Homeland Security

United States Coast Guard

Report of the International Ice Patrol in the North Atlantic

2008 Season
Bulletin No. 94
CG-188-63

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Season of 2008

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Forwarded herewith is Bulletin No. 94 of the International Ice Patrol (IIP), describing the Patrol's services and ice conditions during the 2008 season. With 976 icebergs drifting into the transatlantic shipping lanes near the Grand Banks of Newfoundland over the course of the season, 2008 was our most active year in the last decade and our 14th busiest since the loss of RMS *Titanic* in 1912. Their wide geographic distribution, not only as generally expected to the south and east, but also to the west, made for a unique season.

For the first time in history, the International Ice Patrol conducted a memorial ceremony for the victims of the RMS *Titanic* at the Fairview Lawn Cemetery in Halifax, Nova Scotia on April 15th. This event was a highlight of a season that was marked by significant media interest due to the large number of icebergs posing a threat to mariners.

While managing the significant iceberg threat and media interest, Ice Patrol also investigated the feasibility of alternative methods of conducting ice reconnaissance, including conducting an operational test of satellite reconnaissance data and performing a study on the suitability of commercial reconnaissance.

On behalf of all of the dedicated women and men of the International Ice Patrol, I hope that you enjoy reading this report on the 2008 season.

S. D. Rogerson
Commander, U.S. Coast Guard
Commander, International Ice Patrol

International Ice Patrol
2008 Annual Report

Contents

Cover photograph: 2008 HC-130 Operational Test and Evaluation in Goose Bay, NL

Abbreviations and Acronyms

AOR	Area of Responsibility
BAPS	iceBerg Analysis and Prediction System
CALIB	Compact Air Launched Ice Beacon
CAMSLANT	Communications Area Master Station atLANTic
CCG	Canadian Coast Guard
CIS	Canadian Ice Service
CWAS	USCG Air Station Clearwater, FL
DDH	callsign for Hamburg Germany
DDK	callsign for Pinneberg Germany
ECAS	USCG Air Station Elizabeth City, NC
FLAR	Forward-Looking Airborne Radar
GMES	Global Monitoring for Environment and Security
HF	High Frequency
HMCS	Her Majesty's Canadian Ship
IIP	International Ice Patrol
INMARSAT	INternational MARitime SATellite (also Inmarsat)
IRD	Ice Reconnaissance Detachment
KT	Knot
LAKI	Limit of All Known Ice
M	Meter
MB	Millibar
MCTS	Marine Communications and Traffic Service
M/V	Motor Vessel
NAIS	North American Ice Service
NAO	North Atlantic Oscillation
NIC	National Ice Center
NIK	callsign for CAMSLANT
NM	Nautical Mile
NMF	callsign for USCG Communications Station Boston
NTIS	National Technical Information Service
NWS	National Weather Service
PAL	Provincial Aerospace Limited
RADAR	RAdio Detection And Ranging (also radar)
RMS	Royal Mail Steamer
SOLAS	Safety Of Life At Sea
SLAR	Side-Looking Airborne Radar
VON	callsign for MCTS St. John's
WOCE	World Ocean Circulation Experiment

Introduction

This is the 94th annual report of the International Ice Patrol (IIP), which is under the operational control of Commander, U.S. Coast Guard Atlantic Area. The report contains information on IIP operations, environmental conditions, and iceberg conditions in the North Atlantic during 2008. The U.S. Coast Guard International Ice Patrol was formed soon after RMS *Titanic* sank on 15 April 1912. Since 1913, except for periods of World War, IIP has been monitoring iceberg danger on and near the Grand Banks of Newfoundland and broadcasting the Limit of All Known Ice (LAKI) to mariners. The activities and responsibilities of IIP are delineated in U.S. Code, Title 46, Section 738, and the International Convention for the Safety of Life at Sea (SOLAS), 1974 under 17 signatory nations.

The International Ice Patrol conducted aerial reconnaissance from St. John's, Newfoundland, to search for icebergs in the southeastern, southern, and southwestern regions of the Grand Banks. In addition to IIP reconnaissance data, Ice Patrol received iceberg reports from other aircraft and mariners in the North Atlantic. At the Operations Center in Groton, Connecticut, personnel analyzed iceberg and environmental data and used the iceBerg Analysis and Prediction System (BAPS) computer model to predict iceberg drift and deterioration. Based on the model's prediction, IIP produced ice warnings, including the weekly/daily chart and text bulletin. In addition to these routine broadcasts, IIP responded to individual requests for iceberg information.

VADM D. Brian Peterman was Commander, U.S. Coast Guard Atlantic Area until 10 July 2008, when he was relieved by VADM Robert J. Papp, Jr. CDR Scott D. Rogerson was Commander, International Ice Patrol for the entire season.

For more information about the International Ice Patrol, including historical and current ice charts and bulletins, visit our website at www.uscg-iip.org.

Summary of Operations

IIP monitors iceberg danger near the Grand Banks of Newfoundland from 15 February to 01 July as mandated by SOLAS. This period is regarded as the Ice Season. The Grand Banks are normally free of icebergs from August through January. Although the Ice Season normally extends from February through July, IIP reporting services will commence whenever iceberg populations pose a threat to the primary shipping routes between Europe and North America and will continue until the threat has passed. Unless the iceberg population requires daily warnings to mariners earlier in the year, beginning on the first Friday following February 15th, Ice Patrol transmits an ice chart and text bulletin depicting the iceberg distribution. These products, known as "weekly products," are transmitted each Friday until ice conditions are severe enough to necessitate transmission of daily products or until the end of the Ice Season.

In 2008, IIP actively monitored the iceberg danger to transatlantic shipping in its Area of Responsibility (AOR), defined as the region bounded by 40°N, 50°N, 39°W, and 57°W (**Figure 1**).

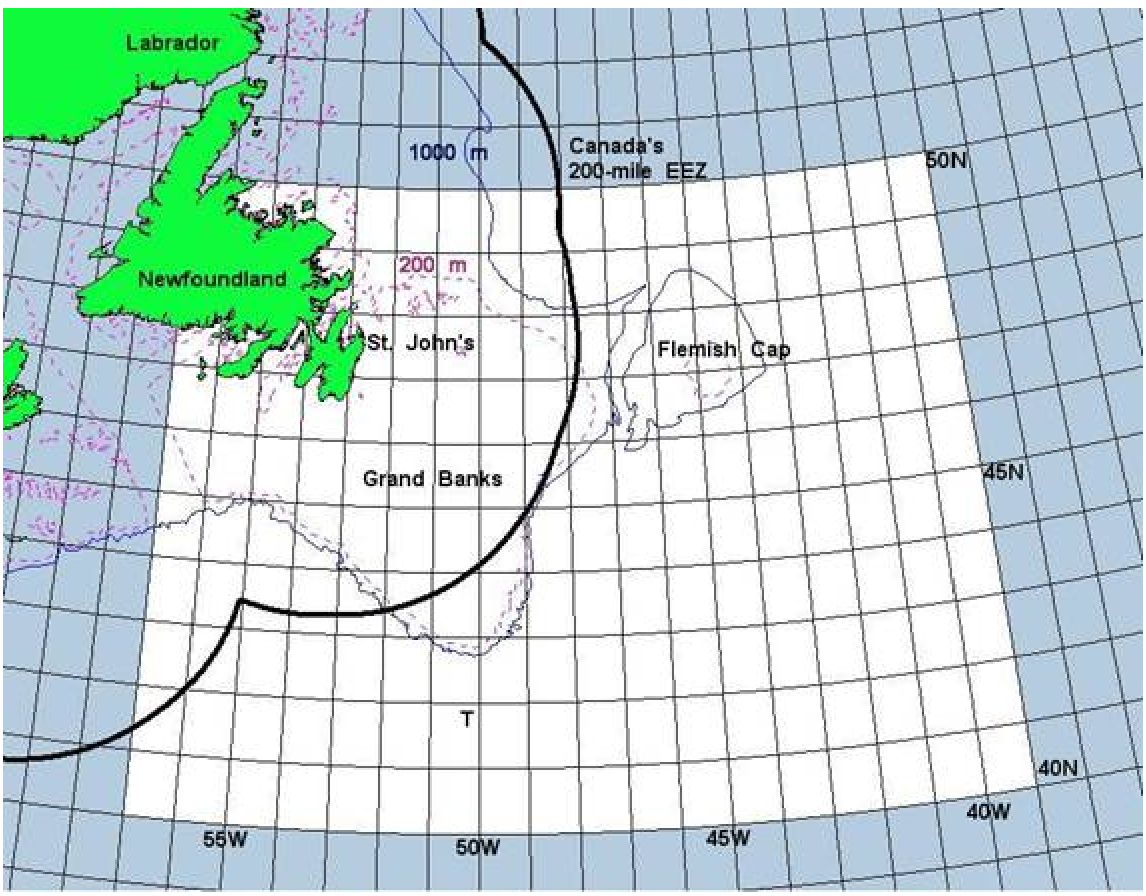

Figure 1. IIP's operating area. T indicates the location of *Titanic*'s sinking.

IIP opened the season and began issuing weekly products on Friday, 15 February. Ice conditions were light throughout February and most of March. However, by late March, a significant iceberg distribution was tracked south of 48°N, the latitude that marks the nominal northern extent of the trans-Atlantic shipping lanes, prompting the transition to daily products on 28 March. IIP's ice warnings were distributed daily until 15 July, the final day of the 2008 Ice Season.

During the 2008 Ice Year, the period from 01 October 2007 to 30 September 2008, IIP's Operations Center in Groton, Connecticut received, analyzed, and processed 1,860 information reports concerning oceanographic, atmospheric, and/or ice conditions throughout IIP's AOR. These reports were generated by various land, sea, air, and space platforms including: lighthouses along the Newfoundland coast, merchant and Canadian Coast Guard vessels operating within or near the Grand Banks of Newfoundland, IIP reconnaissance flights, commercial aerial reconnaissance flights contracted by the Canadian Ice Service (CIS) and provided by Provincial Aerospace Limited (PAL), and satellite data processed by the National Ice Center (NIC) and C-CORE, a commercial satellite reconnaissance provider located in St. John's, NL.

Of the 1,860 information reports received by IIP, 400 reports relayed ice information identifying 7,758 individual objects, including icebergs, growlers, and stationary radar targets. Even though 7,758 individual objects were reported to IIP, only 4,696 objects were merged by IIP to the iceberg drift and deterioration model known as BAPS. The disparity between the number of reported and merged objects illustrates two important points regarding IIP operations. First, each ice information report is judged against several factors concerning accuracy and timeliness to ensure that only the most reliable information is used to generate IIP products. In 2008, IIP did not merge 1,319 objects, based on these criteria. In addition, IIP is not the only organization making adjustments in BAPS. IIP maintains a strong partnership with CIS, and both organizations utilize the same, shared iceberg database in BAPS. Under current agreements, CIS merges any icebergs or radar targets detected north of 50°N and/or west of 55°W, and IIP merges targets south of 50°N and/or east of 55°W. During 2008, CIS merged 1,743 icebergs, bergy bits, growlers, and radar targets to BAPS.

In total, there were 6,439 objects merged to BAPS by IIP and CIS throughout the 2008 Ice Year, representing 2,693 distinct icebergs, bergy bits, growlers, and radar targets. Of these 2,693 objects, approximately 1,322 distinct objects were sighted, detected, or predicted to have drifted into IIP's AOR.

Information Reports

A critical factor contributing to IIP's successful history is the support received from the maritime community. This influence is measured by the sheer volume of voluntary information reports IIP receives from merchant vessels each year. These reports are sent in response to a long-standing IIP request for weather conditions, sea surface temperatures, and ice sightings from any vessel transiting within or near the Grand Banks of Newfoundland. Receiving on scene and up-to-date information helps ensure the accuracy of IIP products. All ships that provided reports including weather, sea surface temperature, ice, and/or stationary radar target reports during the 2008 ice season are listed in **Appendix B**.

Although the majority of reports were received from merchant vessels, IIP received valuable information from several other sources as well. **Figure 2** provides the breakdown of the sources for all information reports received during the 2008 Ice Year. After merchant vessels, the next greatest source of information reports were from commercial reconnaissance, which includes PAL and C-CORE. Commercial reconnaissance provided 153 reports, accounting for 8% of the total reports.

