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GEOGRAPHICAL PAPER No. 12

Gulf of St. Lawrence Ice Survey, Winter 1956

*W. A. Black
C. N. Forward*

GEOGRAPHICAL BRANCH

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P R E F A C E

Gulf of St. Lawrence Ice Survey, Winter 1956,
is the work of the Canadian Ice Distribution Survey which examines and reports on the condition and distribution of ice in specific areas of Canada. At the request of the Defence Research Board, the Geographical Branch provided two geographers, W.A. Black and C.N. Forward, to act as aerial ice observers and to carry out this survey.

This is the first occasion for an aerial survey to be undertaken by the C.I.D.S. It is hoped that the gulf ice survey will continue during subsequent winters and also be extended into other areas where specific information on ice conditions is required.

N. L. Nicholson,
Director,
Geographical Branch.

GULF OF ST. LAWRENCE ICE SURVEY, WINTER 1956

INTRODUCTION

The aerial survey of sea ice conditions in the Gulf of St. Lawrence during February and March, 1956 was undertaken by the Geographical Branch in cooperation with the Atlantic Oceanographic Group, the Royal Canadian Navy, and the Royal Canadian Air Force. The survey was co-ordinated by the Geophysical Research Section of the Defence Research Board. The operation was planned to begin approximately one month earlier than the Department of Transport's annual ice survey of the Gulf of St. Lawrence. This early date provided an unusual opportunity to carry out comprehensive observations of the development and movement of sea ice in various parts of the gulf.

Aircraft and crews were provided by the Royal Canadian Air Force. Canso, Lancaster and P₂V Neptune aircraft were used for the survey. Ten flights of 6 to 8 hours duration were undertaken on the following dates: February 11, 18, 21, 23, 26, 27, 29, and March 2, 4, and 6. Aircraft were generally flown at 1,000 feet elevation and the tracks flown were approximately 1,300 miles in length. The operation was based at Greenwood, N.S. but four of the flights originated from Summerside, P.E.I.

Aerial reconnaissance extended westward to the Saguenay River, eastward to Belle Isle and southward to Cabot Strait. Flight patterns were varied to permit the greatest possible observation of ice conditions. The western, central and southern parts of the gulf came under most frequent observation. Most of the reconnaissance was carried out on schedule; variations were introduced because of overcast weather conditions, in which case the flight track was adjusted in order to secure maximum observation.

GEOGRAPHICAL BRANCH

Ice conditions experienced throughout the Gulf of St. Lawrence region were light, and the shipping track was relatively free except for scattered bands of brash. Ice accumulation south of the shipping track consisted largely of young ice with concentrations between 5/10 and 10/10. North of the shipping track accumulation consisted primarily of strings and bands of ice except in the Strait of Belle Isle area where concentrations were between 5/10 and 10/10. The heaviest concentration of winter ice occurred in the Strait of Belle Isle area. Patches of winter ice were observed in the western end of Northumberland Strait and in the gulf off Cape Breton. Each of these areas contained a considerable proportion of open water and very young ice. Landfast winter ice occupied the bays and harbours observed along the flight track. As the winter was unusually mild the development of young ice to winter ice was delayed, and in many parts of the gulf was arrested entirely. (January temperatures were 18°F. to 20°F. above the mean of 2°F. to 6°F. in the northern part of the gulf, and 10°F. above the mean of 18°F. to 19°F. in the southern part of the gulf). Offshore winds opened broad leads along the coasts and frequently detached land-fast ice. Ice in the form of strings and bands of brash passed from the Gulf of St. Lawrence into Cabot Strait.

Ice conditions observed during the reconnaissance are summarized graphically in figures 1 to 10. Each chart covers the duration of a single flight and represents the combined observations made by the ice observers. A general report that follows gives a summary of ice conditions presented on each chart.

The route of the H.M.C.S. Labrador and the location of the stations made in the Gulf of St. Lawrence are given in figure 11. Winter oceanographic observations were made for the first time in the gulf during February - March, 1956. The aerial reconnaissance flights provided the Winter Oceanographic Survey with ice coverage. The results of the correlation between ice distribution and oceanographic conditions are found in 'A Preliminary Report of the Winter Oceanographic Survey in the Gulf of

GULF OF ST. LAWRENCE ICE SURVEY, WINTER 1956

St. Lawrence', 1956, by L. M. Lauzier.

EXPLANATION OF TERMS

1. The symbols and system of ice reporting used is that of the U.S. Navy Hydrographic Office.
2. Cn Concentration by size: -- 6 tenths of slush, brash and block; 2 tenths of small and medium floes; 1 tenth of giant floes and field; total 9 tenths coverage.
3. Young or very young ice: -- Newly formed level ice that is usually transparent.
4. Winter ice: -- Usually more or less unbroken, level sea ice of the current winter's growth.
5. Landfast ice: -- Ice that remains fast along a coast or is attached to the shores of harbours or bays.
6. Strings or bands of slush, brash or block are used in the text in place of the standard term 'less than 1/10 concentration'.

CONCLUSION

Ice coverage in the gulf consisted principally of young ice or of ice that was well ground up (brash). Water areas were extensive throughout the ice covered surface. These conditions resulted from the unusually mild weather and from strong winds that prevented the development of winter ice. Winds and currents carried the drift ice from the gulf through Cabot Strait. Such physical conditions indicated the possibility of an early opening of navigation about April 1, unless a period of prolonged low temperatures occurred in March after the cessation of the ice survey.

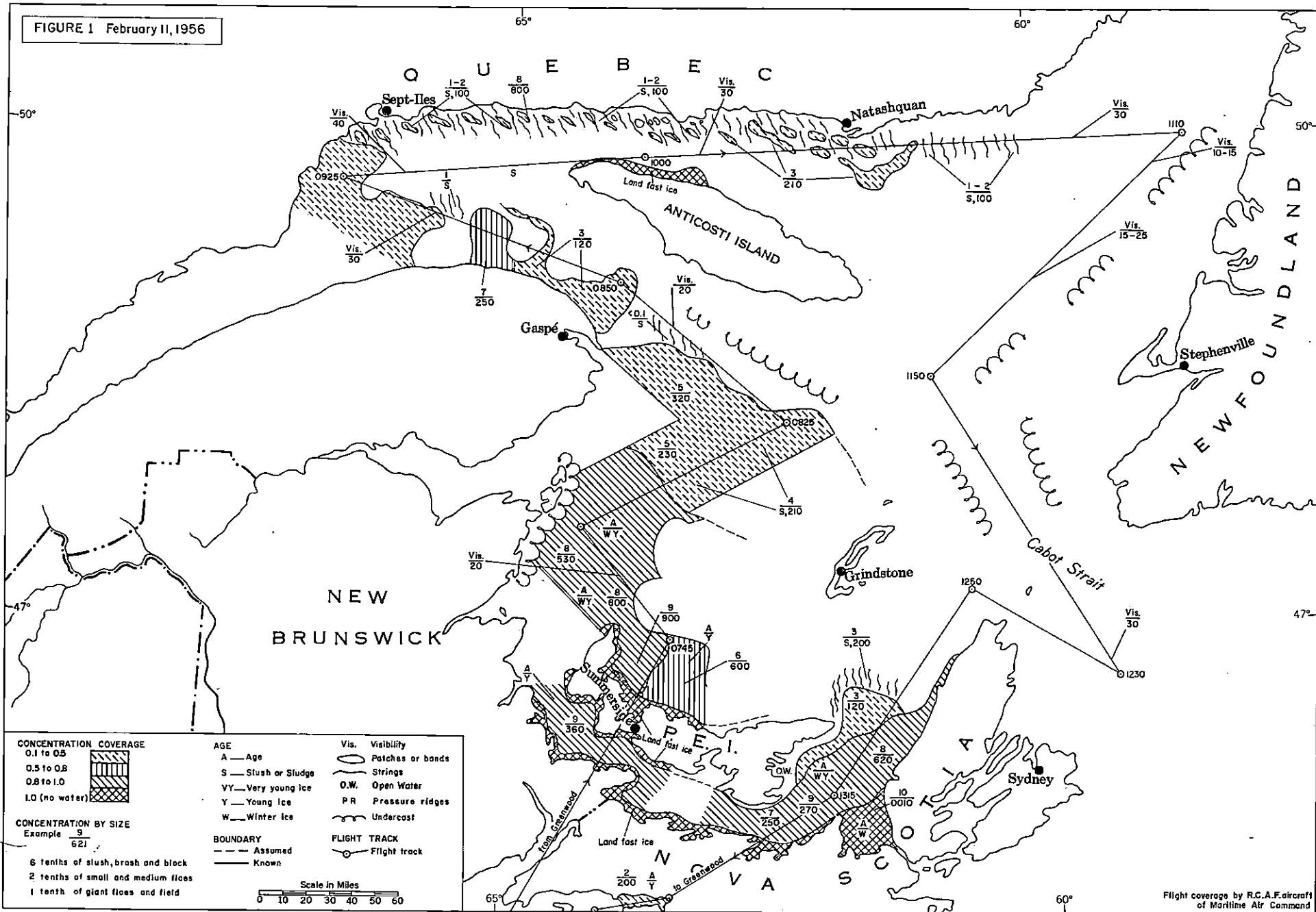
Figure 1 (February 11/56)

