areas occurred in the vicinity of the Saguenay, in the St. Lawrence River, and off the south coast of Anticosti Island.

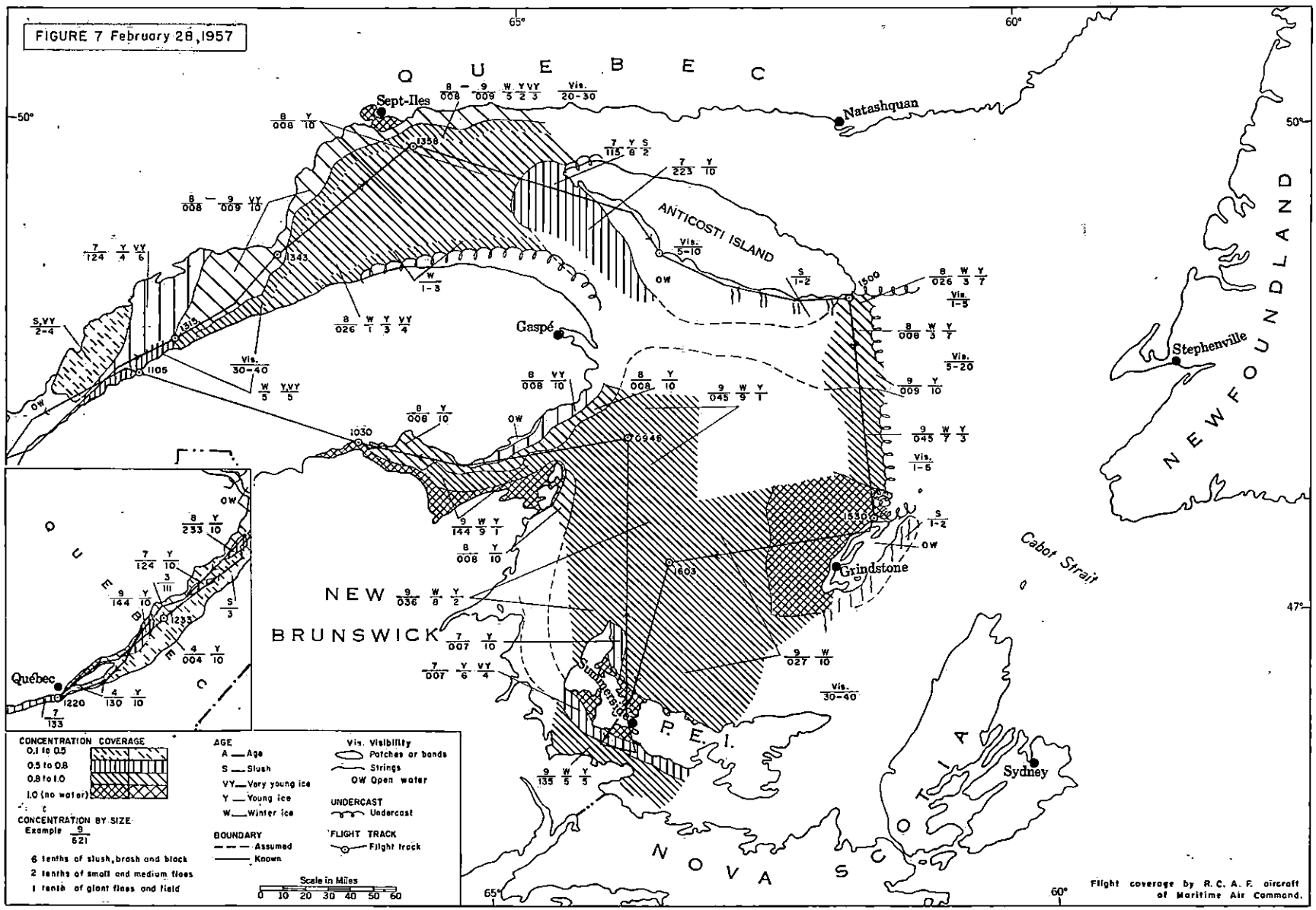
FIGURE 7 February 28, 1957
QUEBEC
NEWFOUNDLAND
NOVA SCOTIA
NEW BRUNSWICK
P.E.I.
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Sydney
Québec
Summerside
ANTICOSTI ISLAND
Cabot Strait
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
UNDERCAST
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R. C. A. F. aircraft of Maritime Air Command.

Figure 8 (March 1/57)

Weather conditions. The climatic conditions that prevailed from February 22 to 28 continued through March 1 with low temperatures dominating the entire gulf and extending the area of young ice off the New Brunswick coast and off the southern coast of Anticosti Island.

Changes in ice distribution. Two important changes were noted: the extension of the young ice area eastward of the New Brunswick coast, and the extension of young ice into an open water area south of Anticosti Island.

Ice distribution. Young ice extended from the St. Lawrence estuary to the eastern end of Anticosti Island. Local areas of 7/10 winter alternating with areas of 4/10 young and 3/10 very young ice occurred at the southern entrance to the St. Lawrence River. The winter ice tended to run in belts paralleling the Gaspé coast or curving in broad belts at right angles to the coast. Approximately 9/10 of the young ice consisted of slush and sludge. Shelving was in progress and accounted for as much as 7/10 of the ice surface. Adjacent to open water, slush and sludge were the main young ice features. Winter ice covered the eastern and central gulf areas. In the eastern part massive floes from the northeast arm composed part of the winter ice; much of this was snow-covered. The winter ice off the Newfoundland coast consisted mainly of consolidated block and small floes whose surface details were rough and snow-free. Between the Magdalen Islands and Cape Breton, pressure ridges accounted for 3/10 to 6/10 of the winter ice surface. In Northumberland Strait, winter ice coverage accounted for 9/10 at the eastern end and approximately 3/10 at the western end of the Strait.

Open water. The main area of open water extended eastward from the ice edge in Cabot Strait. A narrow belt of open water approximately 1/2 mile wide bordered the northern coast of Prince Edward Island as far eastward as Cape Tryon.