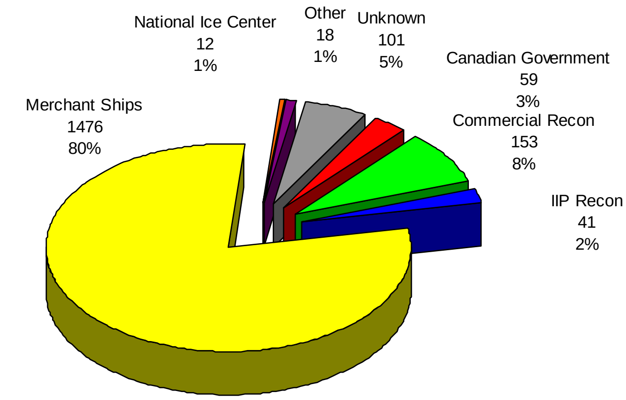

Figure 2. Reporting sources for the 1860 information reports received at IIP in 2008. Information reports include ice, sea surface temperature, and weather reports.

Ice Reports

In 2008, 400 of the 1,860 information reports received by IIP contained data on icebergs or stationary radar targets. Commercial reconnaissance accounted for the largest percentage of ice reports at 37%. Merchant ships reported the second largest fraction at 34%, and the Canadian Government followed with 14%. IIP aerial reconnaissance provided 10%, and various other sources, including NIC, combined to relay the remaining 5% of iceberg reports (**Figure 3**).

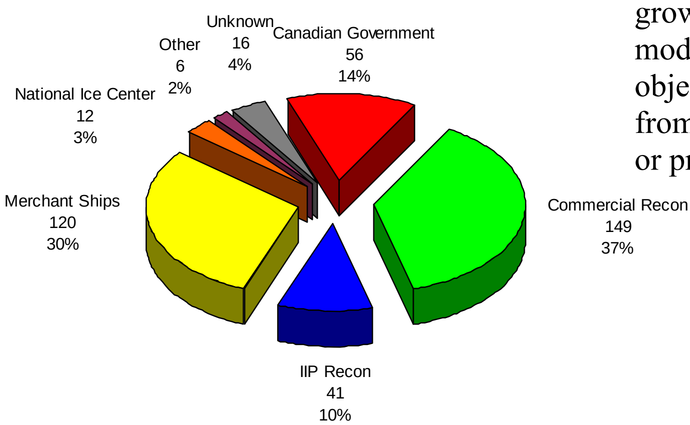

Figure 3. Reporting sources for the 400 iceberg reports received during the 2008 Ice Season. Ice reports include individual iceberg sightings and stationary radar target information.

Figure 4 shows the distribution for all 7,758 ice related reports made to IIP for the 2008 Ice Year. These reports include not only icebergs, but also bergy bits, growlers, and stationary radar targets. These reports are evaluated for accuracy to determine whether to merge the information into BAPS.

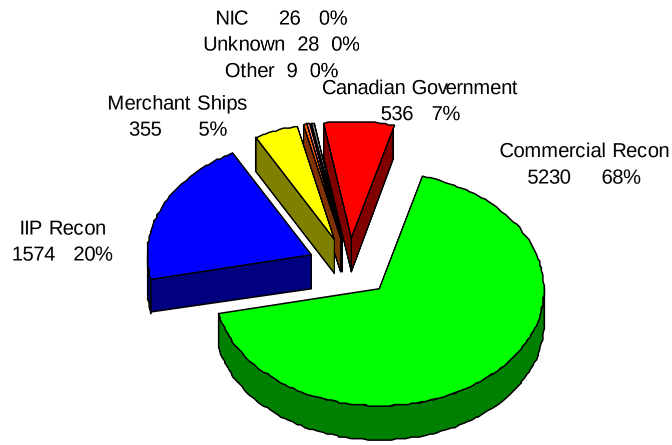

Figure 4. Number of ice observations by reporting source. Ice reports include icebergs, bergy bits, growlers, and stationary radar targets.

Merged Targets

Throughout the 2008 Ice Year, there were 6,439 updates to BAPS. This number includes additions of new objects (icebergs, growlers and stationary radar targets) to the model, resighting new observations to existing objects in the model, and deletions of objects from the model based on recent reconnaissance or predicted deterioration (**Figure 5**).

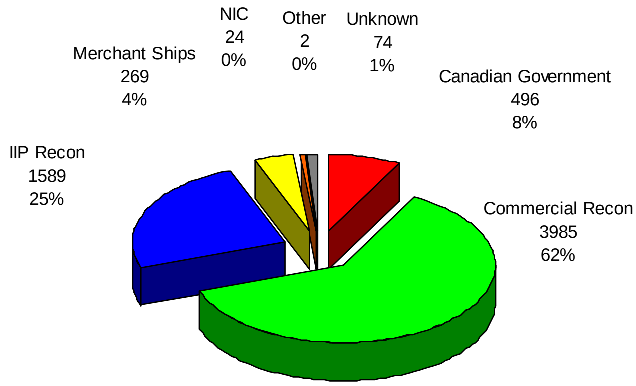

Figure 5. Distribution of reporting sources for all ice reports incorporated into BAPS for the 2008 Ice Year.

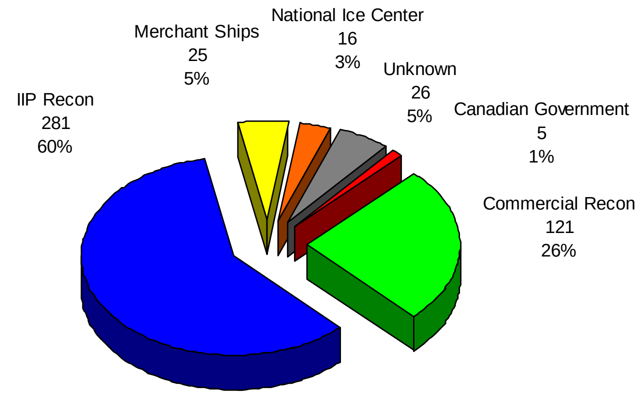

Figure 6. Sources of LAKI iceberg sightings/detections.

Commercial reconnaissance had the largest role, accounting for 62% of the updates to BAPS. Rounding out the largest shares, IIP reconnaissance flights and the various platforms representing the Canadian Government accounted for 25% and 8% of the updates to the iceberg drift and deterioration model, respectively.

LAKI Iceberg Sightings

In order to meet SOLAS mandates, IIP develops a Limit of All Known Ice (LAKI) in order to inform mariners of the southern, eastern, southeastern, and southwestern limit of the iceberg population. During the 2008 Ice Season, IIP began creating and distributing the LAKI with the commencement of daily products on 28 March. On this date, IIP was tracking nine icebergs south of 48°N. The icebergs used to the set the LAKI are of critical importance because they define the boundary for ice-free ship navigation, and as a result, the majority of IIP's reconnaissance missions focus on this boundary. In 2008, IIP flights accounted for 60% of all LAKI iceberg sightings or detections (**Figure 6**).

Products and Broadcasts

IIP issued weekly ice warnings, including the ice chart and text bulletin, each Friday from 15 February to 21 March stating that IIP was monitoring iceberg conditions, but was not yet issuing daily products. The weekly ice chart also illustrated the current iceberg population. The transition to daily products occurred on 28 March when the iceberg population threatened the trans-Atlantic shipping lanes. Daily products containing LAKI data valid for 1200Z, as well as sea-ice, iceberg distribution, and radar target information continued until the season was closed on 15 July.

In 2008, IIP transmitted 110 scheduled ice bulletins and nine revised bulletins via SafetyNET. All scheduled bulletins reached SafetyNET on time. The on-time delivery percentage for Ice Charts was 98%, as seven ice charts were not broadcast at the scheduled time, with the correct information, and/or in their entirety.

Detailed information concerning product format and distribution methods can be found in IIP's annual Announcement of Services, in Publication 117, and on the IIP website.

Safety Broadcasts

Any report of an iceberg or stationary radar target near or beyond the published LAKI challenges the accuracy of IIP products and is a potential threat to safe navigation. When IIP receives such a report, IIP transmits an unscheduled safety broadcast to mariners to report the location and the type of target detected. During the 2008 Ice Season, IIP sent nine unscheduled safety broadcasts for four icebergs and three radar targets outside the LAKI and one iceberg and one radar target dangerously close to, but within, the LAKI.

The information published in IIP's ice chart and bulletin is intended to be valid for a 24 hour period, defined as 1200Z of the current day through 1200Z the following day. Ice reports requiring a safety broadcast also have the potential to impact IIP's published products. If there is at least two hours until the release of the following day's products, IIP's current products will be revised and retransmitted.

All nine reports requiring a safety broadcast during the 2008 Ice Season required a revision of the ice chart and bulletin. Five of those revisions also required a change to the LAKI. As a result of these revisions, the accuracy of IIP's products fell to 92%, while LAKI accuracy was 96% (**Figure 7**).

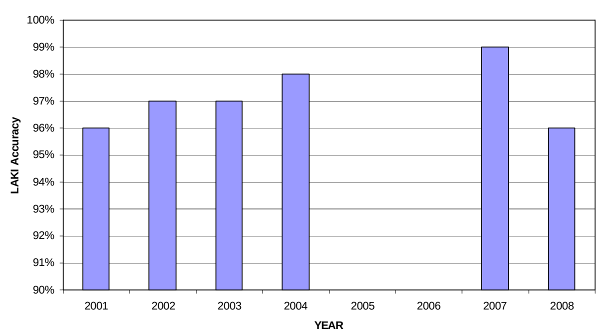

Figure 7. Recent historical distribution of LAKI accuracy as measured by the number of revisions to the LAKI based on icebergs reported outside the limit. (Note: No LAKI was produced in 2005 and 2006 due to extremely light ice conditions during those ice seasons.)

Historical Perspective

To determine the severity of an ice season, IIP uses two different measurements. The first is season length, measured in the number of days when daily products were issued. The second measurement is the number of icebergs crossing south of 48°N. This number includes icebergs that were initially detected south of 48°N and those which were originally sighted further north and drifted south of that latitude according to BAPS.

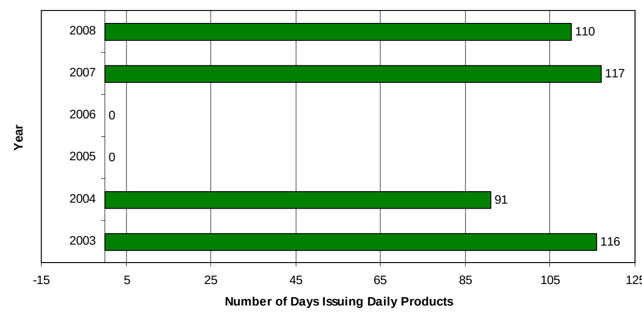

Figure 8. Recent historical length of season as measured by number of days IIP issued daily products. (Note: Due to extremely light ice conditions, no daily products were transmitted in 2005 and 2006.)

The 2008 Ice Season lasted 110 days with 976 icebergs sighted, detected, or predicted to have drifted south of 48°N (**Figure 8**). The season length falls into the lowest third percentile when compared to the last 25 years (1983-2008), the timeframe encompassing IIP's modern reconnaissance era (**Figure 9**).

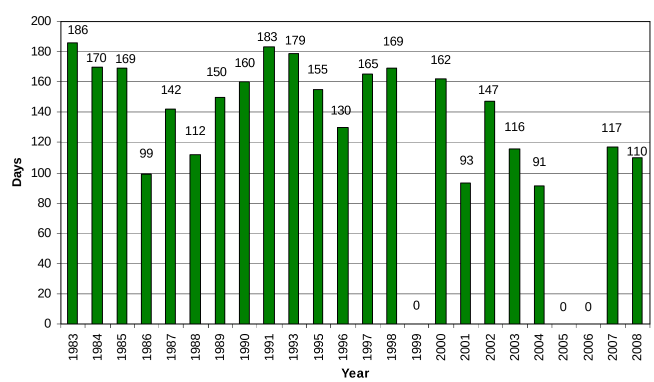

Figure 9. Length of Ice Seasons from 1983-2008 as measured by the number of daily products issued by IIP.