Ice distribution. Landfast winter ice of 10/10 coverage extended along the south shore of Northumberland Strait from Cape George to Richibucto Harbour, George Bay, and the north shore of the strait between Cape Bear and West Point. It extended along the northwest coast of Anticosti Island. Ice with a concentration from 8/10 to 10/10 covered Northumberland Strait and the western side of the gulf to approximately $48^{\circ} 00'$ N. latitude. Concentrations of 1/10 to 5/10 stretched northwards of $48^{\circ} 00'$ N., skirted the Gaspé coast and extended across the St. Lawrence estuary to Seven Islands. A second area lay off the east coast of Prince Edward Island. Strings and bands of slush, brash and block paralleled the north shore of the gulf. Local strings of brash occurred along the ice edge. The ice consisted predominantly of young ice with occasional areas of winter ice at the eastern and western ends of Northumberland Strait.

Open water. Open leads occurred off the east coast of Prince Edward Island and off Pictou Island.

Weather conditions. Visibility throughout varied from 15 to 30 miles. Considerable overcast was experienced. Winds were predominantly from the northwest quadrant.

FIGURE 1 February 11, 1956



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 $\frac{9}{621}$
- 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 or Sludge
- VY — Very young ice
- Y — Young ice
- W — Winter ice

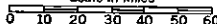
BOUNDARY

- Assumed
- Known

Vis. Visibility

- Patches or bands
- Strings
- O.W. Open Water
- PR Pressure ridges
- Undercast
- FLIGHT TRACK
- Flight track

Scale in Miles



Flight coverage by R.C.A.F. Aircraft of Maritime Air Command

Figure 2 (February 18/56)

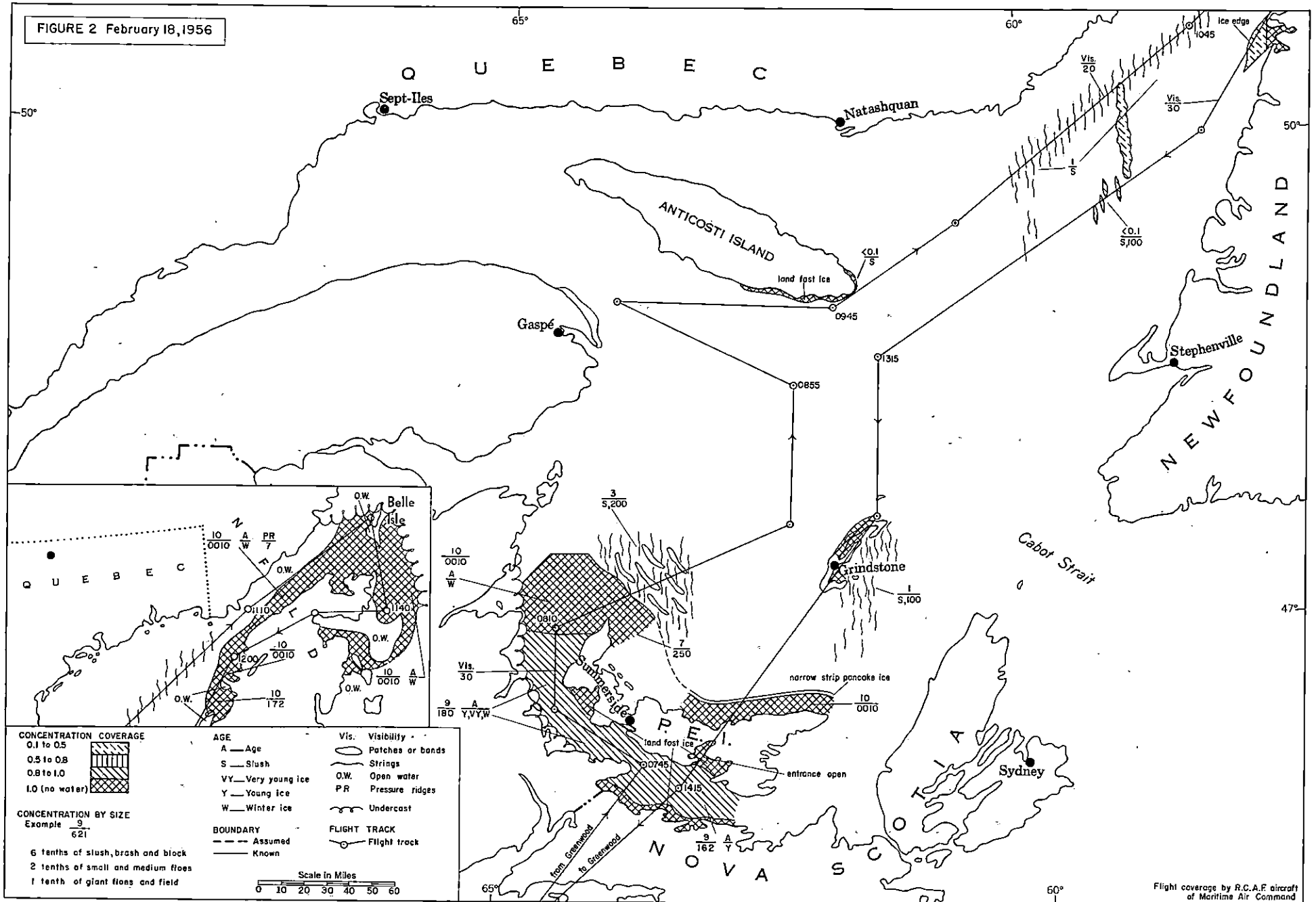
Variation from previous reconnaissance. The major change in the distribution of ice from that observed on the previous flight consisted of its disappearance in the western part of the gulf between $47^{\circ} 30' N.$ and the Gaspé coast. Ice concentrations had increased to 10/10 off the north coast of Prince Edward Island and in the extreme northwestern entrance to Northumberland Strait. Landfast winter ice was reduced along the coasts of Northumberland Strait.

Ice distribution. Landfast ice on the south shore of Northumberland Strait extended from Caribou Harbour to Baie Verte, and on the north side of the strait it covered Egmont and Hillsborough bays. It also bordered the southeastern coast of Anticosti Island, the south shore of the Strait of Belle Isle, and covered the lagoons of the Magdalen Islands. Ice coverage of 8/10 to 10/10 concentration paralleled the north coast of Prince Edward Island northward to Miramichi Bay, the southern half of the Strait of Belle Isle southwards to St. John and Hare bays, and covered Northumberland Strait. No ice in concentrations of 5/10 to 8/10 was observed. Strings and bands of slush, brash and block extended along the northwestern arm of the gulf, in the area southeast of the Magdalen Islands, and locally along the flight track. Ice was predominantly young. Winter and polar ice with occasional bergy bits and growlers occurred in the Strait of Belle Isle area. This ice surface was rough.