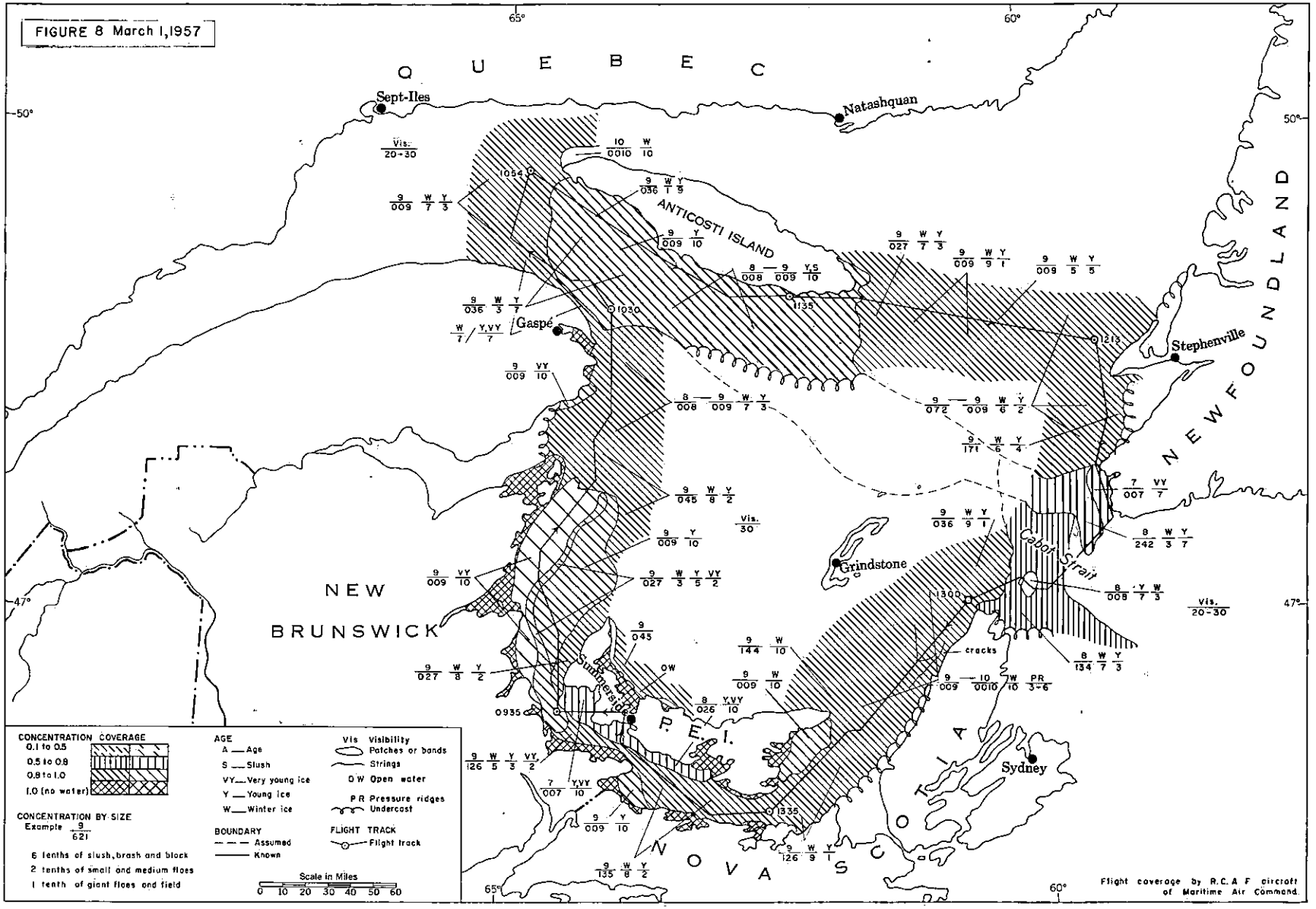
FIGURE 8 March 1, 1957
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
P.E.I.
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Sydney
Summerside
Cabot Strait
cracks
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis Visibility
Patches or bands
Strings
OW Open water
PR Pressure ridges
Undercost
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F aircraft of Maritime Air Command.

Figure 9 (March 5/57)

Weather conditions. From March 2 to 5, a low pressure air mass extended over the gulf. There were easterly winds during the first part of the period and northwesterly winds during the second part. Wind speeds varied from 10 - 30 m.p.h. Sixteen inches of snow fell in the western part of the gulf. Temperatures were mostly in the 20's throughout the region, with the average minimum and maximum temperatures being 19.7°F. and 27.5°F. respectively. Such temperatures extended the area of open water in the western part of the gulf.

Changes in ice distribution. Open water in the western part of the gulf and south of Anticosti Island increased in area. Young ice dominated the southeastern entrance to the St. Lawrence River. Other changes in the ice distribution could not be determined owing to poor visibility.

Ice distribution. Young ice covered the western side of the gulf, with shelving 3/10 to 8/10 of the ice surface. In the southern entrance to the St. Lawrence River belts of 9/10 winter ice alternated with belts of 9/10 young. Floes of winter river ice were visible within 10 miles of the Gaspé coast and amounted to 1/10 of the winter ice surface. Off the Gaspé coast young ice consisted of scattered strings of slush and sludge, brash and block. Blocks of landfast ice were scattered throughout the area. Winter ice with a concentration of 134 to 009 covered the area north and south of the Magdalen Islands and a concentration of 126 dominated the eastern entrance to Northumberland Strait.

Open water. Areas of open water lay off the east coast of New Brunswick, off Anticosti Island, off Magdalen Islands and off the east coast of Prince Edward Island. Open water areas off the New Brunswick and Gaspé coasts were expanding in size when observed on March 6.

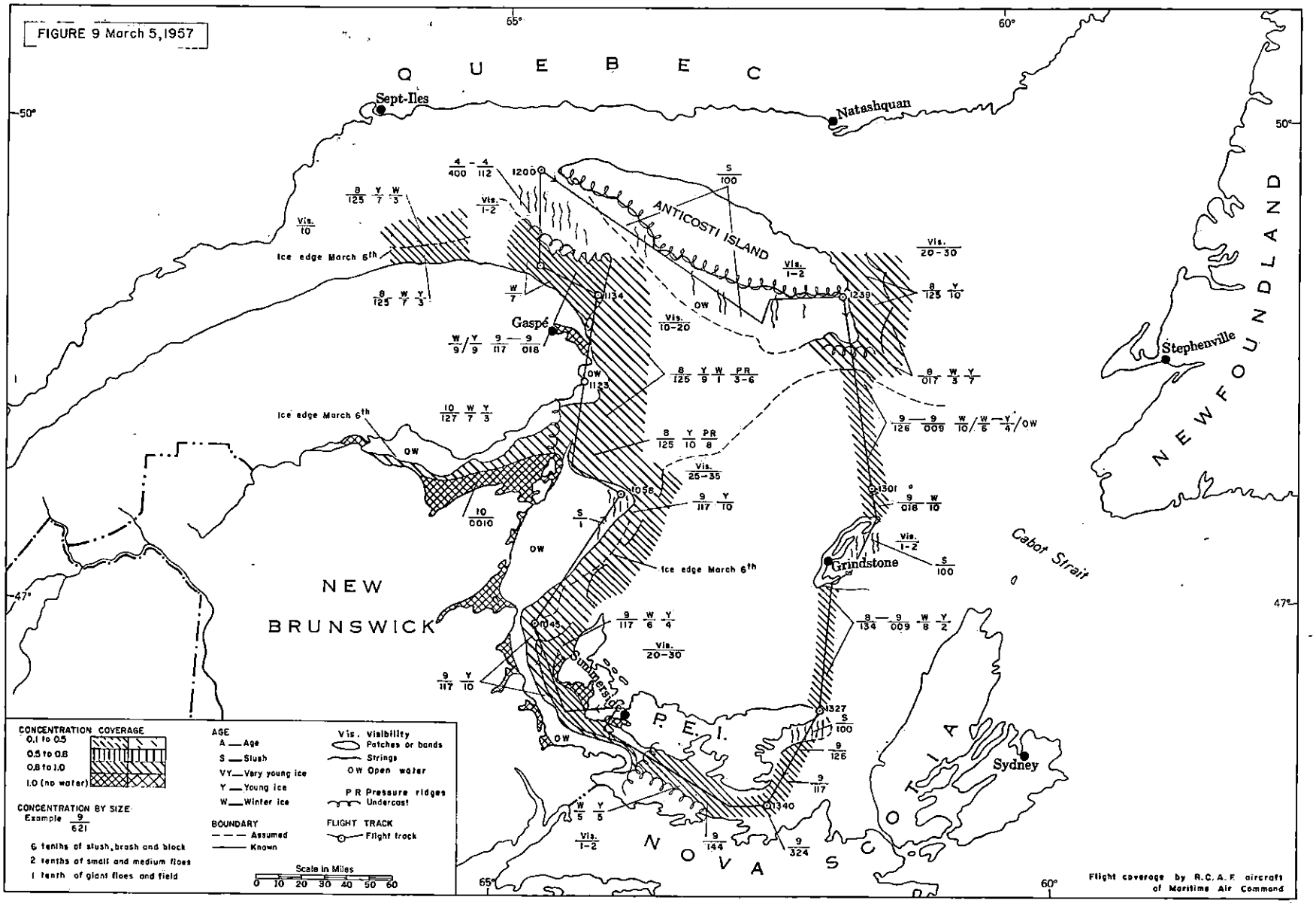
FIGURE 9 March 5, 1957
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
P.E.I.
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Sydney
Summerside
ANTICOSTI ISLAND
Cabot Strait
Ice edge March 6th
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command