However, the 2008 Ice Season climbed into the top ten most severe when judged against iceberg populations south of 48°N (**Table 1**).

Rank	Year	Bergs South of 48°N
1	1984	2022
2	1991	1976
3	1994	1765
4	1993	1753
5	1995	1432
6	1998	1380
7	1983	1352
8	1985	1063
9	1997	1011
10	2008	976

Table 1. Ranking of most severe ice seasons based on cumulative number of icebergs south of 48°N for the past 25 years (1983-2008).

The total number of icebergs detected during the 2008 Ice Season was slightly higher than the modern seasonal average (1983-2007) of 823 icebergs (**Figure 10**). However, the 976 icebergs detected or drifted south of 48°N in 2008 was more than twice the seasonal average (1900-2007) of 472 icebergs measured against iceberg records dating back to 1900.

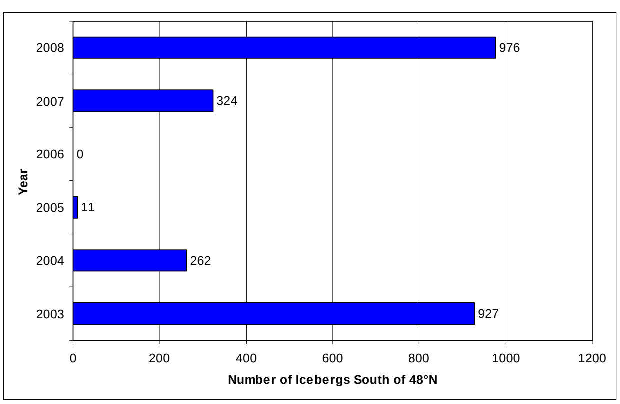

Figure 10. Recent historical distribution of the number of icebergs detected south of 48°N.

Canadian Support

As they do every year, the Canadian Government generously supported IIP during 2008. CIS shared its valuable reconnaissance data and ice expertise with IIP. The synchronized iceberg modeling database, now in its third year of operation, ensured that all ice information received by IIP or CIS was quickly merged and accurately reflected on ice products.

IIP also appreciated the critical support from PAL and C-CORE who supplied valuable ice observation data throughout the 2008 season. **Figure 11** shows the number of information reports provided by C-CORE, PAL, and members of the Canadian Government, including icebreakers and lighthouses. This season marked the first time that IIP entered targets provided by C-CORE into BAPS operationally, thus providing valuable insight and feedback into the satellite reconnaissance program.

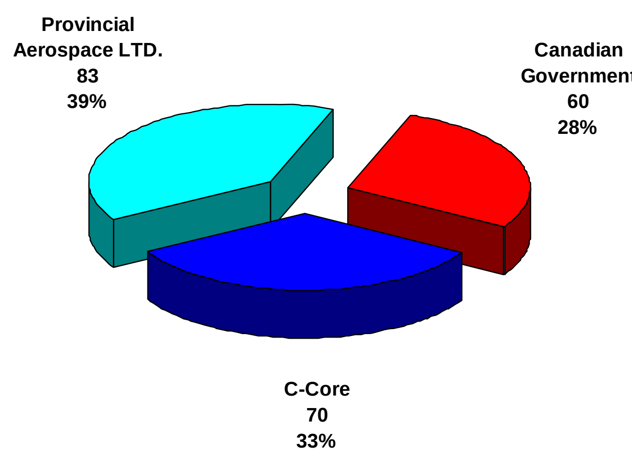

Figure 11. Distribution information reports provided by Canadian reporting sources for the 2008 Ice Season.

Iceberg Reconnaissance and Oceanographic Operations

Ice Reconnaissance Detachment (IRD)

The Ice Reconnaissance Detachment (IRD) is a sub-unit under Commander, International Ice Patrol (CIIP) partnered with Coast Guard Air Station Elizabeth City (ECAS).

During the 2008 Ice Season, twelve IRDs deployed to observe and report icebergs, sea-ice, and oceanographic conditions on and near the Grand Banks of Newfoundland. All observations were transmitted to the IIP Operations Center (OPCEN) where they were entered into BAPS, processed, and distributed (as described in Summary of Operations chapter) to mariners operating in IIP's AOR. This information was also used for oceanographic research.

The pre-season IRD departed on 05 February to conduct official meetings with IIP partners in Elizabeth City, NC and St. John's, NL and to determine the early season iceberg distribution. The detection of a light iceberg distribution during the pre-season IRD resulted in the cancellation of IRD1. The remaining IRDs were conducted as scheduled with the exception of IRDs 12-14 which were cancelled due to a light iceberg distribution at the end of the season. The post-season IRD was completed on 31 July concluding 2008 IIP deployments to St. John's, NL.

Throughout the 2008 Ice Season, IIP operated out of its forward operating base in St. John's, NL for a total of 99 days and completed 37 iceberg reconnaissance flights. A summary of 2008 IRD operations is provided in **Table 2**.

IRD	Deployed Days	Iceberg Patrols	Flight Hours
PRE	10	3	27
1	Cancelled		
2	9	3	31.5
3	8	3	43
4	11	3	39.1
5	11	4	51
6	8	5	42.9
7	9	2	42.3
8	9	6	48
9	9	3	30.1
10	7	2	26.4
11	6	3	29.2
12	Cancelled		
13	Cancelled		
14	Cancelled		
POST	3	0	10.5
TOTAL	**99**	**37**	**421**

Table 2. 2008 IRD Summary. Flight hours include patrol, logistics and transit hours.

Aerial Iceberg Reconnaissance

Coast Guard aircraft provided the primary means of detecting icebergs in the vicinity of the Grand Banks in 2008. All 2008 aerial iceberg reconnaissance operations were conducted using HC-130H (1500 series) long-range reconnaissance aircraft equipped with the Motorola AN/APS-135 Side-Looking Airborne Radar (SLAR) and the Texas Instruments AN/APS-137 Forward-Looking Airborne Radar (FLAR) provided by ECAS. IIP began using the SLAR in 1983 and the FLAR in 1993. In 2000, the Maritime Surveillance System 5000 (MSS5000) was incorporated with the SLAR. An Automated Information System (AIS) receiver and display was added to the radar suite in 2006.

The SLAR-FLAR combination allowed IIP to use 30 nm track spacing to achieve 200% radar coverage on each patrol despite poor visibility **(Figure 12)**.

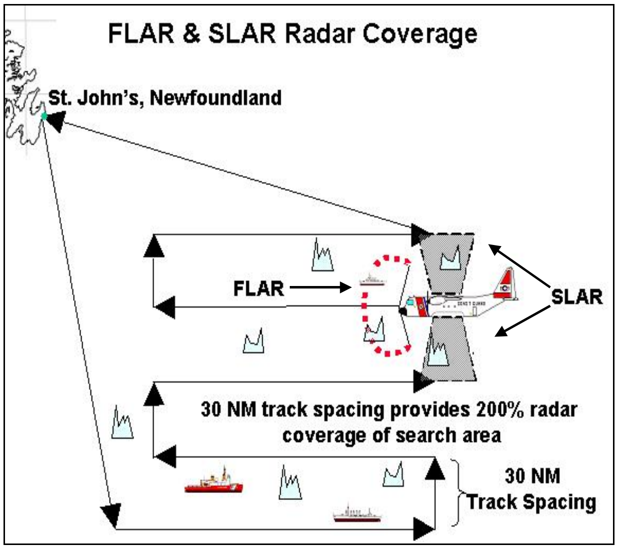

Figure 12. IIP Radar Reconnaissance Plan.

A detailed description of IIP's reconnaissance strategy is provided on IIP's web site at *http://www.uscg-iip.org* in the FAQ section.

Due to the consistently inclement environmental conditions and poor visibility in IIP's AOR, detecting and classifying targets is a perpetual challenge. It is for this reason that the SLAR-FLAR combination has become critical to IIP operations. IIP relies on the detection capability of the SLAR, and the classification capability of the FLAR as the primary means of conducting IIP iceberg reconnaissance. Although both the SLAR and FLAR provide clues to target classification, the FLAR's imaging capability is relied upon as the primary means of discriminating targets.

In 2008, IRDs detected a total of 1,528 icebergs. Radar alone (FLAR and/or SLAR; not seen visually) identified 46% (710) of the icebergs while the remaining 54% (818) were identified using a combination of visual and radar information or by visual means alone.

The Grand Banks are a productive fishing ground frequented by fishing vessels, ranging from 20 to over 70 meters in length. Determining whether an ambiguous radar contact is an iceberg or a vessel is particularly difficult with small targets. These contacts sometimes create similar radar returns and cannot easily be differentiated. Therefore, when a radar image does not present distinguishing features, IIP classifies the contact as a radar target (R/T).

Figure 13 displays the number and types of targets that IRDs detected during 2008.

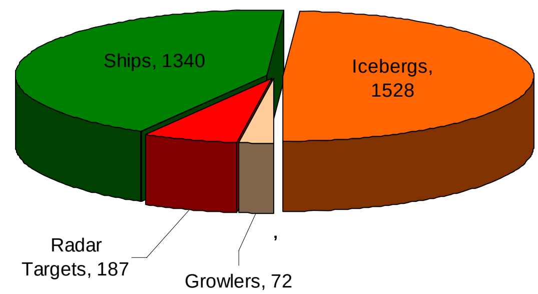

Figure 13. Breakdown of targets detected by IRDs in 2008.

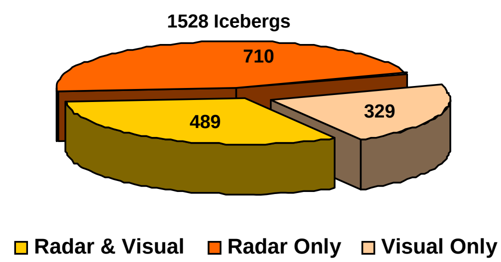

Figure 14. Breakdown of icebergs by detection source.

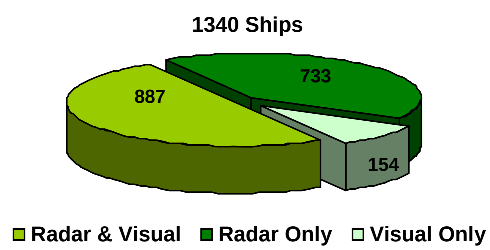

Figure 15. Breakdown of ships by detection source.

The Grand Banks region has been rapidly developed for its oil reserves since 1997. In November 1997, Hibernia, a gravity-based oil-production platform, was set in position approximately 150 nm offshore on the northeastern portion of the Grand Banks. In addition to Hibernia, other drilling facilities—including Glomar Grand Banks, Terra Nova, and Henry Goodrich—are routinely on the Grand Banks. Consequently, this escalated drilling has increased air and surface traffic in IIP's AOR, further complicating target identification. However, this difficulty is offset by the information reports this traffic provides. Reports from ships, aircraft, and drilling platforms greatly aid IIP in the creation of a LAKI that is as accurate and reliable as possible.

Radar Testing and Evaluation

IIP conducted testing of the HC-130J long-range reconnaissance aircraft equipped with EDO ELTA-2022 radar and additional testing of the HC-130H (1700 series) equipped with the SELEX Seaspray radar. Testing was conducted in coordination with ECAS and USCG Air Station Clearwater, FL (CWAS) to determine the suitability of these aircraft and radars for future IIP iceberg reconnaissance operations.

The additional testing of the SELEX Seaspray radar installed on the HC-130H long-range aircraft (CG-1711) was conducted during the pre-season IRD and IRD8. This testing resulted in five sorties flown by the CG-1711.

Table 3 provides a summary of 2008 SELEX test flights

Date	Aircraft	Sensor	Flight Hours
13 Feb 08	CG-1711	Selex Seaspray	7.7
03 Jun 08	CG-1711	Selex Seaspray	7.2
04 Jun 08	CG-1711	Selex Seaspray	8.1
05 Jun 08	CG-1711	Selex Seaspray	6.4
06 Jun 08	CG-1711	Selex Seaspray	5.1
TOTAL			**34.5**

Table 3. 2008 SELEX Test flight summary.