Open water. Open leads occurred south of Belle Isle and between Cape Bauld and St. Anthony Harbour. The northern parts of the Strait of Belle Isle and Hare Bay were open.

Weather conditions. Visibility varied from 12 to 30 miles. Overcast limited reconnaissance in the Belle Isle area. Winds were predominantly from the northwest.

FIGURE 2 February 18, 1956



Flight coverage by R.C.A.F. aircraft of Maritime Air Command

Figure 3 (February 21/56)

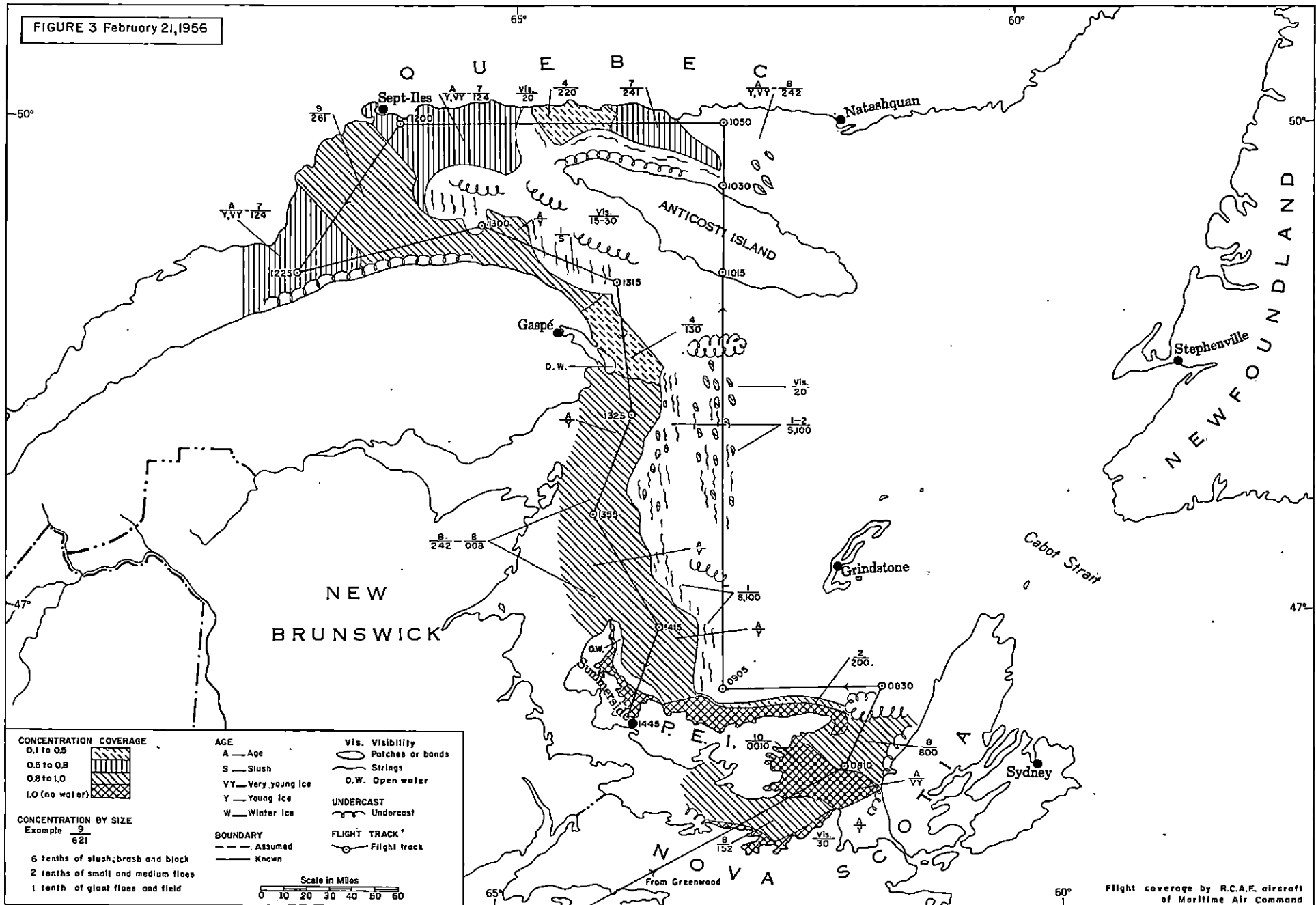
Variation from previous reconnaissance. The major changes in the distribution of the ice pattern from the previous flights consisted in the recurrence of the ice in the area between $47^{\circ} 30' N.$ and the Gaspé coast, and a reduction in its concentration off the northwest coast of Prince Edward Island. Ice was more concentrated in the St. Lawrence estuary, and more extensive along the north shore of the gulf than on February 11.

Ice distribution. Landfast winter ice bordered the southern part of Northumberland Strait between Cape George and Cape John, George Bay, and the bays on the north side of Prince Edward Island. Ice concentration of 10/10 was limited to a belt paralleling the north coast of Prince Edward Island and to an area southeast of the island. Concentrations of 8/10 to 10/10 dominated the western part of the gulf, and extended westward to the St. Lawrence estuary. Concentrations of 5/10 to 10/10 covered a large part of the St. Lawrence estuary and the northern part of the Jacques Cartier Passage. Strings and bands of slush, brash and block occurred along the ice edge particularly in the western part of the gulf. Young ice was predominant, the only winter ice being the landfast ice observed in the bay.

Open water. Open leads occurred off Cape Gaspé and off Prince Edward Island between Cape Tryon and North Point.

Weather conditions. Visibility varied from 5 to 25 miles. Considerable amount of overcast and snow squalls were experienced. Winds were predominantly from the west.

FIGURE 3 February 21, 1956



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 $\frac{9}{621}$
- 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

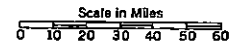
- Patches or bands
- Strings
- O.W. Open water

UNDERCAST

- Undercast

FLIGHT TRACK

- Flight track



Flight coverage by R.C.A.F. aircraft of Maritime Air Command

Figure 4 (February 23/56)

Variation from previous reconnaissance. Major variations in the pattern of ice distribution from the previous flight were the ice coverage of 5/10 to 8/10 concentration in the west-central part of the gulf, the reduction in area and concentration of ice in the St. Lawrence estuary, and the expansion in area of ice of 8/10 and 10/10 concentration at the eastern entrance to Northumberland Strait.

Ice distribution. Landfast winter ice was limited to the bays on the south side of Northumberland Strait and to the bays on the north coast of Prince Edward Island. Concentrations of 10/10 covered the southwestern part of Northumberland Strait and formed a narrow belt parallel to the north coast of Prince Edward Island. Concentrations of 8/10 to 10/10 were limited to a small area off the northeast coast of Prince Edward Island. The area of ice of 5/10 to 8/10 concentration was unusually extensive and covered the west-central part of the gulf, the southeastern entrance to the St. Lawrence estuary, and extended a considerable distance off the Cape Breton coast. Ice with concentrations of 1/10 to 5/10 occupied the north-central part of the gulf, the western part of the St. Lawrence estuary and the eastern entrance to Northumberland Strait. Strings, bands and patches of brash were particularly numerous along the northern half of the track. Young ice was predominant throughout the observation area; winter ice occurred in patches at the eastern entrance to Northumberland Strait.

Open water. No leads observed.

Weather conditions. Visibility varied from 5 to 25 miles. Overcast reduced the effectiveness of the reconnaissance in the northern half of the track. Winds were predominantly from the west.