Figure 10 (March 8/57)

Weather conditions. From March 6 to 8 a high pressure air mass moved eastward over the gulf with northerly winds of 10 to 15 m.p.h. Temperatures continued to move higher, particularly over the St. Lawrence estuary and the north shore. Average minimum and maximum temperatures for the north shore were 25.8°F. and 32.8°F., and for the southern gulf were 20.4°F. and 32.2°F. These temperatures caused extensive areas of open water and young ice.

Changes in ice distribution. Young ice dominated the western area and included the St. Lawrence estuary and Jacques Cartier Passage.

Ice distribution. The young ice that covered the western part of the gulf varied in concentration from 125 to 027. In this area the greatest concentration of winter ice occurred off Cape Gaspé and amounted to 7/10 of the surface. Approximately 1/10 of this winter ice was of river origin. Approximately 7/10 of the young ice surface had originated from slush and sludge. Winter ice covered the south-central gulf area. Extensive areas of young ice alternating with winter ice lay between Anticosti Island and the coast of Newfoundland. In Cabot Strait brash and block and small floes composed the greater part of the ice surface. Between Cape Breton Island and the Magdalen Islands, a shattered ice surface of 234 gave way to 0010 north of Prince Edward Island. North-south trending cracks, 5 to 50 ft. in width, progressively increased in number toward Cape Kildare, Prince Edward Island.

Open water. Open water areas and areas covered by very young ice bordered the lee shore of the mainland and islands. The St. Lawrence River was almost ice free; the only ice visible was in areas where shoals and islands gave protection from wind and wave action.

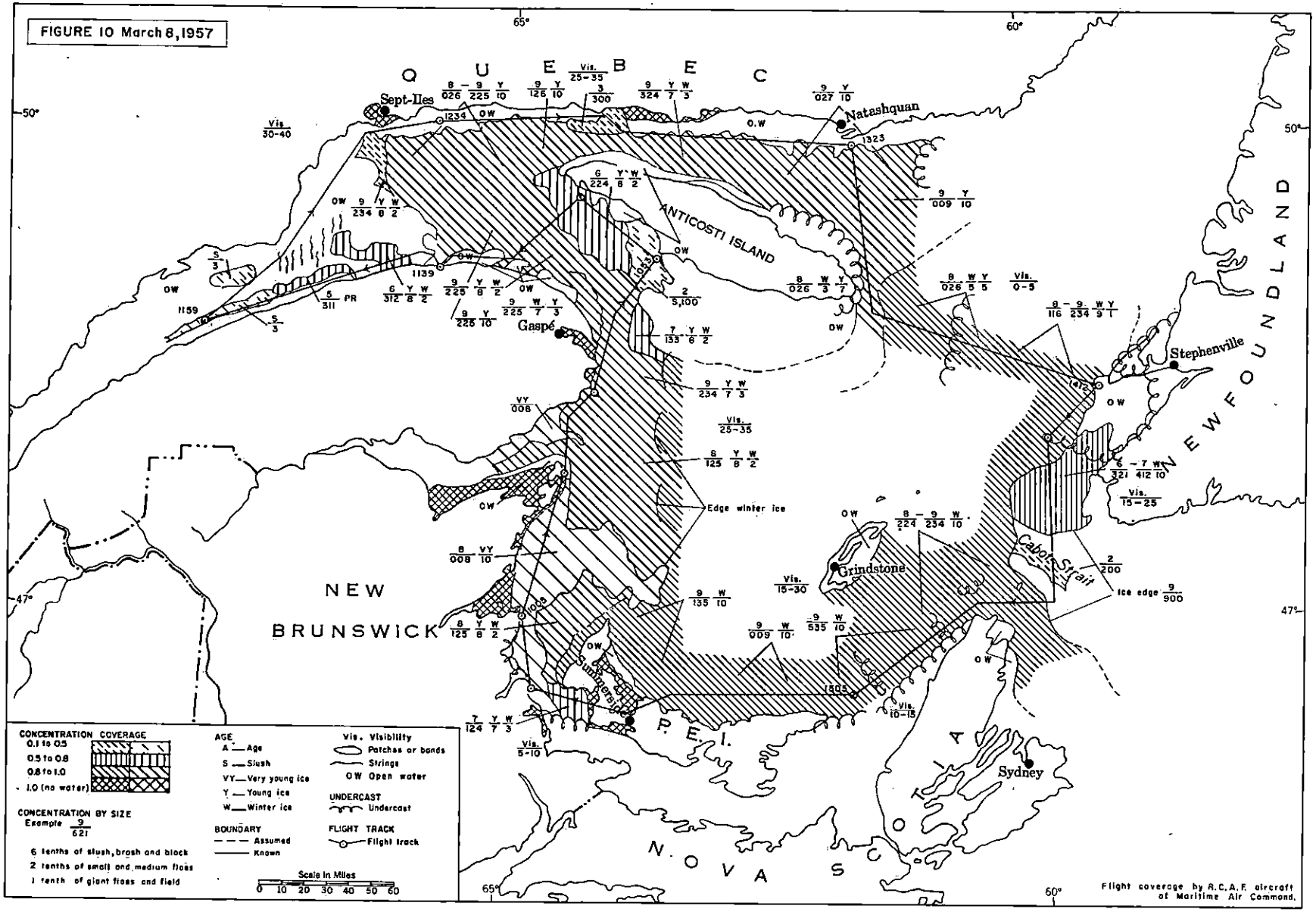
FIGURE 10 March 8, 1957
QUEBEC
NEW BRUNSWICK
NEWFOUNDLAND
NOVA SCOTIA
P.E.I.
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Summerside
Sydney
Cabot Strait
Edge winter ice
Ice edge 9/900
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
UNDERCAST
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command.

Figure 11 (March 11/57)

Weather conditions. From March 9 to 11 a low pressure air mass moved over the gulf with winds from an east to southeast direction at 25-40 m.p.h., followed by a high pressure ridge on March 11 with northerly winds of 25-50 m.p.h. Temperatures in the southern part were in the 30's, but were 10°F. lower in the northern part of the gulf. The average minimum and maximum temperatures for the north shore were 21.4°F. and 30.4°F., and for the southern gulf were 30.5°F. and 36.5°F. Open water areas expanded in size in the western and northern parts of the gulf.

Changes in ice distribution. The main change from the previous flight was the reduction of the area covered by young ice in the western parts of the gulf, and the predominance of shattered ice types in the St. Lawrence estuary.