Several months after the 2008 Ice Season closed, initial testing of the HC-130J (CG-2006) long-range aircraft equipped with a mission system including the EDO Elta-2022 radar, electro optical infrared (EOIR) camera, and AIS was conducted, including comparative testing with the HC-130H (CG-1502) equipped with SLAR, FLAR and AIS. This testing resulted in four sorties flown by the CG-2006 and two sorties flown by the CG-1502 out of Goose Bay, NL in September 2008. Testing was conducted in Davis Strait near Iqaluit, Nunavut Territory and near the west coast of Greenland (**Figure 9**).

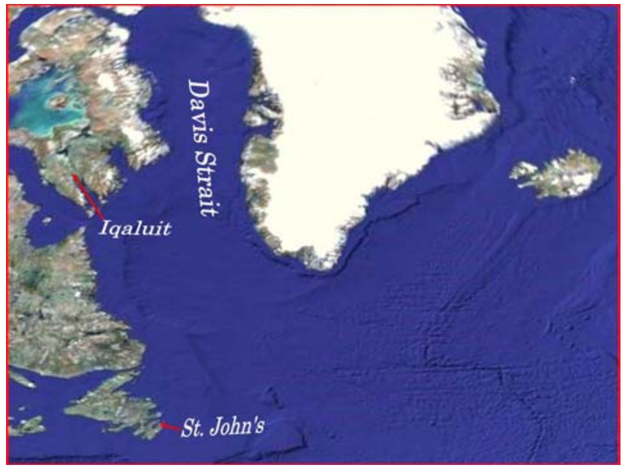

Figure 9. Graphic depiction of Davis Strait.

Table 4 provides a summary of 2008 ELTA test flights.

Date	Aircraft	Sensor	Flight Hours
23 Sep 08	CG-2006	Elta 2022	8.2
24 Sep 08	CG-2006	Elta 2022	8.1
26 Sep 08	CG-2006	Elta 2022	8.3
26 Sep 08	CG-1502	SLAR/FLAR	8.2
27 Sep 08	CG-2006	Elta 2022	8.5
27 Sep 08	CG-1502	SLAR/FLAR	8.8
TOTAL			**50.1**

Table 4. 2008 ELTA Test flight summary.

All testing was done in anticipation of integrating new long-range reconnaissance aircraft with new sensors into future IIP reconnaissance operations as the HC-130H (1500 series) aircraft with SLAR and FLAR are phased out of service. Coast Guard Headquarters CG-711 office is conducting an in depth analysis to determine the detection capability and suitability of both aircraft for future use in IIP reconnaissance operations. CG-711 will provide IIP a detailed report that will be included as an appendix to the 2009 IIP Annual Report. These aircraft and sensors may be used in the conduct of IIP reconnaissance operations as early at the 2009 Ice Season.

Commercial Reconnaissance Study

IIP initiated a commercial reconnaissance study in 2008 to determine the feasibility of using commercial reconnaissance aircraft to supplement future IIP reconnaissance operations and reduce IIP's dependence on USCG aircraft.

The study is focused on determining the capability and cost of using commercial reconnaissance aircraft to augment IIP reconnaissance during early, middle, and late season conditions, as well as comparing light, medium and severe Ice Seasons. Once complete, a detailed report will be provided to IIP by Potomac Management Group (PMG), the USCG Research and Development Center government contractor hired to conduct the study. This report will also be included as an appendix in the 2009 IIP Annual Report.

2008 Flight Hours

In addition to the 37 IRD sorties and eleven test sorties, 38 transit flights were conducted. **Figure 10** shows IIP's flight hours for 2008.

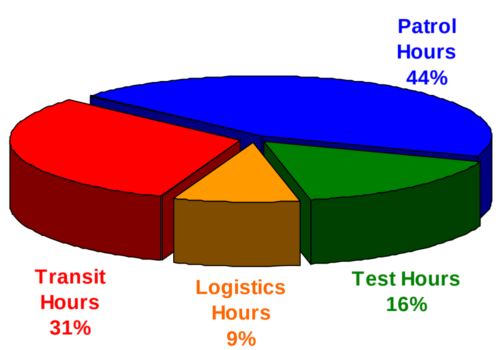

Figure 10. 2008 Flight Hours.

IIP used 528.3 flight hours during the 2008 Ice Season, representing a moderate increase from the last four years (**Figure 11**).

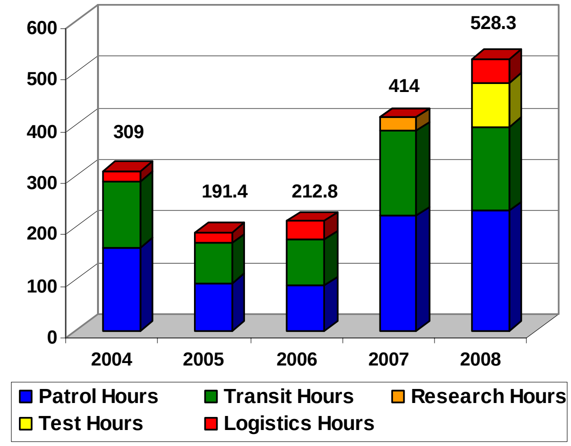

Figure 11. Summary of flight hours (2004-2008). (Note: Test hours indicates radar testing.)

Figure 12 compares flight hours with the number of icebergs south of 48°N since 1999.

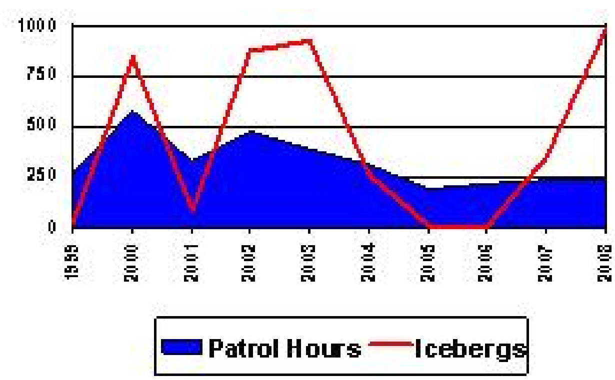

Figure 12. Flight hours versus icebergs south of 48°N (1999-2008).

Satellite Iceberg Reconnaissance

All 2008 satellite iceberg reconnaissance operations were conducted in cooperation with the U.S. National Ice Center (NIC) and USCG Intelligence Coordination Center (ICC), both located in Suitland, MD, and with C-CORE. C-CORE is affiliated with Memorial University in St. John's, NL and has been working in cooperation with IIP since 2003. A breakdown of targets detected by satellites is provided in **Table 5**.

	NIC	C-CORE
Radar Target (RT)	3	1
Growler	2	0
Small Iceberg	13	7
Medium Iceberg	6	30
Large Iceberg	0	18
Very Large Iceberg	2	14

Table 5. 2008 Satellite Iceberg Reports Merged into BAPS by IIP.

In 2008, IIP and NIC coordinated the development and implementation of a Standard Operating Procedure (SOP) for conducting satellite iceberg reconnaissance and ambiguous target identification. IIP intends to continue to work with C-CORE and other satellite providers in the development of reliable satellite reconnaissance capabilities.

Public Affairs

During the 2008 Ice Season, there was substantial media interest due to the large iceberg population. Pioneer Productions, a documentary crew, accompanied IIP on IRD5 to film footage of patrols and perform interviews for their documentary on the *Titanic*. CBC included IIP in three separate news spots, and IIP was featured in a broadcast on NPR for four minutes. The Newfoundland Independent and the Telegram, both newspapers in St. John's, NL, printed articles about IIP's mission. *The Day*, the local newspaper in New London, CT, printed 16 articles about IIP with 11 of them concerning the ice season and mission. In total in 2008, IIP managed a nearly overwhelming number of media inquiries, resulting in over 30 printed articles in the U.S. and Canada, six television and radio broadcasts, including CNN and NPR across the U.S. and German Television across Europe, and three documentaries that will air globally.

In addition, IIP conducted a memorial ceremony for the victims of the RMS *Titanic* at the Fairview Lawn Cemetery in Halifax, Nova Scotia on April 15th, 2008 (IRD5). The ceremony was the first of its kind in IIP history and included the blessing of 3 wreaths to be cast into the North Atlantic Ocean on the next reconnaissance patrol. In Fairview Lawn Cemetery, there are 121 victims from the sinking. Bouquets were also placed at the Mount Olivet Cemetery and the Baron De Hirsch Cemetery where additional victims are buried. Two local news crews from Halifax attended and reported on the ceremony.

Commemorative Wreath Deployments

IRDs air-deployed four wreaths in conjunction with regular ice reconnaissance operations in 2008. During IRD5, three wreaths commemorated the 96th anniversary of the sinking of the RMS *Titanic*, and one wreath commemorated the WWII Greenland Patrol during IRD9.

Environmental Conditions

Environmental conditions in IIP's AOR permitted adequate visibility for visual-only reconnaissance (≥10 nm) only 35% of the time during the 2008 Ice Season. Consequently, IIP relied heavily on the SLAR-FLAR combination to detect and classify targets in pervasive low-visibility conditions including low cloud decks and fog, minimizing the flight hours necessary to accurately monitor the iceberg population.

Oceanographic Operations

In 2008, IIP air-deployed two World Ocean Circulation Experiment (WOCE) drifting buoys from USCG HC-130H aircraft and coordinated the deployment of three WOCE drifting buoys from Canadian Coast Guard (CCG) vessels. These buoys were deployed on the Grand Banks of Newfoundland and in the offshore and inshore branches of the Labrador Current. The WOCE drifting buoys, with drogues centered at 15 or 50 meters, provided near real-time ocean current data that was used to modify the historical current database in BAPS. **Figure 13** shows 2004-2008 air and ship WOCE drifting buoy deployments.

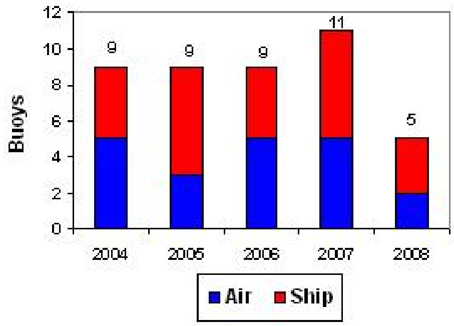

Figure 13. WOCE Drifter Deployments (2004-2008).

All five WOCE drifting buoys functioned properly and transmitted oceanographic data for varying durations, ranging from two to nine months and counting.

Air-deployed WOCE drifting buoys are purchased by IIP and prepared and deployed through cooperative efforts by IIP and ECAS personnel. Buoy deployments are conducted in conjunction with IRD iceberg reconnaissance operations when flying patrols near desired drop locations.

Ship-deployed WOCE drifting buoys are purchased and prepared by IIP personnel and deployed by vessels of opportunity, including CCG vessels operating out of St. John's, NL. As part of a volunteer operation, these vessels of opportunity deploy WOCE drifting buoys at locations requested by IIP. The ship deployments are done on a "not to interfere" basis and save IIP significant amounts of time and money while strengthening international partnerships. IIP continues to rely more on ship deployments. **Figure 15** depicts composite drift tracks for the WOCE drifting buoys deployed in 2008. Detailed WOCE drifter information is provided in IIP's *2008 WOCE Buoy Drift Track Atlas.* This atlas is available by request from IIP.