FIGURE 4 February 23, 1956

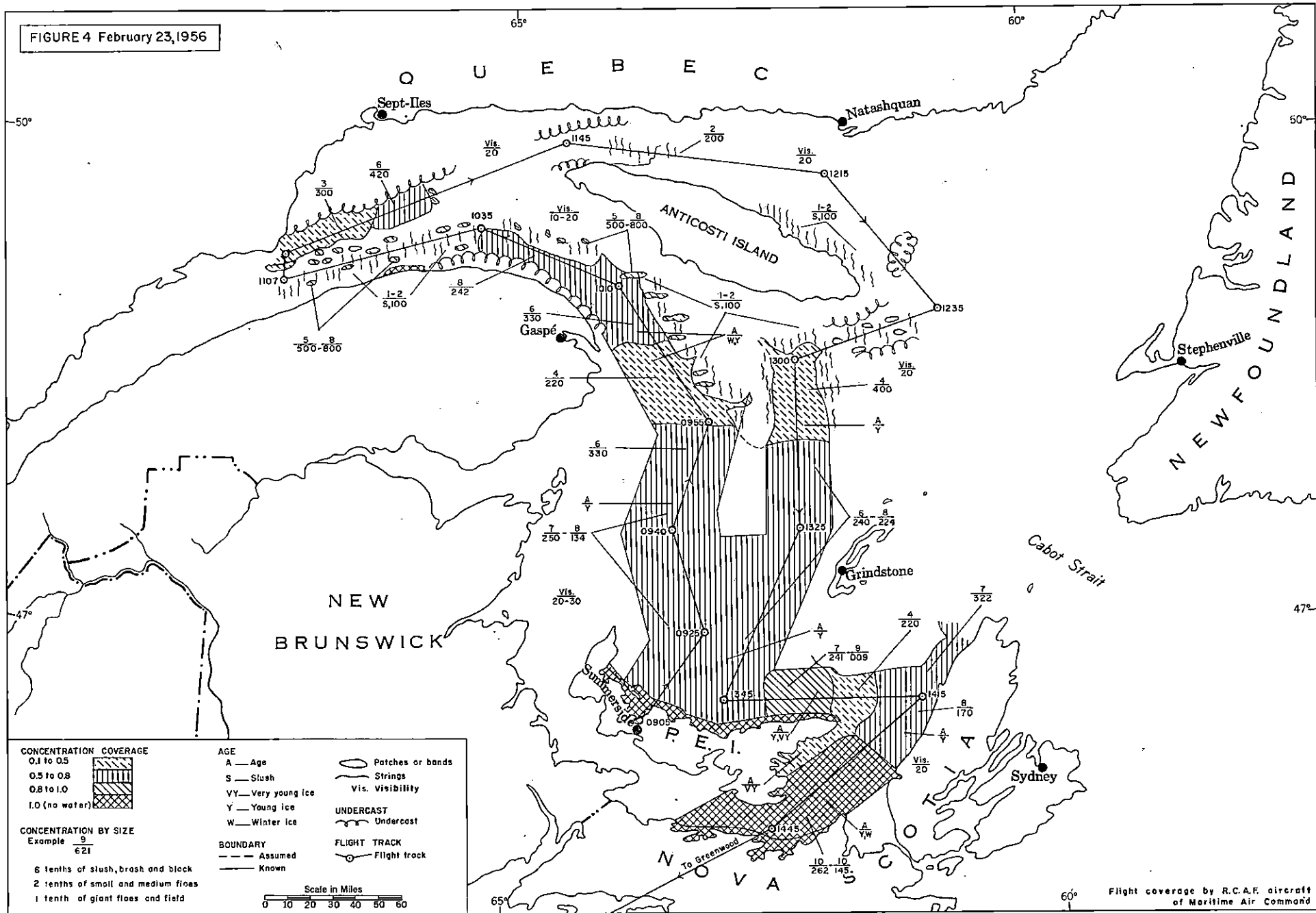


Figure 5 (February 26/56)

Variation from previous reconnaissance. The pattern of ice distribution was more confused than had been observed on any of the previous flights. Prolonged southerly winds had driven the ice off the southern shores to the central parts of the gulf. At the eastern entrance to Northumberland Strait ice concentrations were less than those observed from the previous flight.

Ice distribution. Landfast winter ice was limited to the protected bays. No areas of total (10/10) ice coverage were observed. Ice concentrations of 5/10 to 8/10, and 8/10 to 10/10 were predominant in the west-central part of the gulf and in the southeastern part of Northumberland Strait. Ice coverage of 1/10 to 5/10 occupied the central gulf area. Strings and bands of brash were numerous along the southern parts of the track. Young ice was predominant throughout Northumberland Strait, but contained patches of winter ice.

Open water. Open water bordered the northern coast of Prince Edward Island and the northern shore of Nova Scotia.

Weather conditions. Low-lying stratus clouds reduced visibility considerably over much of the reconnaissance area and curtailed operations along the north shore of the Gulf of St. Lawrence. Winds were from the south.

FIGURE 5 February 26, 1956

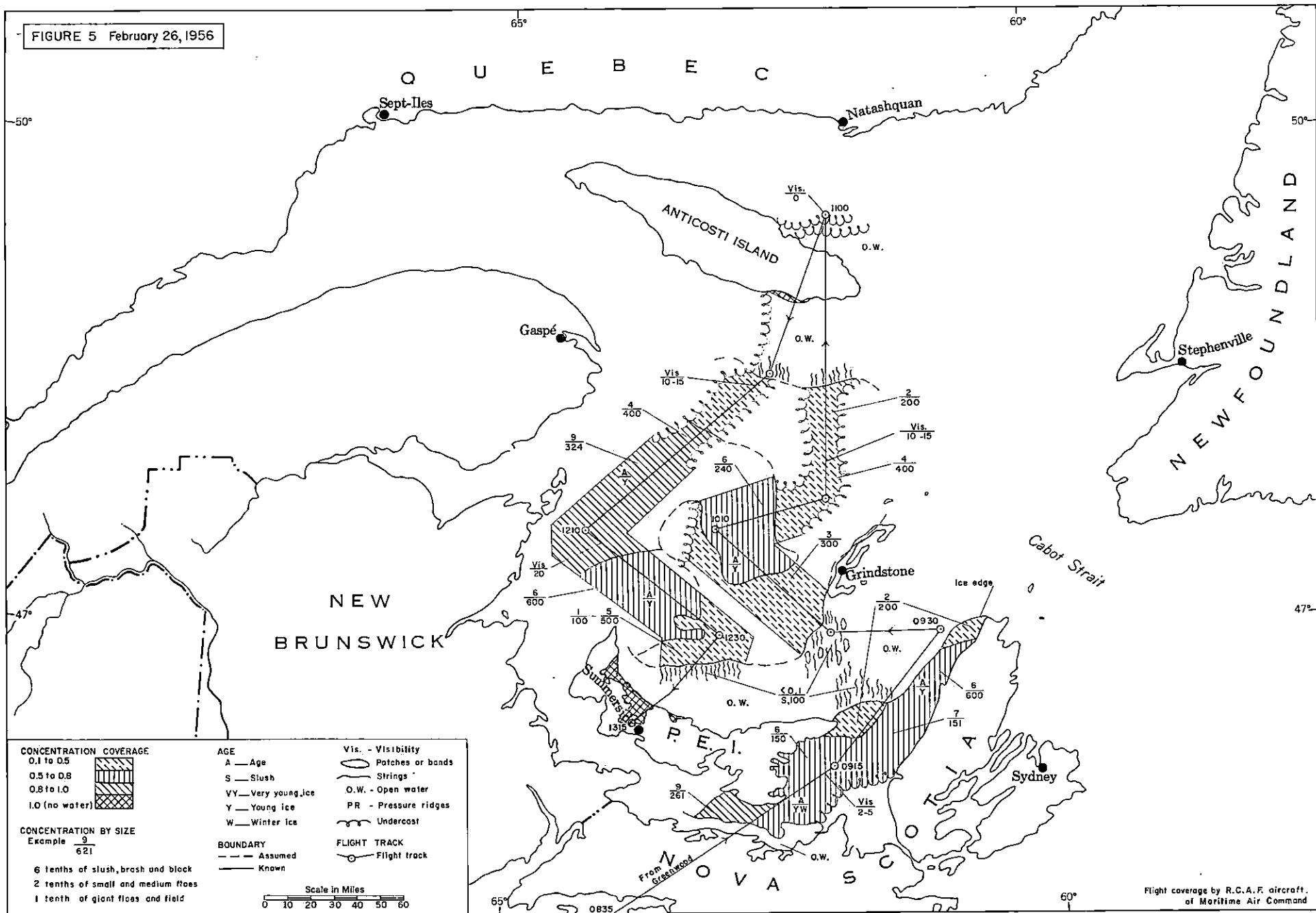


Figure 6 (February 27/56)

Variation from previous reconnaissance. The pattern of ice distribution in the central part of the gulf resembled that observed on the previous flight; however, a wedge of ice that lay off the north coast of Prince Edward Island had reduced the extent of open water previously observed.