Ice distribution. Winter ice covered an extensive area of the gulf with concentration of 126 to 027 in the western part, 332 along the north shore, 017 to 531 along the eastern part, and 125 to 324 in Northumberland Strait. In Chaleur Bay 7/10 of this ice was in pressure ridges. Sludge and brash occupied an extensive area toward the eastern end of Anticosti Island; smaller areas of sludge occurred in other parts of the gulf. Large floes and field ice dominated the gulf except along the shipping track between Cabot Strait and the St. Lawrence estuary where brash and block constituted important types and varied in concentration from 700 to 900 in the estuary to 531 in Cabot Strait.

Open water. Open water areas paralleled the east and south shore of Prince Edward Island, the west coast of New Brunswick, the west shore of Cape Breton Island and the north shore. The St. Lawrence River was ice free with open water extending along the Gaspé coast and into the estuary to include the south coast of Anticosti Island. Smaller open water areas occurred in other parts of the gulf.

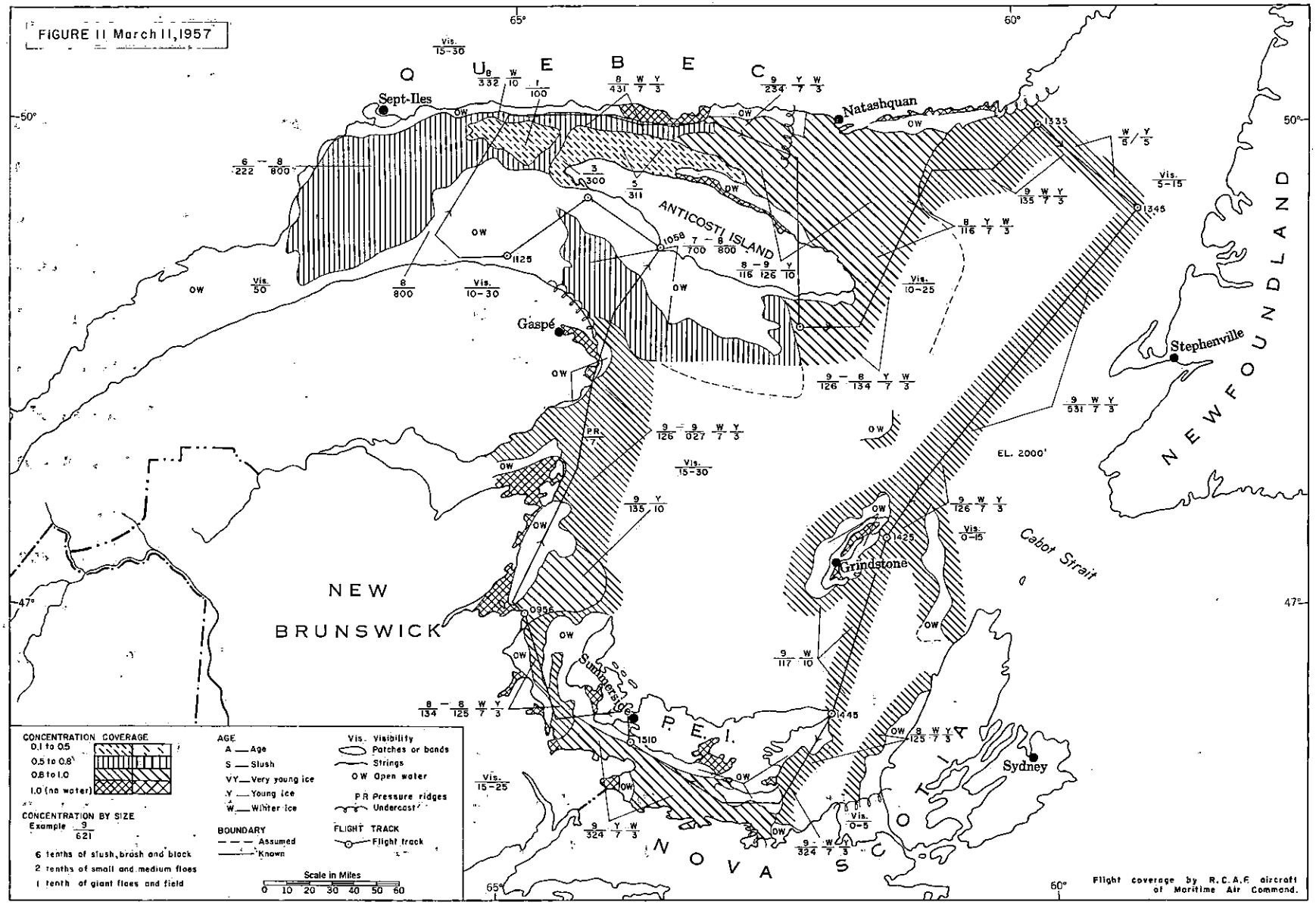
FIGURE 11 March 11, 1957
QUEBEC
NEWFOUNDLAND
NEW BRUNSWICK
NOVA SCOTIA
P.E.I.
ANTICOSTI ISLAND
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Sydney
Summerside
Cabot Strait
EL. 2000'
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command.

Figure 12 (March 13/57)

Weather conditions. The high pressure ridge of air continued to cover the region; winds, chiefly from a northeasterly quarter had speeds of 15 to 30 m.p.h. Temperatures were approximately 10°F. lower in the estuary but elsewhere were in the 30's. The average minimum and maximum temperatures for the estuary were 22°F. and 31°F., and in the other parts of the gulf were 30°F. and 38°F. These milder temperatures probably resulted in the St. Lawrence estuary being ice-free and in open water in southern and eastern areas.

Changes in ice distribution. The most important change was the westward drift of the ice from the west coast of Newfoundland.

Ice distribution. Ice concentrations varied from 009 to 450 in the Magdalen Islands area; from 116 to 225 in the northeastern arm; and 324 to 1000 in the Strait of Belle Isle. In the eastern area concentrations varied from 126 to 323, and from 135 to 315 northwest of Cape Breton and 234 in Northumberland Strait. Winter ice occupied from 7/10 to 10/10, with 2/10 to 7/10 in pressure ridges near the Magdalen Islands; 3/10 along the north shore; and 9/10 in the northeast arm and Strait of Belle Isle. Snow covered from 1/10 to 2/10 of the winter ice in the north, and from 7/10 to 10/10 in the northeastern arm. Between the Magdalen and Anticosti islands young ice lay in broad east-west belts with concentrations from 134 to 600. A second area of young ice and sludge lay south of Cape Whittle with concentrations of 0010. Extensive areas of brash, block and small floes occupied the shipping lanes between Cabot Strait and Anticosti Island, and in the ice edge from Cape Breton to the Strait of Belle Isle.

Open water. The main open water areas lay off the west coast of Newfoundland, the south coast of Prince Edward Island, the east coast of New Brunswick and the west coast of Cape Breton. The St. Lawrence estuary was reported to be ice-free.