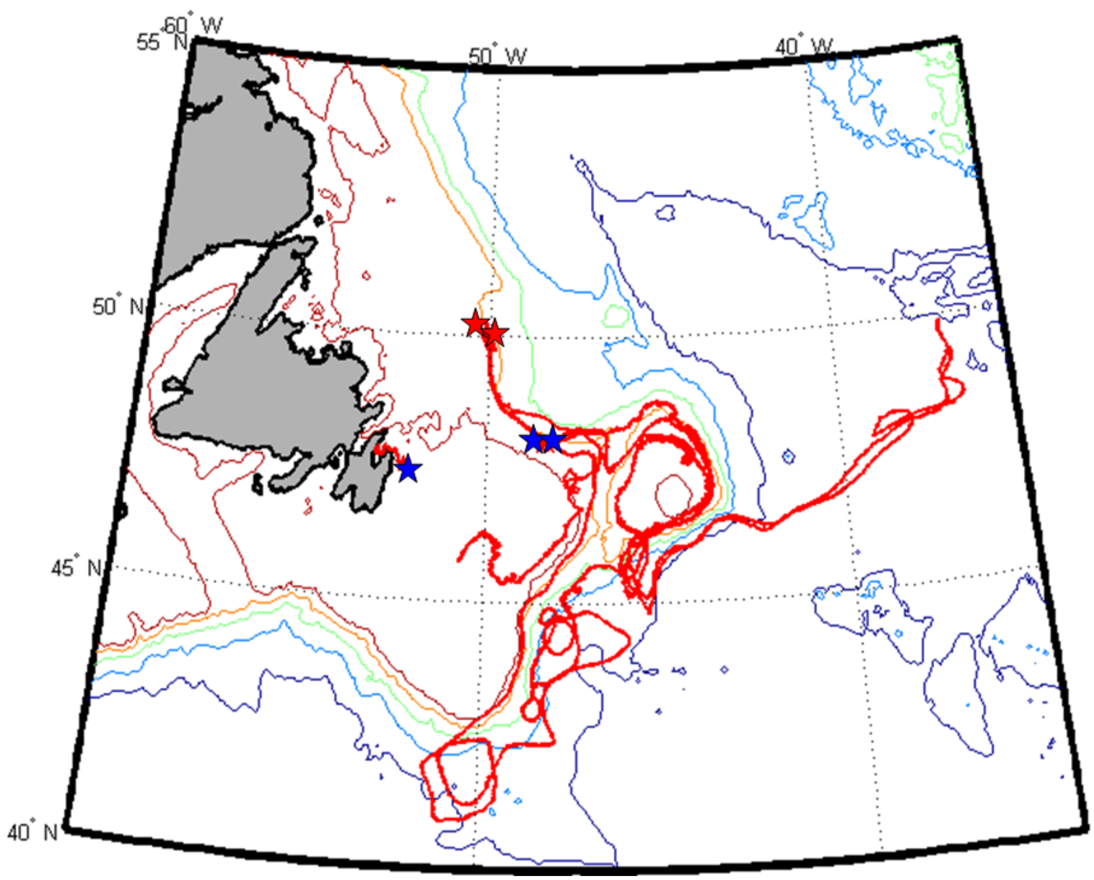

Figure 15. Composite buoy tracks. Red stars represent drop locations of air-deployed buoys. Blue stars represent ship-deployed buoys.

Ice and Environmental Conditions

Introduction

During 2008, IIP estimated that 976 icebergs drifted into the shipping lanes near the Grand Banks of Newfoundland. This places 2008 in the extreme-season class (>600 icebergs passing south of 48°N) as defined by Trivers (1994). It was also the 16th greatest number of icebergs passing into the shipping lanes in IIP records, which extend back to 1900.

This section describes the progression of the ice year and the accompanying environmental conditions. The following month-by-month narrative begins as sea ice began forming along the Labrador coast in December 2007 and concludes on 15 July 2008 when Ice Patrol sent its final daily ice warnings to mariners.

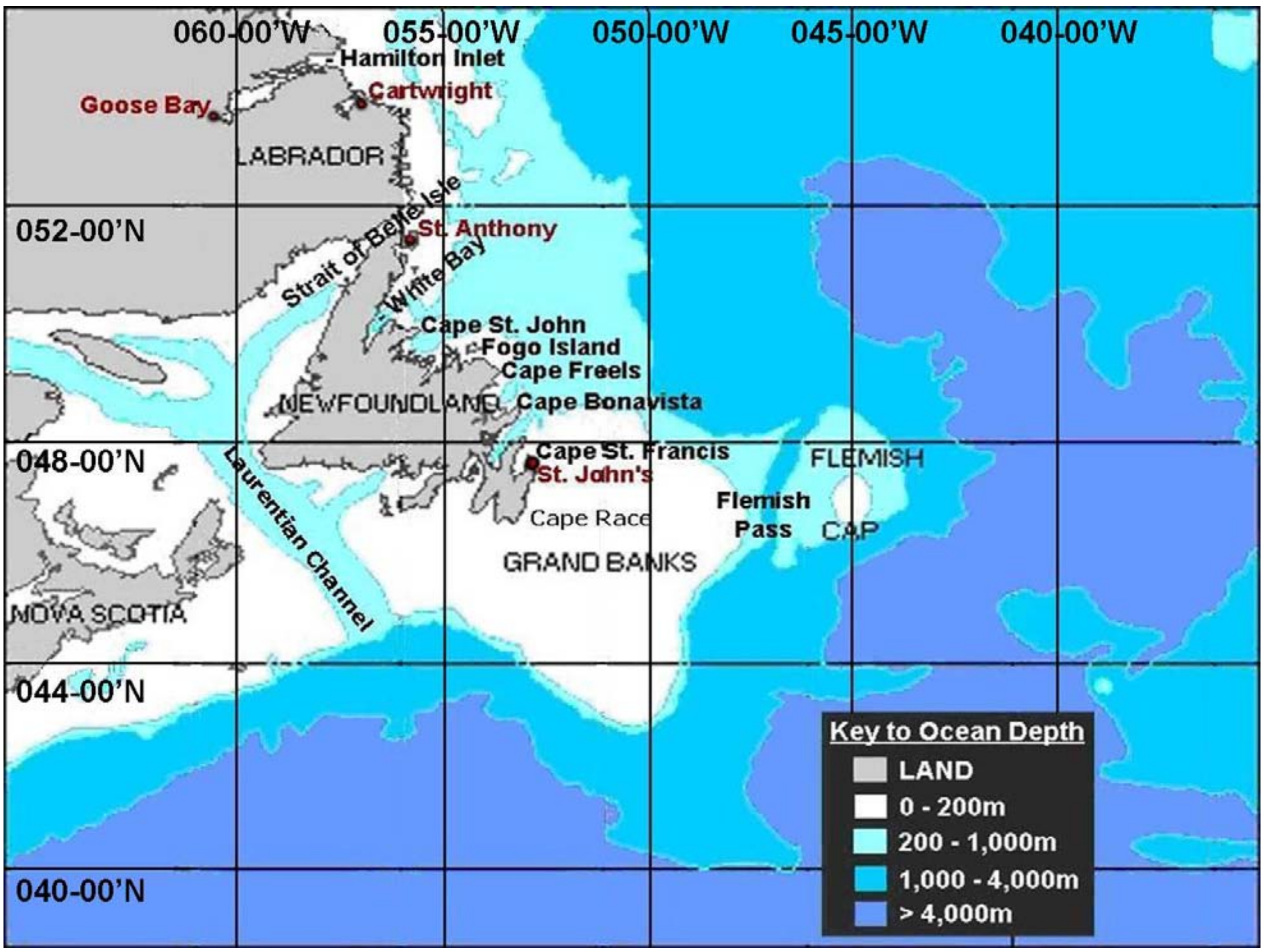

Figure 16. Grand Banks of Newfoundland.

The narrative draws from several sources, including the Seasonal Summary for Eastern Canada, Winter 2007-2008 (Canadian Ice Service, 2008); sea-ice analyses provided by CIS and NIC; sea surface temperature anomaly plots provided by the National Oceanic and Atmospheric Administration's National Weather Service (NOAA/NWS, 2008a); and, finally, summaries of the iceberg data collected by Ice Patrol and CIS. The plots on pages 38 to

56 document the limit of all known ice (LAKI) twice a month (the 15th and last day of each month) for the period during which Ice Patrol provided daily warnings to mariners in 2008.

The progress of the 2008 Ice Year (October 2007 through September 2008) is compared to sea-ice and iceberg observations from the historical record. The sea-ice historical data are derived from the Sea-ice Climatic Atlas, East Coast of Canada, 1971-2000 (CIS, 2001), which provides a 30-year median of ice concentration at seven-day intervals for the period from 26 November through 16 July. Historical iceberg information is derived from Viekman and Baumer (1995), who present LAKI climatology from mid-March to 30 July based on 21 years of Ice Patrol observations from 1975 through 1995. They provide the extreme, 25th percentile, median, 75th percentile, and minimum LAKIs for the period. The 25th and 75th percentiles indicate that, respectively, 25% and 75% of the LAKI were more extensive than those historical positions. Finally, the average number of icebergs estimated to have drifted south of 48°N for each month was calculated using 108 years (1900 through 2007) of Ice Patrol records (IIP, 2008).

Pre-Season Predictions

The pre-season sea-ice forecast (CIS, 2007), which was issued on 04 December 2007, predicted a near-normal advance and retreat of the sea ice in 2008, to include the following details.

- The southern ice edge of sea ice would move to the entrance to the Strait of Belle Isle (**Figure 16**) by the end of December.
- During March, the southern ice edge would reach the latitude of St. John's, but most of the significant ice would remain north of Cape Bonavista.
- Sea ice would begin a slow retreat during the last week of March and would retreat at a near-normal pace throughout the spring.

From 15-26 October 2007, CIS conducted a census of the iceberg population off the southern coast of Baffin Island. The census was based on RadarSat (W-3) and Envisat images (Desjardins, 2007). The resulting iceberg count was 178, the lowest number of icebergs seen since the CIS fall surveys began in 2000. The offshore icebergs in this population are likely to be the earliest icebergs to arrive at 48°N, and thus are considered the vanguard of the iceberg season. Desjardins (2007) predicted a late-February opening to the 2008 Ice Season (defined as the date that IIP starts providing daily warnings to mariners), with the additional expectation that the season might be a short one. He based this prediction on the October iceberg survey and the October–November meteorological and oceanographic (primarily sea surface temperature in the northern Labrador Sea) and meteorological conditions.

December 2007

Colder-than-normal air temperatures in Labrador throughout December promoted vigorous sea-ice development along the Labrador coast. The mean monthly air temperatures at Cartwright, Goose Bay and Nain, Labrador were 1.8°C to 3.0°C below normal (Environment Canada Atlantic Region, 2008). Normal sea surface temperature conditions persisted near the Labrador coast throughout the month (NOAA/NWS, 2008). The southern edge of the main ice pack reached Cape Chidley, the northernmost point in Labrador, during the second week of December, about one week later than normal. By the third week of the month, slightly ahead of normal and the pre-season sea-ice forecast.

January 2008

Labrador experienced near-normal air temperatures during January while eastern Newfoundland was slightly warmer than normal, with St. John's and Gander recording monthly average air temperatures 1.3°C and 1.0°C above normal, respectively (Environment Canada, 2008).

Sea-ice expansion in early January was slow in east Newfoundland waters. Although the southern extent of the ice edge was normal at mid-month, the area east of Newfoundland's northern peninsula was largely ice-free. The Strait of Belle Isle remained blocked with sea ice in mid-month prompting the Canadian Coast Guard (CCG) to recommend that the strait not be used by transatlantic shipping after 15 January. During the second half of the month, sea-ice growth accelerated, and by month's end, it reached normal extent. On 31 January, the southern ice edge was near Cape Bonavista, while the eastern ice edge was approximately 135 nm east of St. Anthony, NL.

The dominant track of storms originating near the U.S. and Canadian east coasts in January 2008 was generally southwest to northeast, which carried the storms into the central Atlantic south of Greenland. In particular, no significant storms moved toward Davis Strait during the period (Bancroft, 2008). This was a dramatic departure from conditions in 2007 when several strong storms moved from Newfoundland northward along the Labrador coast causing wide-spread ice destruction and compressing sea ice along the coast. The January 2008 storm tracks favored sea-ice development along the Labrador coast, which, in turn, favored the protection of any icebergs embedded within the sea ice.

On 22-23 January, a series of iceberg reconnaissance flights conducted by PAL under CIS sponsorship, documented a small iceberg population in the sea ice east of Hamilton Inlet, Labrador, but very few icebergs in the sea ice to the south. The areas east of the sea-ice edge were not searched.

In January 2008, no icebergs passed south of 48°N. The 1900-2007 mean for the month is three.

February 2008

Slightly colder-than-normal conditions prevailed in northern Labrador during February. The average temperature for the month was 0.8°C and 0.9°C below normal at Nain and Goose Bay, respectively. On the other hand, St. John's monthly mean air temperature was 1.5°C above normal.

The southward movement of the ice edge proceeded at a near-normal pace during the first half of February. By mid-month, it was near 48°N, approximately its median position. The eastern extent of the ice was well short of the median for the date. The eastern ice edge was 150 nm east of St. Anthony at mid-month, while its median position is about 50 nm farther to the east.