Ice distribution. Landfast winter ice was limited chiefly to bays and to the south shore of the St. Lawrence River from Rimouski westward to Green Island, opposite the mouth of the Saguenay River. Ice concentrations of 5/10 to 8/10 and from 8/10 to 10/10 covered the west-central part of the gulf, the Gaspé coast westward to Rimouski, the west side of the Magdalen Islands, and the area lying immediately to the north of Prince Edward Island. Ice coverage of 1/10 to 5/10 covered the central and northern gulf area and the western part of the St. Lawrence estuary. Strings and bands of slush and brash were particularly numerous along the north shore of the gulf, and locally along the flight track. Young ice was predominant throughout the entire area, the most extensive winter ice being the landfast ice previously noted.

Open water. The St. Lawrence River was open westward as far as the Saguenay. A broad lead bordered the north coast of Prince Edward Island.

Weather conditions. Visibility varied from 5 to 25 miles. Winds were southwesterly in the southern part of the gulf and from west to northwesterly in the northern gulf area.

FIGURE 6 February 27, 1956

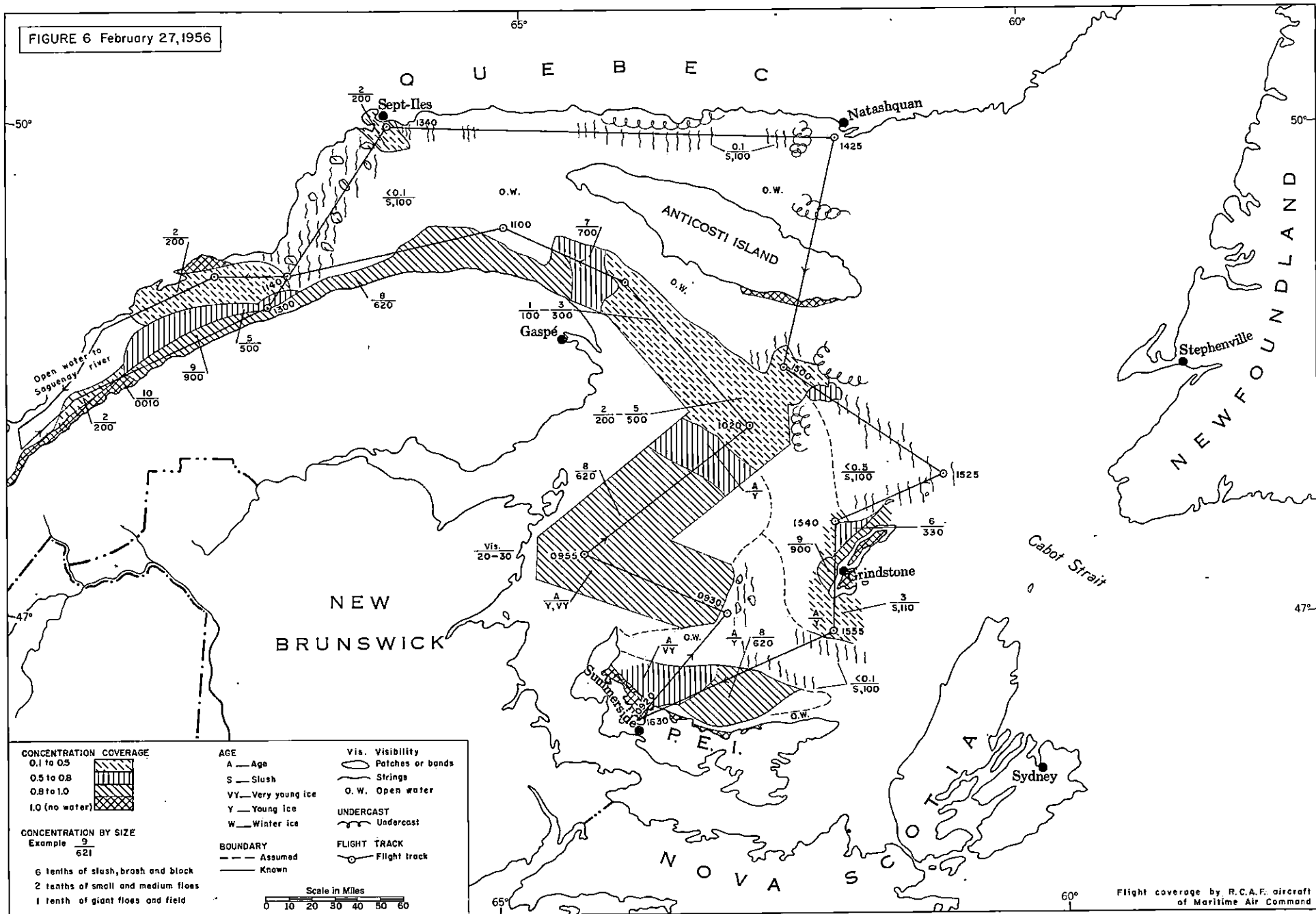


Figure 7 (February 29/56)

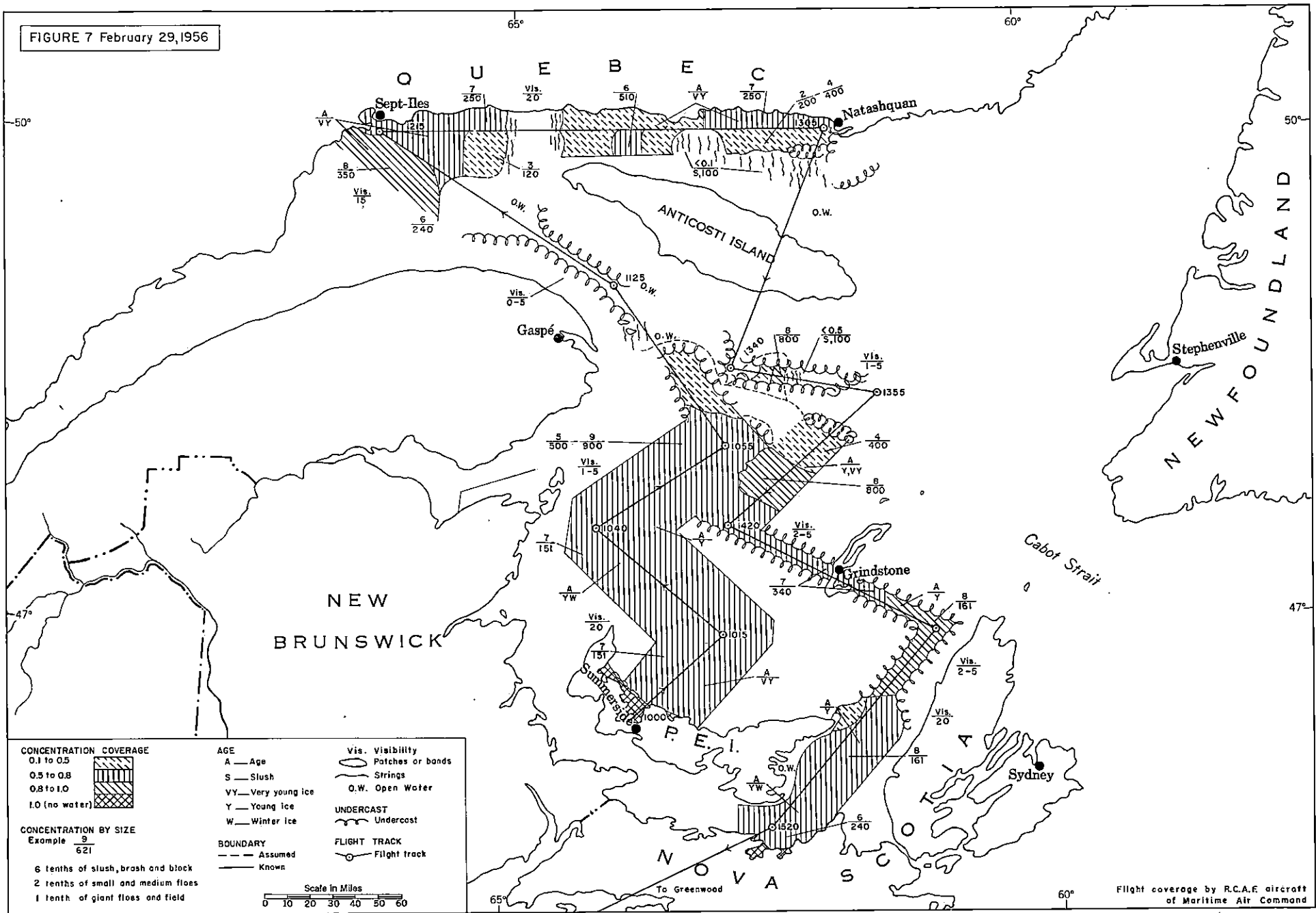
Variation from previous reconnaissance. In comparison with the two previous flights, ice of concentrations 5/10 to 8/10, and from 8/10 to 10/10 now extended eastward over the central part of the gulf. Concentrations of 1/10 to 5/10 appeared to be limited to the northern part of this area. The strings of brash that were encountered on the flight of February 27 on the northern shore of the gulf were largely replaced by an extensive ice coverage.