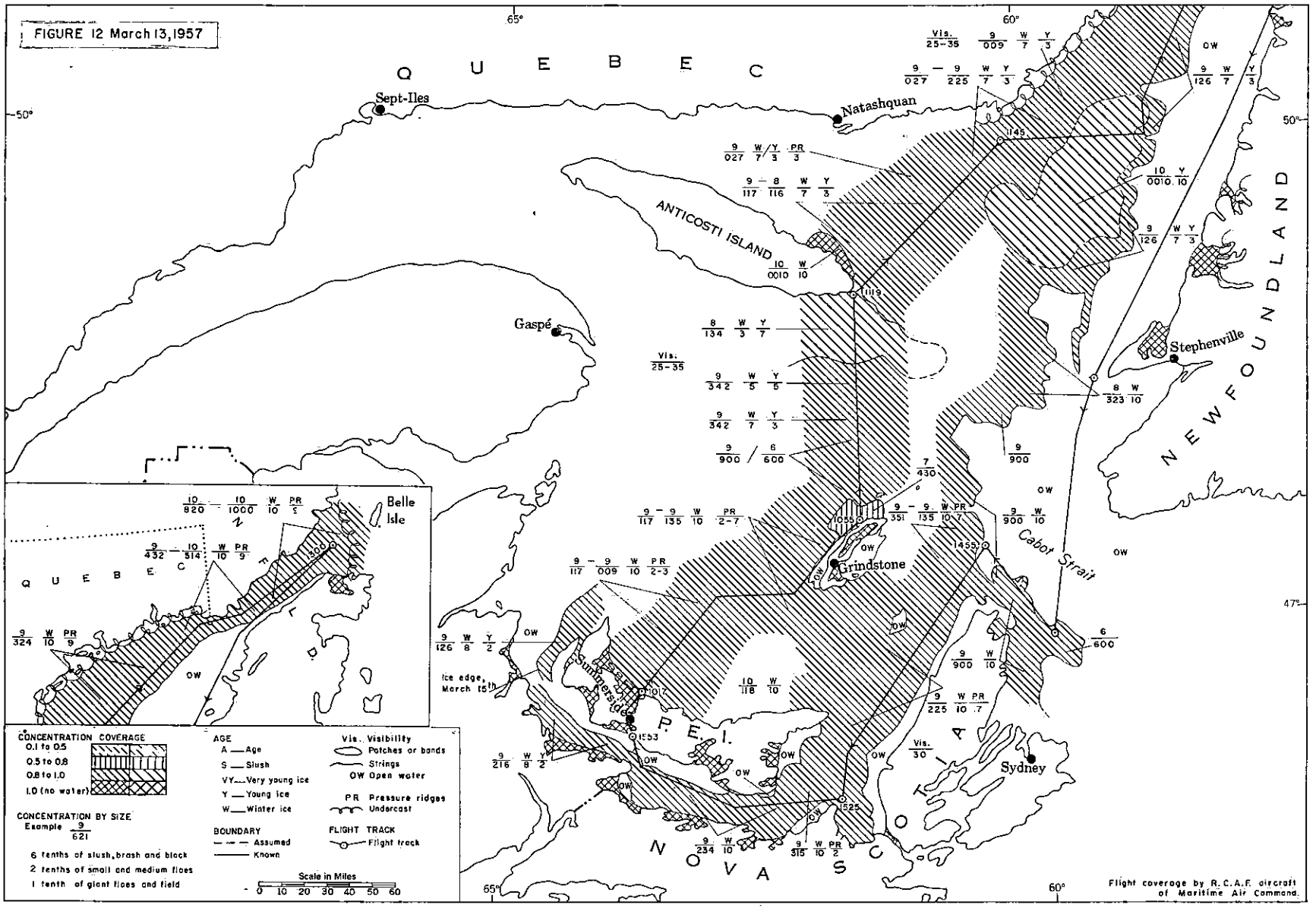
FIGURE 12 March 13, 1957
QUEBEC
NEWFOUNDLAND
NOVA SCOTIA
P.E.I.
Sept-Iles
Natashquan
Gaspé
ANTICOSTI ISLAND
Stephenville
Grindstone
Sydney
Cabot Strait
Belle Isle
Summerside
Ice edge, March 15th
65°
60°
50°
47°
CONCENTRATION COVERAGE
0.1 to 0.5
0.5 to 0.8
0.8 to 1.0
1.0 (no water)
CONCENTRATION BY SIZE
Example 9/621
6 tenths of slush, brash and block
2 tenths of small and medium floes
1 tenth of giant floes and field
AGE
A — Age
S — Slush
VY — Very young ice
Y — Young ice
W — Winter ice
BOUNDARY
Assumed
Known
Vis. Visibility
Patches or bands
Strings
OW Open water
PR Pressure ridges
Undercast
FLIGHT TRACK
Flight track
Scale in Miles
0 10 20 30 40 50 60
Flight coverage by R.C.A.F. aircraft of Maritime Air Command.

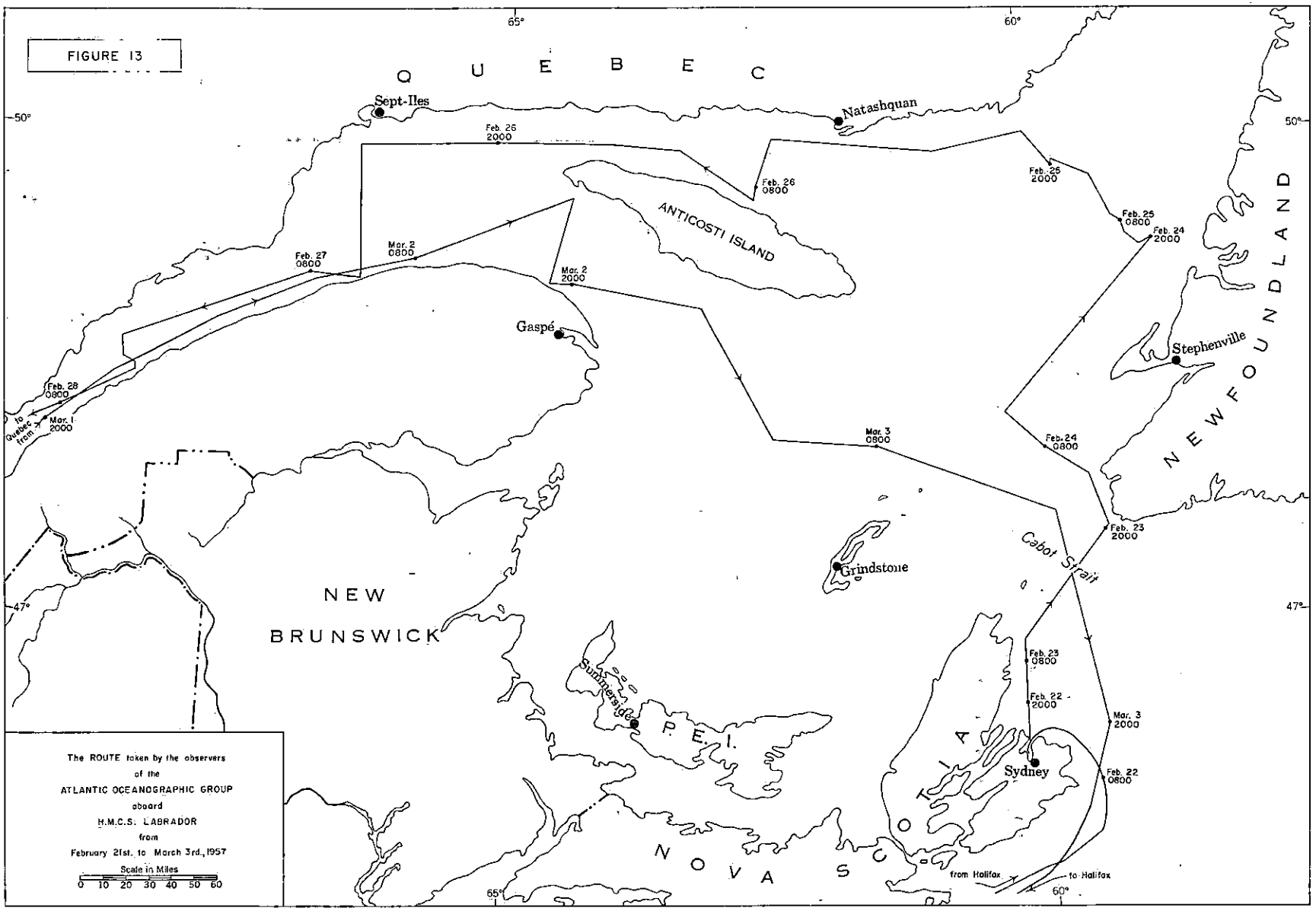
FIGURE 13
Q U E B E C
NEWFOUNDLAND
NEW BRUNSWICK
N O V A S C O T I A
P. E. I.
ANTICOSTI ISLAND
Cabot Strait
Sept-Iles
Natashquan
Gaspé
Stephenville
Grindstone
Summerside
Sydney
65°
60°
50°
47°
Feb. 26 2000
Feb. 26 0800
Feb. 25 2000
Feb. 25 0800
Feb. 24 2000
Feb. 24 0800
Feb. 23 2000
Feb. 23 0800
Feb. 22 2000
Feb. 22 0800
Mar. 3 2000
Mar. 3 0800
Mar. 2 2000
Mar. 2 0800
Feb. 27 0800
Feb. 28 0800
Mar. 1 2000
to Quebec from
from Halifax
to Halifax
The ROUTE taken by the observers of the ATLANTIC OCEANOGRAPHIC GROUP aboard H.M.C.S. LABRADOR from February 21st. to March 3rd., 1957
Scale in Miles
0 10 20 30 40 50 60