The southern and eastern ice edge in Newfoundland waters fluctuated during the second half of February in response to the passage of several storms. No one storm had a dramatic effect on the ice edge, but the net effect was the eastward expansion of the sea ice during the period. By month's end, the eastern edge was 220 nm east of St. Anthony, just slightly east of its normal position. The southern ice edge at the time was about 60 nm north of its normal position.

Several iceberg reconnaissance flights conducted by IIP's pre-season IRD and PAL documented a population of 98 icebergs and radar targets south of 53°N (**Figure 17**), most within the sea ice. Thus, the early iceberg-reconnaissance results pointed to an active iceberg season.

During the month, no icebergs passed south of 48°N. The 1900-2007 mean for February is 15.

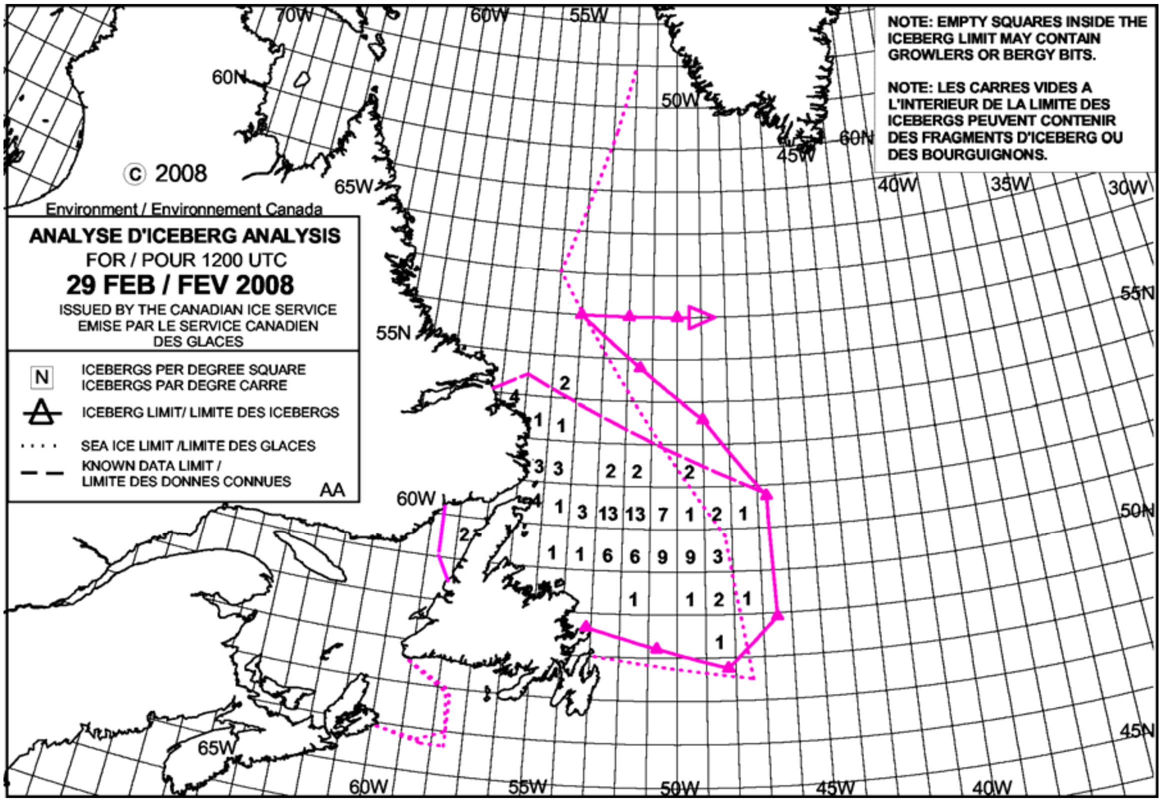

Figure 17. Iceberg distribution on 29 February 2008. The numbers indicate the number of icebergs and radar targets within a one degree of latitude by one degree of longitude bin. (Map courtesy of the Canadian Ice Service)

March 2008

The Canadian Maritime Provinces experienced much colder-than-normal conditions during March. Central Labrador and Labrador's north coast were particularly hard hit, with air temperatures at Nain and Goose Bay 3.9°C below normal. In Goose Bay, the mean daily air temperature was substantially below average on all but a few days during the month (**Figure 18**). Newfoundland was also very cold, with St. Anthony and St. John's reporting monthly mean temperatures 2.0°C and 1.1°C below normal, respectively.

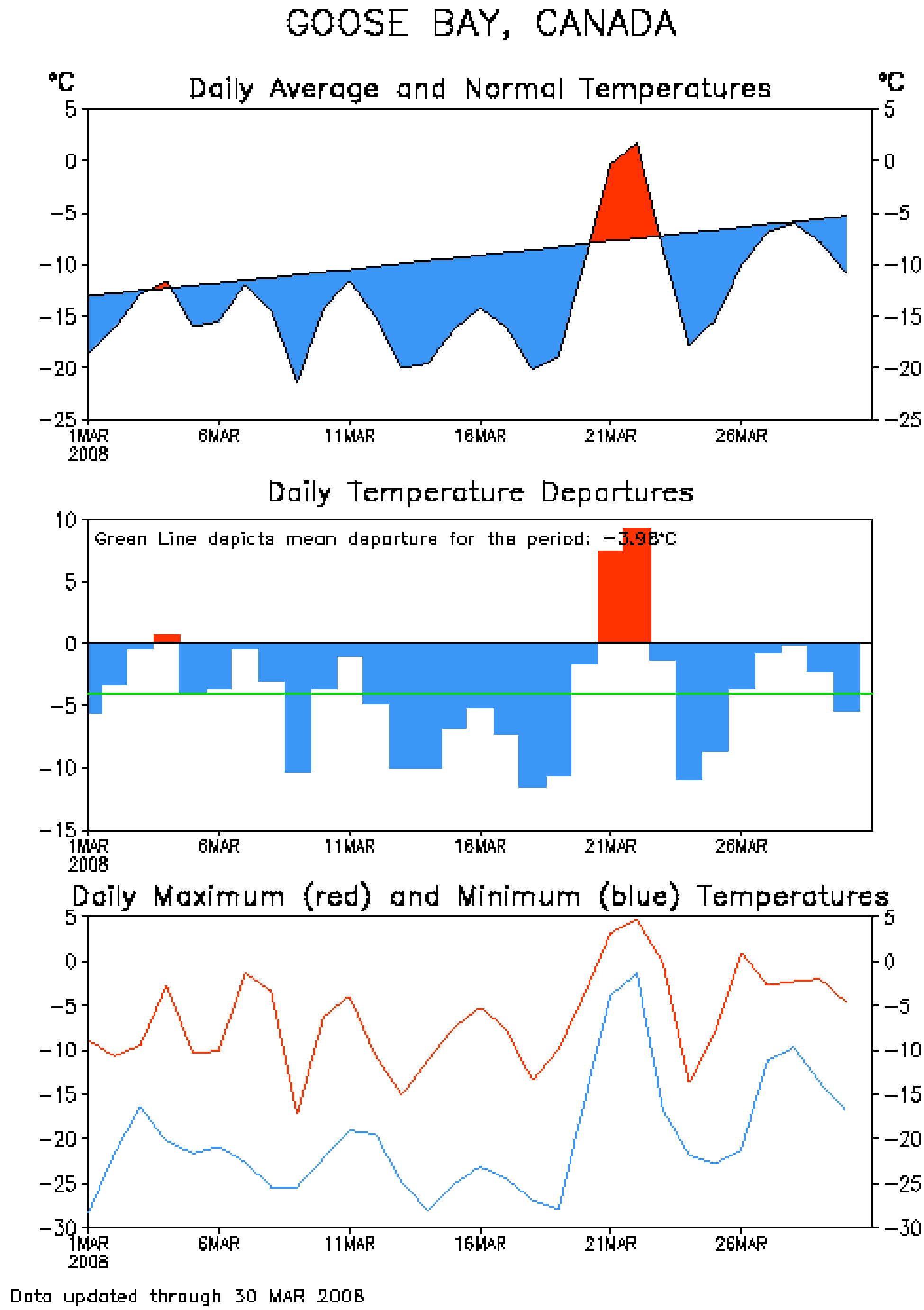

Figure 18. March 2008 air temperature in Goose Bay, Labrador. NOAA/NWS, Climate Prediction Center (NOAA/NWS, 2008b)

As predicted in the pre-season sea-ice forecast (CIS, 2007), the southern ice edge reached the latitude of St. John's in March, and for most of the month, the bulk of the sea ice remained to the north of Cape Bonavista. During the first half of the month, the southern and eastern ice edges remained relatively stable in east Newfoundland waters. Although there were some fluctuations due to the passage of several cyclones, the southern edge remained in the vicinity of 48°N, while the eastern edge was about 200 nm east of St. Anthony. In both cases, the extent was slightly less than the 1971-2000 median (CIS, 2001). The second half of March was stormier. On 17-18 March, the most intense storm (**Figure 19**) seen in the western North Atlantic during the January-April period (Bancroft, 2008) moved south of Newfoundland where it stalled. In addition to bringing blizzard conditions to St. John's, strong northeast winds during the two-day period caused significant sea-ice compaction along the southern coast of Labrador and the north and east coasts of Newfoundland. Rather than beginning its yearly retreat as is the norm, during the last week of March, the southern ice edge started to move rapidly eastward and southward toward Flemish Pass, setting the stage for extraordinary ice conditions in April.

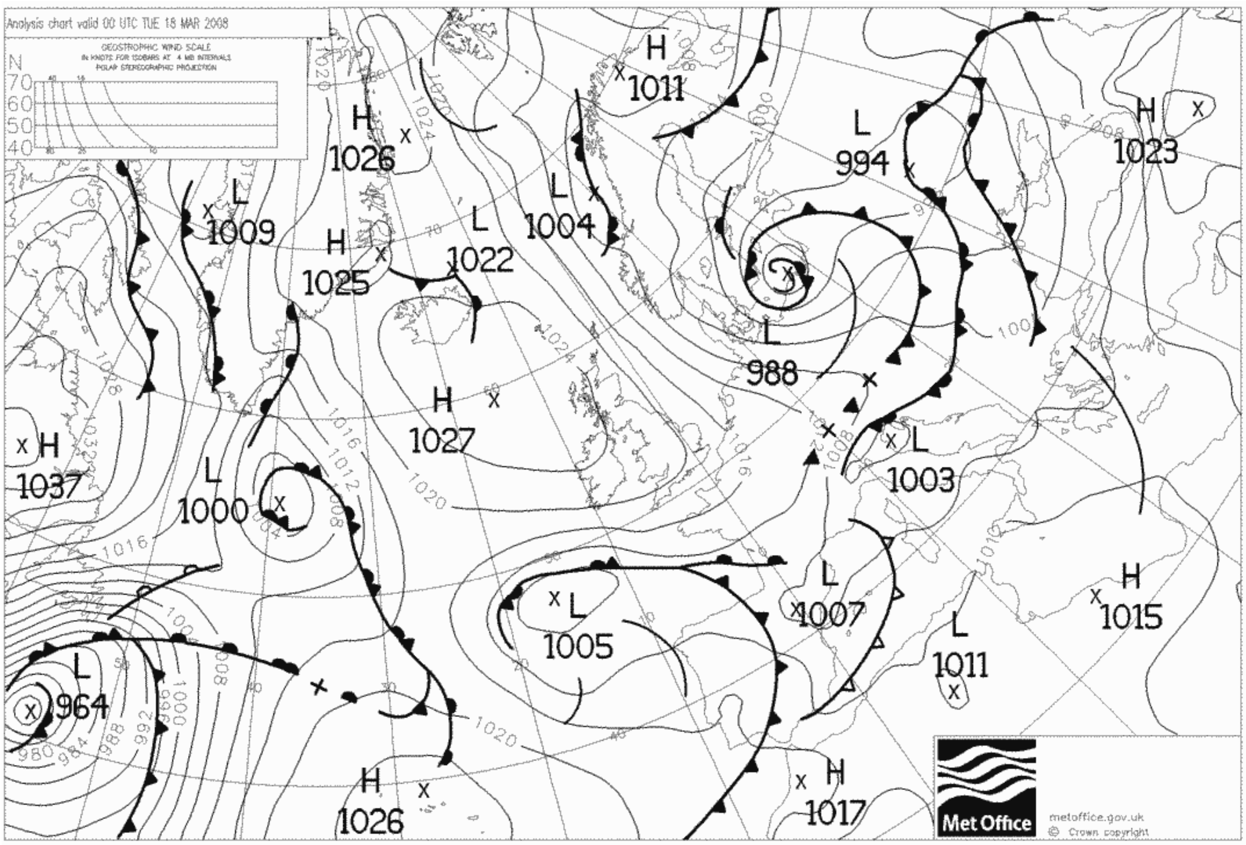

Figure 19. Sea-level pressure for 00Z 18 March 2008. (Plot courtesy of Met Office, Bracknell, UK)

During March, IIP and PAL increased iceberg surveillance over east Newfoundland waters. As the month progressed, it became clear that there was a large iceberg population within the sea ice and in the adjacent open waters. With the danger to the transatlantic mariner increasing, IIP began providing daily iceberg warnings on 28 March, a month later than the pre-season forecast. During the month, 45 icebergs passed south of 48°N, less than the mean of 59.