Ice distribution. Landfast ice was limited to the bays. Ice concentrations of 5/10 to 8/10, and from 8/10 to 10/10 occupied the central gulf area, the western part of the St. Lawrence estuary, the northeastern side of Jacques Cartier Passage, and the northeastern entrance to Northumberland Strait. Ice coverage of 1/10 to 5/10 was limited principally to the northern part of the gulf, and to the northern side of Jacques Cartier Passage. A small area of this concentration also occurred off East Point, Prince Edward Island. Strings and bands of slush and brash occurred locally along the flight track. Young ice was predominant throughout the entire area. Patches of winter ice were observed in the western part of the gulf and in the southeastern part of Northumberland Strait.

Open water. An important shore lead extended from Beaton Point to Bell Point at the eastern end of Prince Edward Island.

Weather conditions. In the central and northern parts of the gulf effective reconnaissance was considerably reduced by undercast and snow squalls. Winds were from the west.

FIGURE 7 February 29, 1956



Flight coverage by R.C.A.F. aircraft of Maritime Air Command

Figure 8 (March 2/56)

Variation from previous reconnaissance. The most important change noted in the distribution of ice during this flight was the extension of 8/10 to 10/10 ice coverage eastward from the previous limits to Cabot Strait. The area and concentration of ice had been reduced considerably in the St. Lawrence estuary and Jacques Cartier Passage.

Ice distribution. Landfast ice was limited to the bays. Ice from 8/10 to 10/10 covered the southern half of the gulf including the northern part of Northumberland Strait. Concentrations of 5/10 to 8/10 occupied the west-central part of the gulf, two areas in the St. Lawrence estuary, and a wedge in the entrance to Cabot Strait. Areas of 1/10 to 5/10 coverage occurred in the north-central part of the gulf and the western part of the estuary. Strings and bands of slush and brash lay along the track off the north shore of the gulf. Although the ice surface consisted chiefly of young ice, patches of winter ice were observed in the area off Cape Breton.

Open water. Major shore leads paralleled the Nova Scotia coast from Cape North to Cape Susan, and from Cape George to Richibucto Bay, and along the northwestern shore of the St. Lawrence estuary.

Weather conditions. Visibility was reduced to 15 miles or less in the western and northern parts of the flight track and undercast occurred frequently. Winds were southerly in the southern part of the gulf and northwesterly in the northern part.

FIGURE 8 March 2, 1956

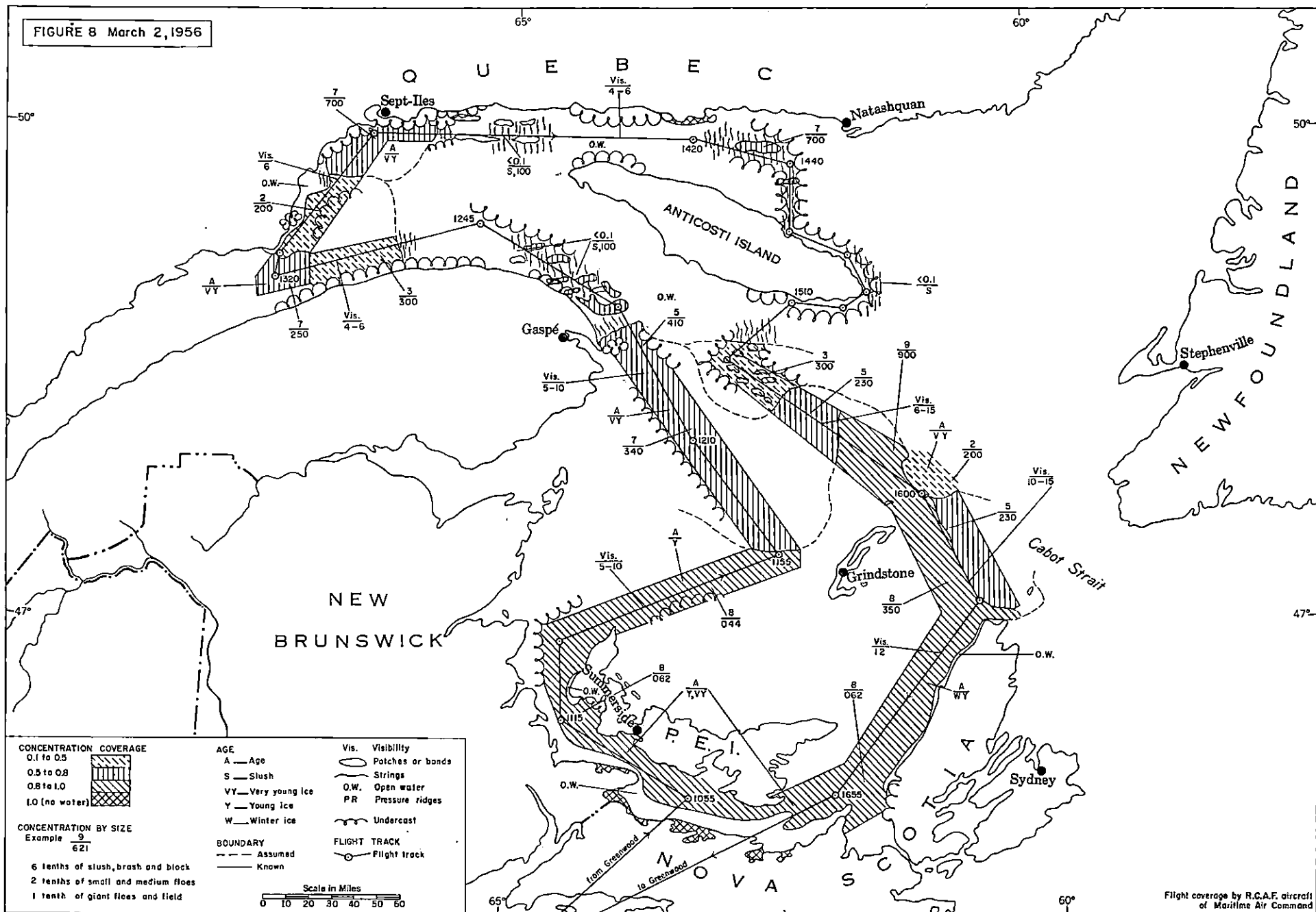


Figure 9 (March 4/56)