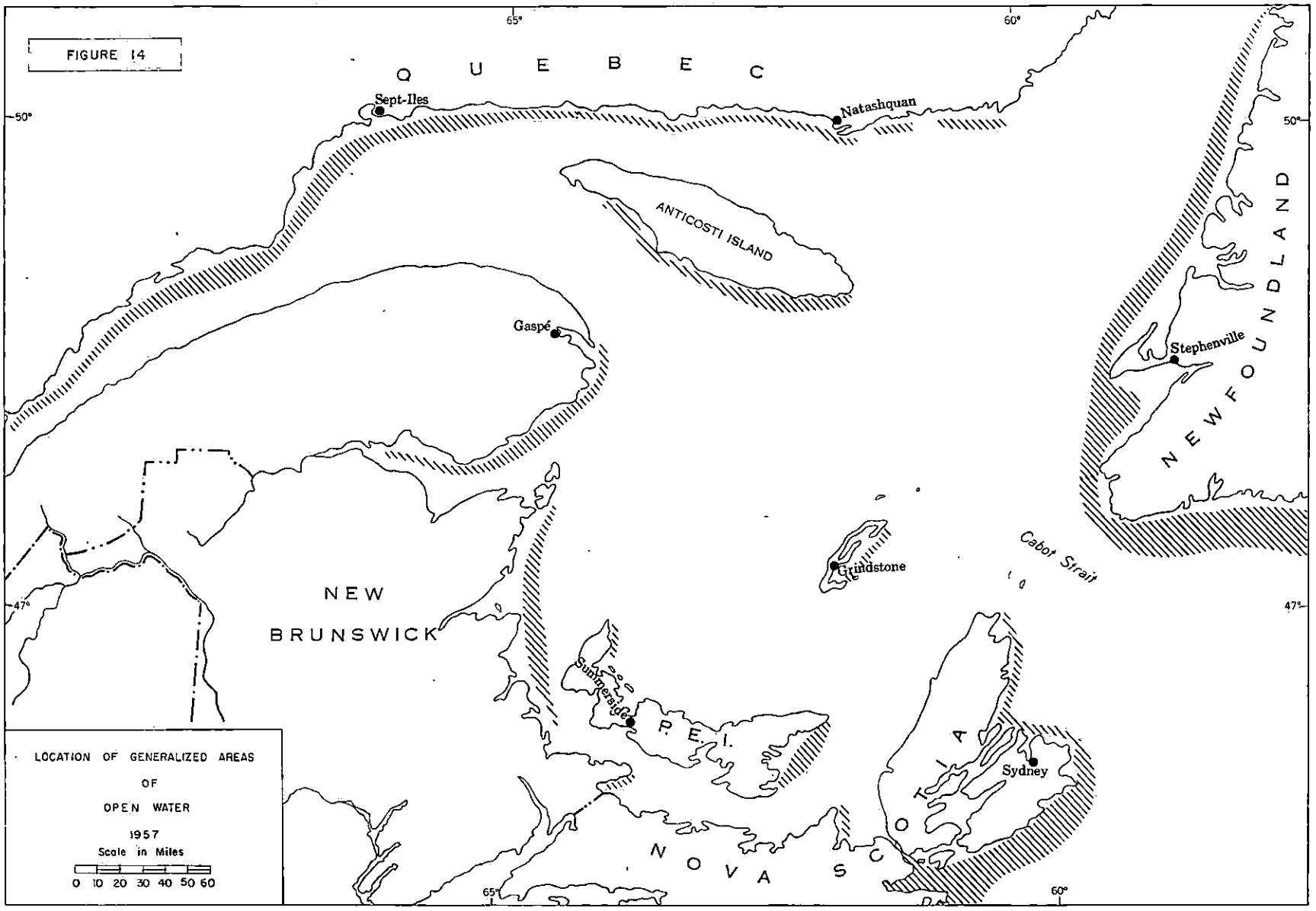
FIGURE 14
65°
60°
50°
47°
Q U E B E C
Sept-Iles
Natashquan
ANTICOSTI ISLAND
Gaspé
NEWFOUNDLAND
Stephenville
Grindstone
Cabot Strait
NEW
BRUNSWICK
Summerside
P. E. I.
Sydney
N O V A S C O T I A
LOCATION OF GENERALIZED AREAS
OF
OPEN WATER
1957
Scale in Miles
0 10 20 30 40 50 60

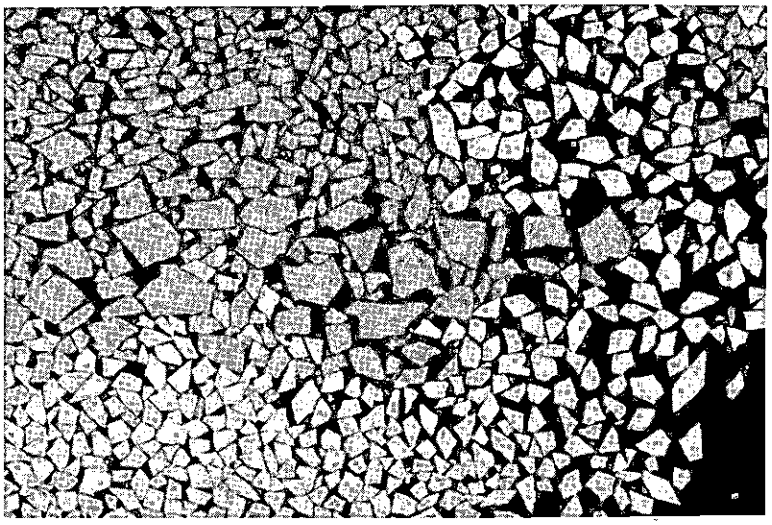

Figure 15

Ice concentration $\left(\frac{8}{800}\right)$ consisting of 5/10 winter ice and 3/10 young ice (February 6).