April 2008

Much warmer conditions returned to Newfoundland and Labrador in April. Labrador was particularly warm, with Goose Bay and Nain recording monthly mean air temperatures 2.4°C and 1.8°C, respectively, above normal. St. John's, which experienced below-normal temperatures in March, returned to near-normal conditions in April.

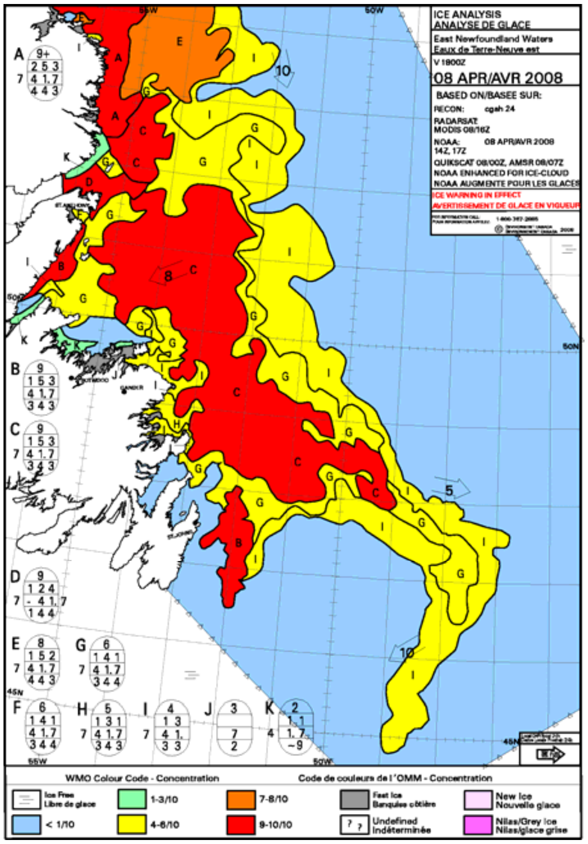

Figure 20. Sea-ice concentrations for 08 April 2008. (Map courtesy of the Canadian Ice Service)

The southeasterly movement of the ice edge that started in late March accelerated in early April. On 30 March, the southern ice edge was at the northern end of Flemish Pass (~47°30'N) and by 08 April it had reached 44°50'N (**Figure 20**), a distance of over 160 nm. The meteorological conditions during the period favored the southward movement (red arrow on **Figure 21**) of the ice edge. The ice was also being driven southward by the offshore branch of the Labrador Current.

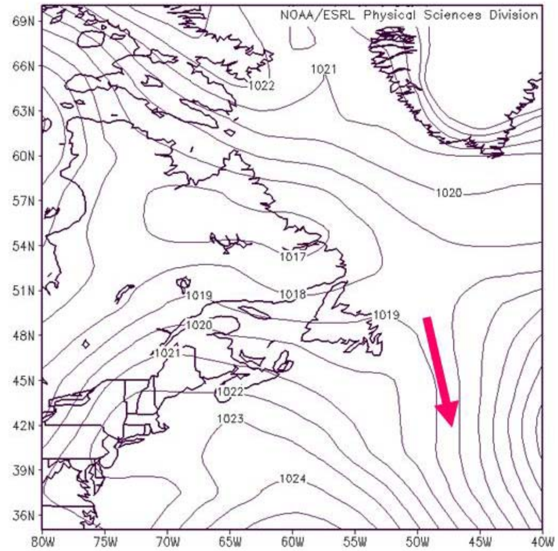

Figure 21. Mean sea-level pressure for 31 March to 08 April 2008. (Plot courtesy of NOAA Earth System Research Laboratory, Physical Sciences Division)

The heavy sea-ice and iceberg conditions in the eastern Grand Banks created havoc with the oil industry in early April. Production at the White Rose oilfield east of St. John's was suspended for several days and the exploratory rig, Global Santa Fe Grand Banks, was towed to an ice-free area.

During the first half of April, sea ice moved southward in the inshore branch of the Labrador Current, which flows close to the Newfoundland's east coast. Though coincident with the ice movement on the eastern edge of the Grand Banks, the ice edge did not extend south of 46°30'N.

In mid-April, there was a brief retreat of the southern ice edge, but this retreat was short-lived. From 20 to 24 April, there was a re-advance of the sea ice that nearly reached 45°N again. This re-advance was driven by the north winds on a large low pressure system that had stalled in the central North Atlantic. The last seven days of April witnessed the abrupt departure of sea ice from the Grand Banks. By 30 April, there was little sea ice south of 50°N. This position is the nearly median position of the southern ice edge for the date. On the other hand, the eastern ice edge, which extended just

55 miles east of St. Anthony, NL, was 40 nm closer to shore than normal.

The severe sea-ice and iceberg conditions resulted in a flood of iceberg reports into Ice Patrol's Operations Center during April. PAL flew at least one iceberg reconnaissance flight per day in support of the oil-field activities on the eastern part of the Grand Banks. Two IIP IRDs conducted eight reconnaissance missions and found 585 icebergs. In addition, there were numerous land and ship reports, including numerous iceberg reports from Canadian icebreakers working to maintain safe domestic marine traffic lanes in the heavy ice conditions.

At mid-month, the southern LAKI was near the 25th percentile, while the eastern LAKI was near the median. The southern LAKI changed little during the second half of April, while the eastern LAKI advanced eastward somewhat, ending the month near the 25th percentile. During the last week of April, the IIP Operations Center began receiving iceberg reports from lighthouses on Newfoundland's south coast, indicating that icebergs were moving past Cape Race and giving a preview of the dramatic LAKI change to come in May.

In April, IIP estimated that 712 icebergs passed south of 48°N. While this number is far above the 1900-2007 mean of 119, it is short of the record for the month. In April 1984, the season with the most icebergs on record, IIP estimated that 953 icebergs passed south of 48°N.

May 2008

Labrador remained slightly warmer than normal in May, with Nain and Cartwright recording 0.9°C and 1.1°C above-normal air temperatures. Eastern Newfoundland experienced near-normal conditions.

Sea ice continued its rapid departure from east Newfoundland waters in early May. By mid-month, all that remained was in White Bay and a narrow strip along the eastern side of Newfoundland's northern peninsula. The sea-ice retreat was now about a week ahead of normal. Shortly after mid-month, on 20 May 2008, the Strait of Belle Isle was again recommended by CCG for transatlantic crossings. By the end of May, the only sea ice south of Hamilton Inlet, Labrador, was a small area of one tenth to three tenths sea ice between Cape St. John and Fogo Island.

In early May, IIP was monitoring over 500 icebergs, growlers, and radar targets south of 48°N. Most were confined to the eastern Grand Banks north of 45°N and west of 45°W. The meteorological conditions at the end of April and beginning of May (**Figure 22**) changed this iceberg distribution radically. Persistent east winds for a nine-day period pushed many icebergs westward toward the Laurentian Channel. In a week, IIP's western ice limit moved westward by more than 160 nm. Numerous ships passing through the waters south of Newfoundland reported icebergs during the period.

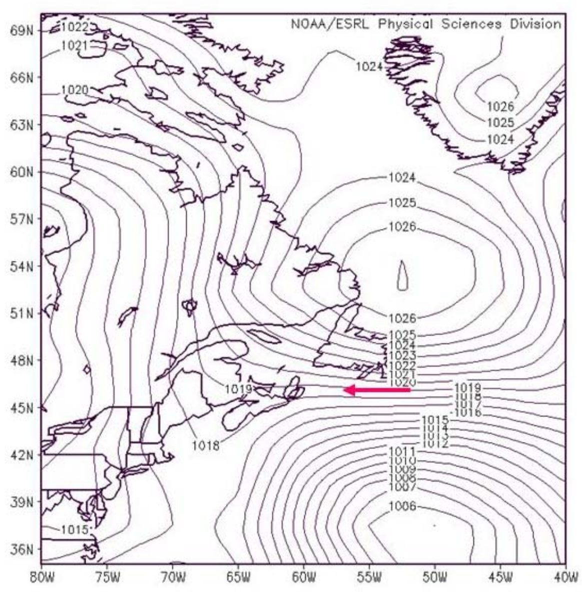

Figure 22. Mean sea-level pressure for 26 April to 04 May 2008. (Plot courtesy of NOAA Earth System Research Laboratory, Physical Sciences Division)

During the first half of May, the southern and eastern LAKI had changed very little from the end of April. In contrast, the mid-May western LAKI was at an extreme westward position not seen by IIP in many years. At the end of May, both the southern and eastern LAKI retreated somewhat, but the western limit remained in the vicinity of 58°W, remaining at an extreme position.

In May, 173 icebergs passed south of 48°N, greater than the 1900-2007 mean of 147.

June 2008

Near-normal air temperatures prevailed in Newfoundland and Labrador in June. The sea surface temperatures in northeast Newfoundland waters and along the southern Labrador Coast were 1°C to 2°C above normal (**Figure 23**).

Throughout the month, the sea ice retreated rapidly toward the north along the Labrador Coast. By the end of June, about two weeks earlier than the norm, sea ice had departed the Labrador coast.

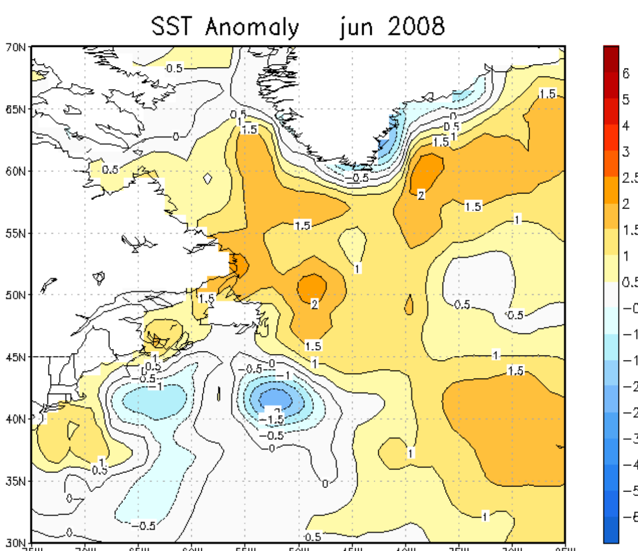

Figure 23. Mean sea surface temperature anomaly for June 2008 in degrees C. [Plot courtesy of NOAA/NWS (2008a)]

The warming ocean waters were also taking a toll on the icebergs in the vicinity of the Grand Banks. By mid-month, only 69 icebergs, growlers, and radar targets were being tracked south of 48°N. The southern, eastern, and western LAKI were at the 75th percentile. Further contraction of the iceberg population during the second half of June left only nine icebergs, growlers, and radar targets south of 48°N.

In June, Ice Patrol estimated that 43 icebergs passed south of 48°N, about half the 1900-2007 mean of 85.

July 2008

On 14 July, after verifying that there were no icebergs threatening the transatlantic shipping lanes, Ice Patrol's last 2008 ice reconnaissance detachment returned from Newfoundland. On 15 July, Ice Patrol broadcast its last daily iceberg warning to mariners.