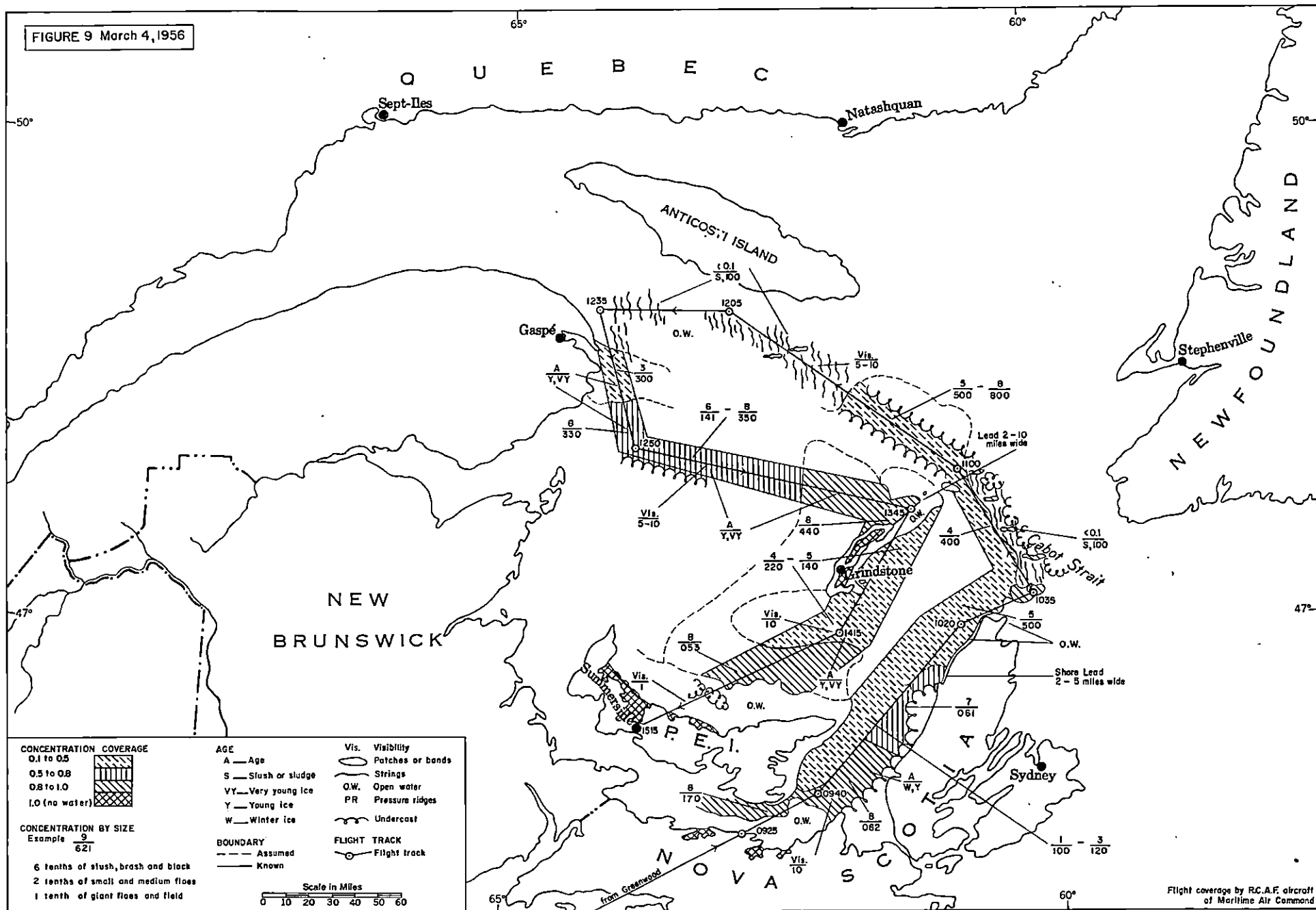
Variation from previous reconnaissance. The main change in the ice pattern was the dominance of 1/10 to 5/10 ice coverage in the east-central part of the gulf, a reduction in concentration from the previous flight.

Ice distribution. Landfast ice was limited to the bays. Ice concentrations of 8/10 to 10/10 were distributed erratically throughout the gulf. Areas occupied were the southeastern part of Northumberland Strait and the central part of the gulf west of the Magdalen Islands. Concentrations of 5/10 to 8/10 covered much of the western part of the gulf, and a large area off the Cape Breton coast. Concentrations of 1/10 to 5/10 lay east and north of this area, and probably extended to the Gaspé coast. Strings and bands of brash occurred principally south of Anticosti Island and towards the entrance to Cabot Strait. Young ice was predominant in the ice-covered area; winter ice occurred as landfast ice in the harbours or as patches at the eastern entrance to Northumberland Strait.

Open water. Shore leads paralleled the Cape Breton coast and the east coast of Magdalen Islands. The southern part of Northumberland Strait was free from ice. Open water extended around the north and east coasts of Prince Edward Island.

Weather conditions. Visibility of 6 to 15 miles reduced the effectiveness of the reconnaissance over much of the area. Undercast was prevalent over the eastern part of the track. Winds were southerly in the southern part of the gulf and northwesterly at the entrance to the estuary.

FIGURE 9 March 4, 1956



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 $\frac{9}{621}$
- 6 tenths of slush, brash and black
 - 2 tenths of small and medium floes
 - 1 tenth of giant floes and field

AGE

- A — Age
- S — Slush or sludge
- VY — Very young ice
- Y — Young ice
- W — Winter ice

BOUNDARY

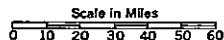
- Assumed
- Known

Vis. Visibility

- Patches or bands
- Strings
- O.W. Open water
- PR Pressure ridges
- Undercoast

FLIGHT TRACK

- Flight track



Flight coverage by R.C.A.F. aircraft of Maritime Air Command

Figure 10 (March 6/56)

Variation from previous reconnaissance. The main change in the pattern of ice coverage from the previous flight was the consolidation of 1/10 to 5/10 coverage to 5/10 to 8/10 coverage in the southern part of the gulf. As on the March 4 flight, open water extended entirely around the north and east coasts of Prince Edward Island. In the north-eastern arm of the gulf and in the Strait of Belle Isle the ice area had extended considerably from that observed on the previous reconnaissance made to the Strait of Belle Isle on February 18.

Ice distribution. Landfast ice was limited to bays and harbours. Concentrations of 8/10 to 10/10 occupied the southeastern part of Northumberland Strait, the vicinity of Brion and Magdalen Islands, and the north shore of the gulf from St. Augustine to Belle Isle. Areas of ice with concentrations of 5/10 to 8/10 included a broad area that extended westward from Cape Breton Island, the northeast arm of the gulf, and the south shore of the Strait of Belle Isle. Areas of 1/10 to 5/10 concentration lay in the vicinity of St. Paul Island and Bird Rocks, to the south of Cape Whittle, and from Belle Isle to Cape Bauld. Strings and bands of slush and brash occurred locally along the flight track. Young ice was predominant throughout the ice area. Patches of winter ice occurred in the southeastern part of Northumberland Strait and on the southern side of the Strait of Belle Isle. In the same area there were growlers and a few scattered bergs.

Open water. Open water areas bordered the north and east coasts of Prince Edward Island, the south coast of Northumberland Strait, and Pistolet Bay.

Weather conditions. Visibility varied from 5 to 25 miles. Undercast restricted reconnaissance in the Belle Isle area. Winds were predominantly from a westerly to northwesterly quadrant.