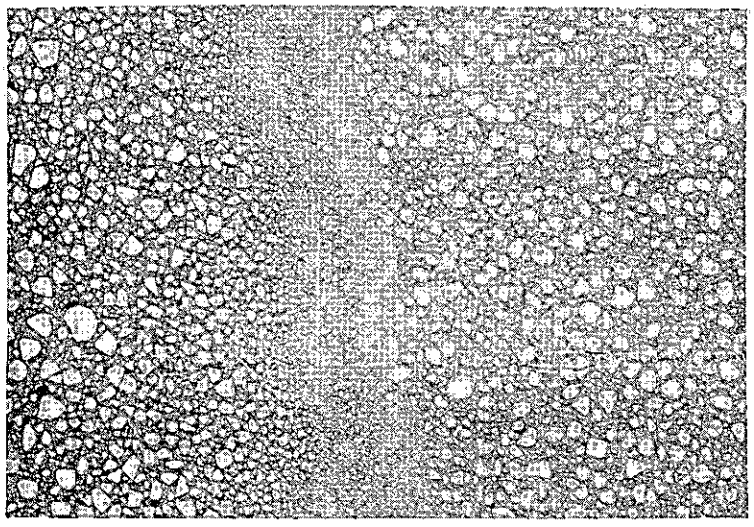

Figure 16

A field of brash and block in which the ice pieces have been sorted by wind and water (March 13).

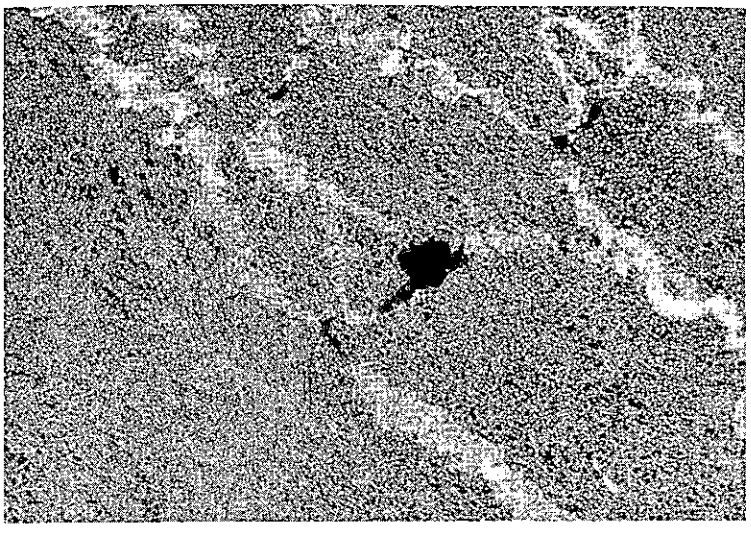

Figure 17

The lines of shelving indicate that the concentration of sludge is in the process of consolidation (March 1).

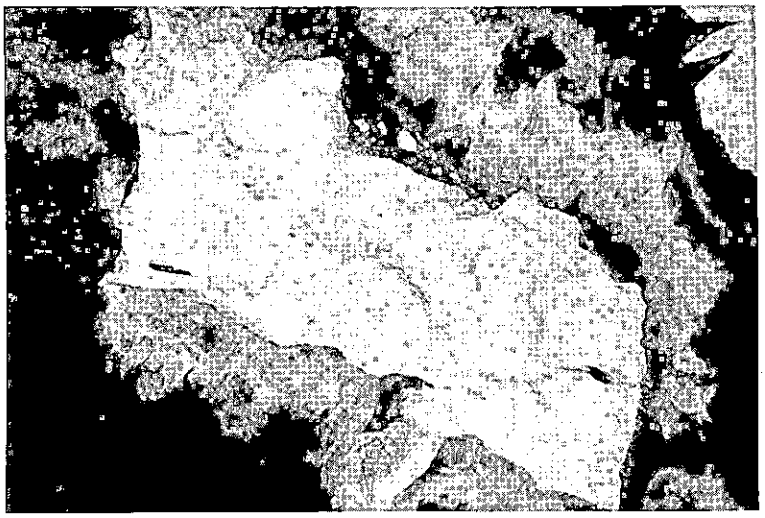

Figure 18

The large winter floe is surrounded by very young ice. The two bands of shelving indicate that the floe is exerting pressure on the young ice (March 1).

Figure 19

An area of sludge consolidated by freezing and compaction is now breaking up (February 19).

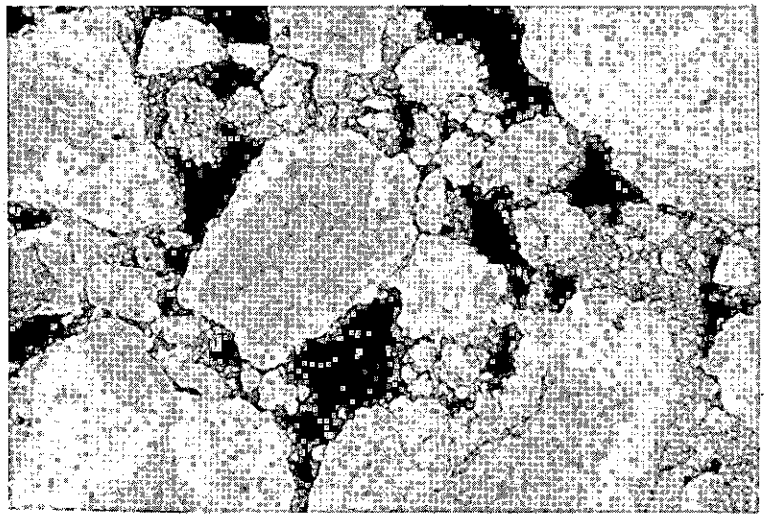

Figure 20

An ice concentration $\left(\frac{8}{260}\right)$ consisting principally of young and winter ice is made up of 2/10 brash and block and 6/10 small to medium floes (March 13).

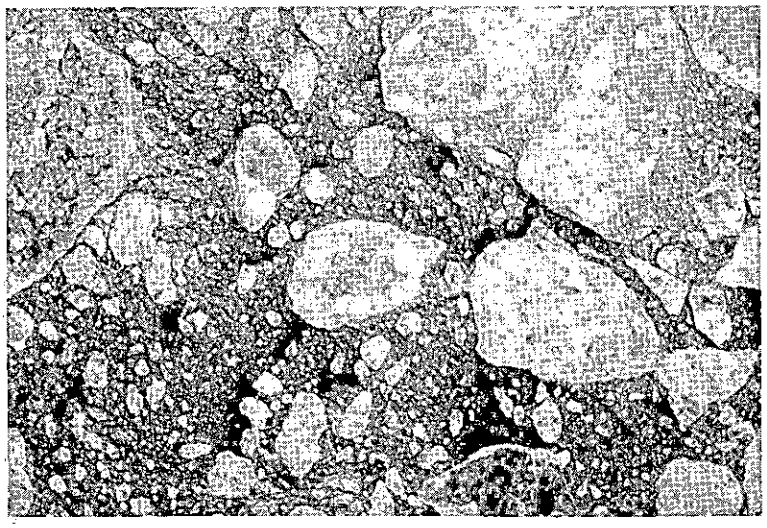

Figure 21

A mass of 'working' ice $\left(\frac{9}{630}\right)$ consisting of 6/10 brash and block, and 3/10 small to medium floes (February 21).

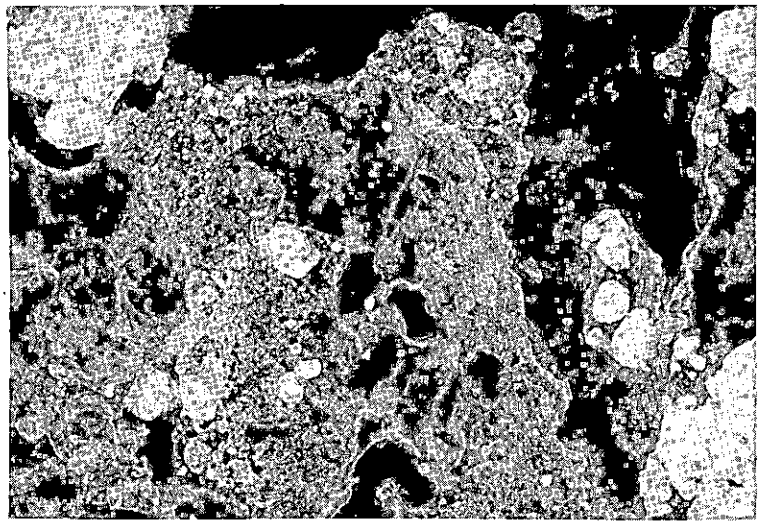

Figure 22

Winter ice being consolidated by the formation of young ice (February 21).

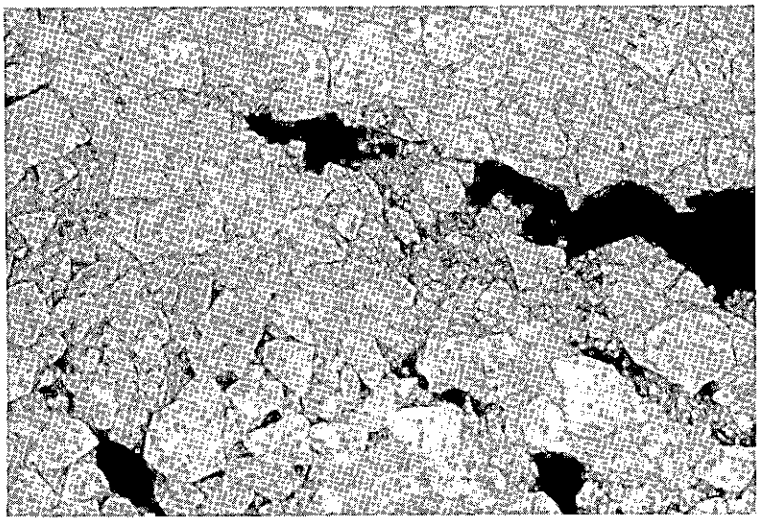

Figure 23

Ice consisting of 3/10 brash and 6/10 block. The rounded corners result from the floes jarring violently against one another (February 14).

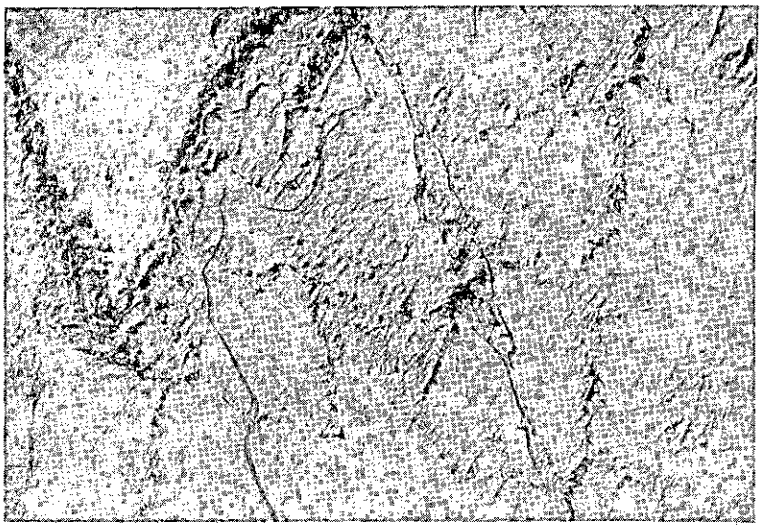

Figure 24

A winter ice field with a heavy snow cover showing pressure ridges and cracks (February 6).

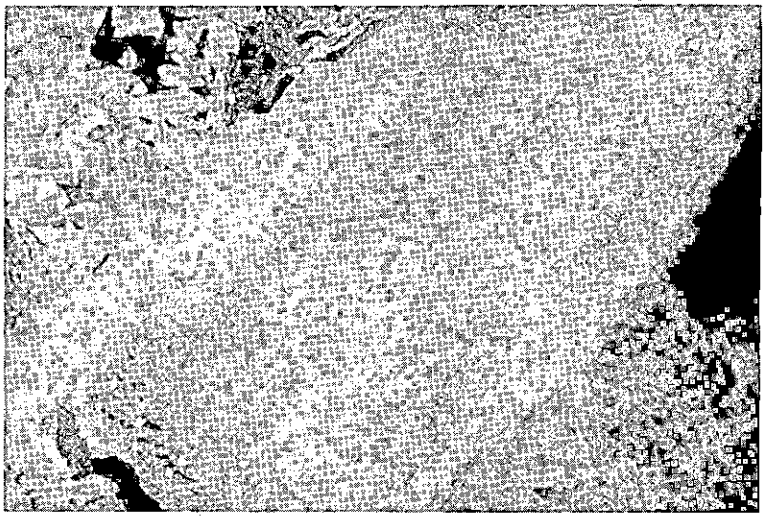

Figure 25

Young ice consisting chiefly of slush and sludge and scattered brash. Formation of young ice indicates that consolidation is in progress (February 14).

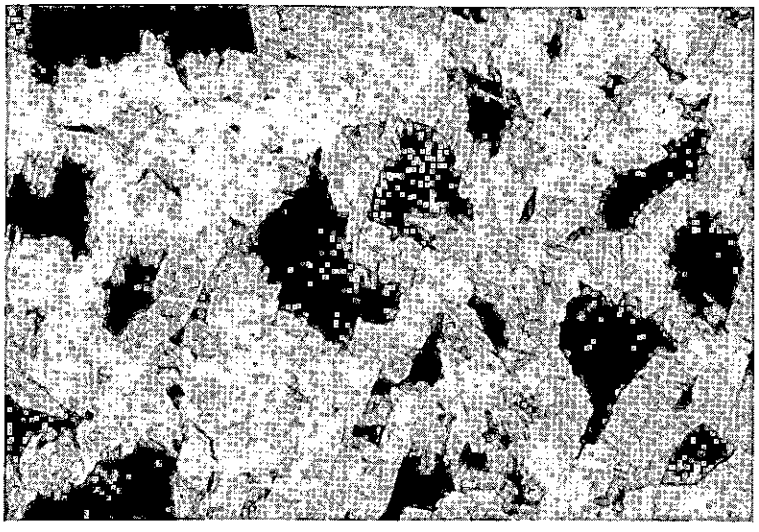

Figure 26

Rectangular interfingering patterns are characteristic of the shelving process of young ice (March 1).