FIGURE 10 March 6, 1956

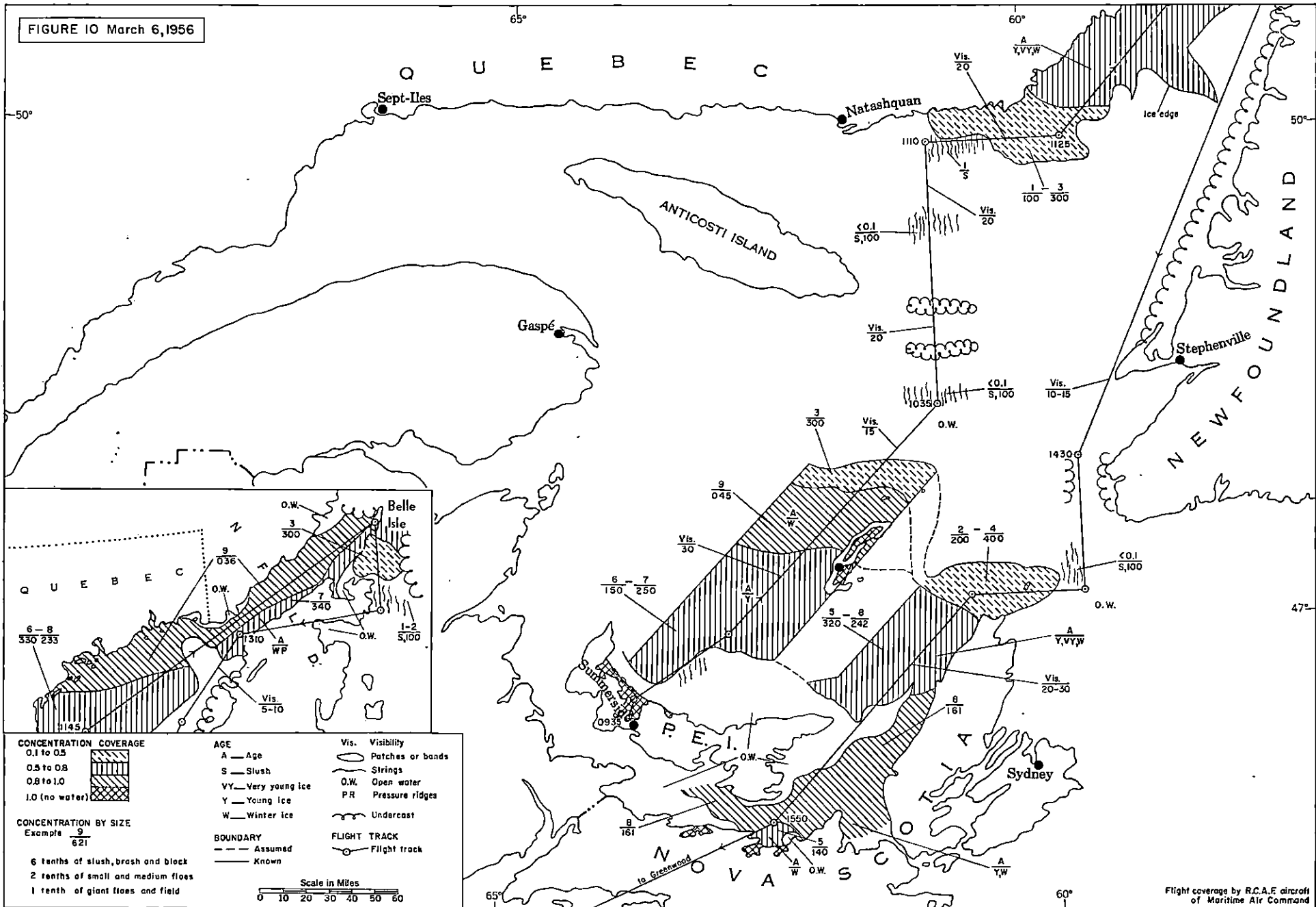
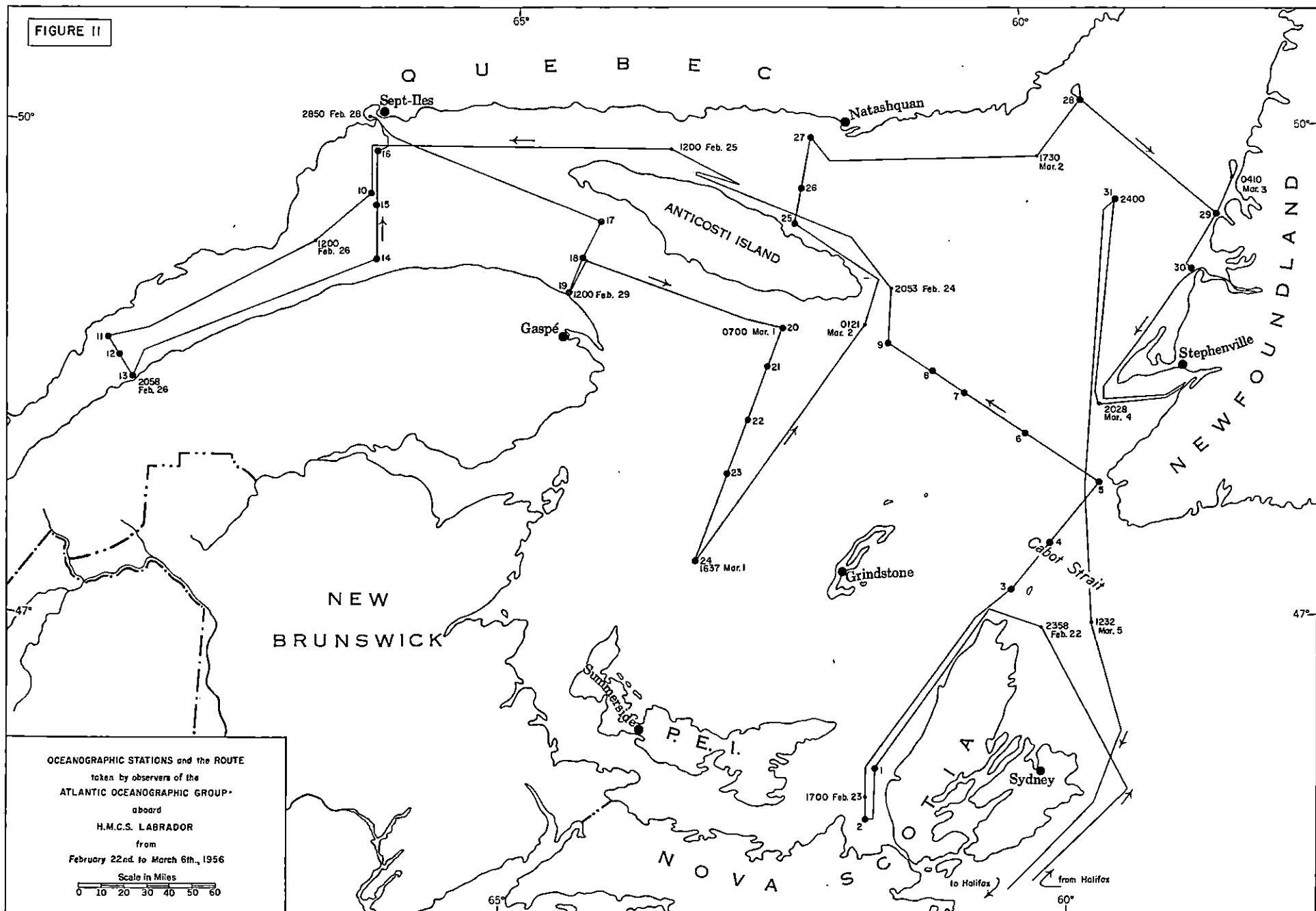


FIGURE II



OCEANOGRAPHIC STATIONS and the ROUTE
 taken by observers of the
 ATLANTIC OCEANOGRAPHIC GROUP
 aboard
 H.M.C.S. LABRADOR
 from
 February 22nd. to March 6th., 1956

Scale in Miles
 0 10 20 30 40 50 60