Three icebergs passed south of 48°N in July, fewer than the 1900-2007 mean of 30.

Discussion

The meteorological and sea-ice conditions immediately preceding the 2008 Ice Season favored the movement of icebergs to the Grand Banks.

The winter 2008 (December 2007 through March 2008) North Atlantic Oscillation (NAO) Index was 2.11 (Hurrell, 2008). This value is calculated using the difference in normalized sea-level atmospheric pressure between Lisbon, Portugal and Stykkisholmur/Reykjavik, Iceland.

The NAO, the dominant pattern of winter atmospheric variability in the North Atlantic, fluctuates between positive and negative phases. The positive phase is associated with meteorological conditions that favor the movement of icebergs into the shipping lanes. These include strong and persistent northwest winds along the Labrador coast, which bring colder-than-normal air temperatures and greater-than-normal sea-ice extent off Labrador and Newfoundland. In addition, the persistent northwest winds promote southward iceberg movement. Warmer-than-normal conditions and less extensive sea ice off the Labrador coast are associated with the negative NAO phase.

The 2.11 NAO Index value in 2008 was strongly positive, which is consistent with the colder-than-normal air temperatures in Labrador and the mean sea-level pressure for December 2007 to March 2008. **Figure 24** indicates winds that favored the southward movement of icebergs from Davis Strait to the Grand Banks.

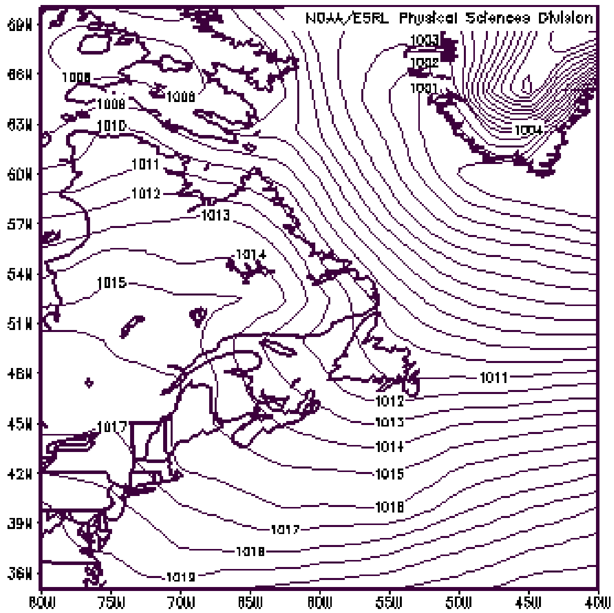

Figure 24. Mean sea-level pressure for 01 December 2007 to 31 March 2008. (Plot courtesy of NOAA Earth System Research Laboratory, Physical Sciences Division)

The above-normal sea-ice coverage from mid-December 2007 through early April 2008 (**Figure 25**) favored the preservation of icebergs during their journey south. Substantial sea-ice concentrations protect icebergs by damping ocean waves, which are a dominant factor in iceberg destruction.

The pattern of the North Atlantic storm tracks in early 2008 also favored the above-normal sea-ice extent along the Labrador coast. Cyclones that typically originate off U.S. and Canadian east coasts moved out into the North Atlantic, not northward as is sometimes the case. During January through April, no intense storms moved northward along the Labrador coast toward Davis Strait (Bancroft, 2008). These storms usually cause significant sea-ice destruction and compact sea ice along the coast.

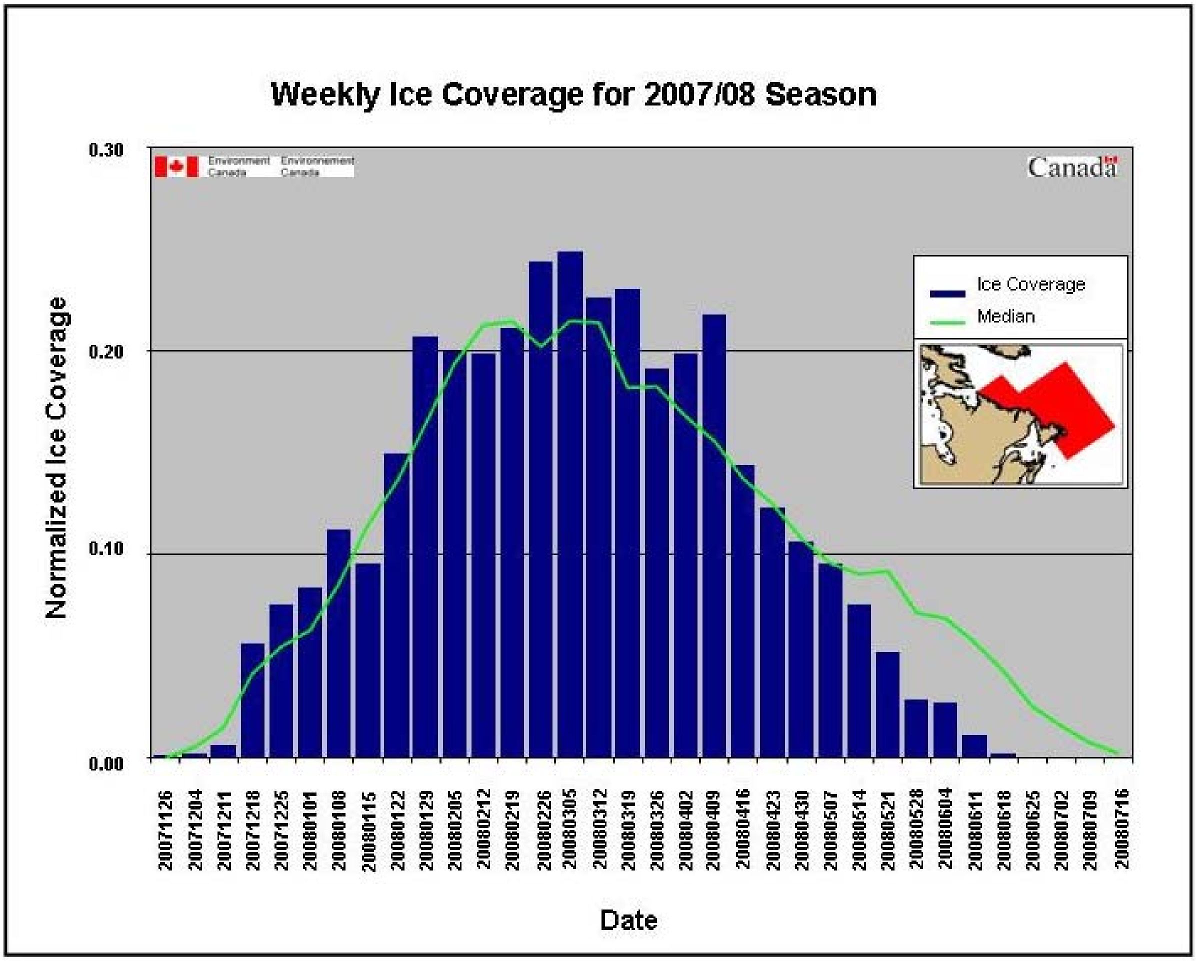

Figure 25. Weekly sea-ice coverage on the Grand Banks and along the Labrador coast for the 2008 Ice Season. The sea-ice coverage is normalized to the total area of the Grand Banks and Labrador coast regions. (CIS, 2008)

Classifying the severity of the 2008 iceberg season depends on the specific measure or measures used for the determination. Based solely on the iceberg count, the 2008 iceberg season was far into the extreme category (>600 icebergs), since 976 icebergs passed into the North Atlantic shipping lanes. This number also greatly exceeds the 1900-2007 mean of 472. Conversely, the 110-day season length (defined as the number of days IIP provided daily iceberg warnings to mariners) places 2008 in the low end of the average severity class (105-180 days).

Two additional factors support classifying 2008 as an extreme iceberg season. The first is the large number of icebergs that passed onto the Grand Banks in April. The 712 icebergs counted in April (**Figure 26**) was the fourth largest number of icebergs counted in any one month in the last 26 years. IIP's extraordinary tempo of operations in April sometimes made it difficult to distinguish newly observed icebergs from those that were previously seen. This may have resulted in some inflation in the April iceberg count, but it is not likely that it was a significant percentage of the observations. The second factor was the rapid westward expansion of the LAKI in May. The area enclosed by the 15 May 2008 LAKI was the greatest for that date since 1995.

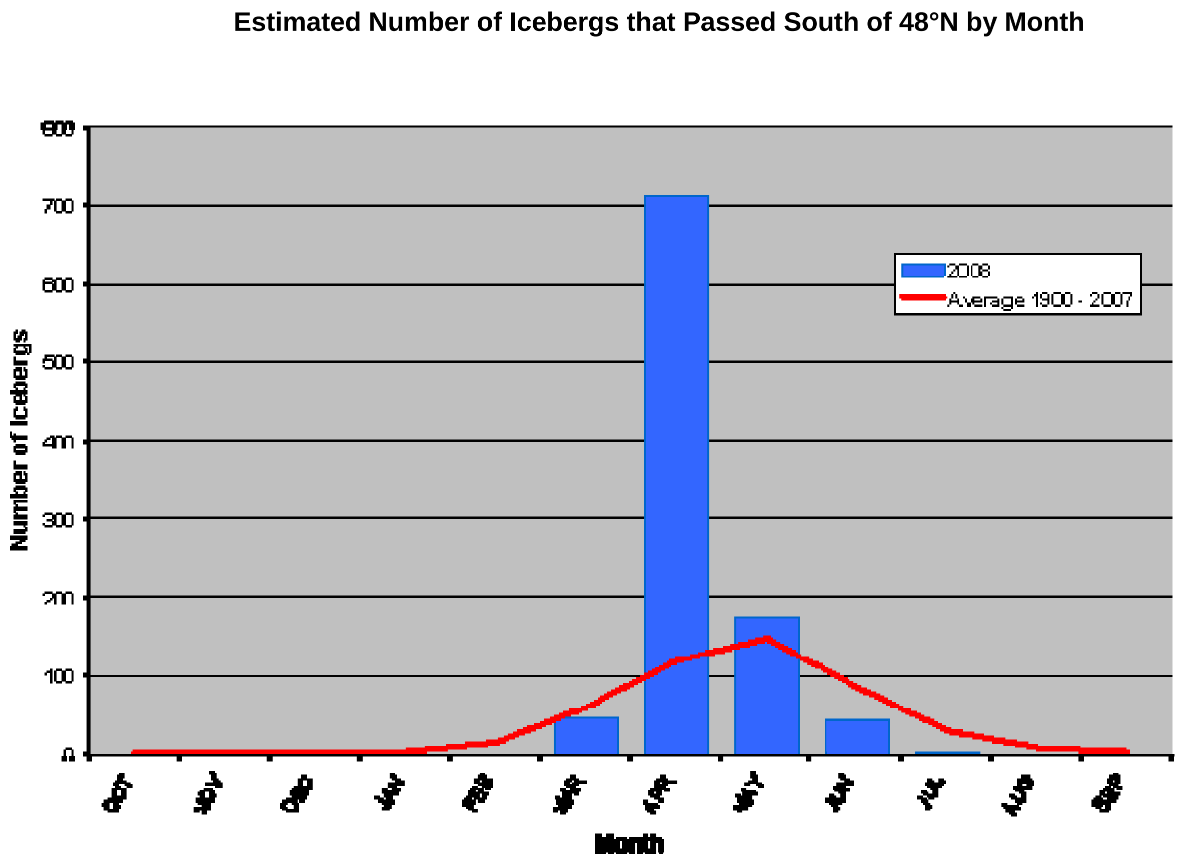

Figure 26. Estimated number of icebergs that passed south of 48°N each month during 2008.

The most balanced measure of the severity of an iceberg season is the Season Severity Index (SSI) proposed by Futch and Murphy (2003). It takes into account three major indicators: number of icebergs estimated to have passed south of 48°N, length of season, and average area enclosed by LAKI. All three indicators, which are weighted equally, are normalized to the mean over the period 1983-2008. Finally, the normalized contributions of each are summed. The 2.87 SSI for the 2008 season (**Figure 27**) suggests that, overall, the season was moderate rather than extreme.

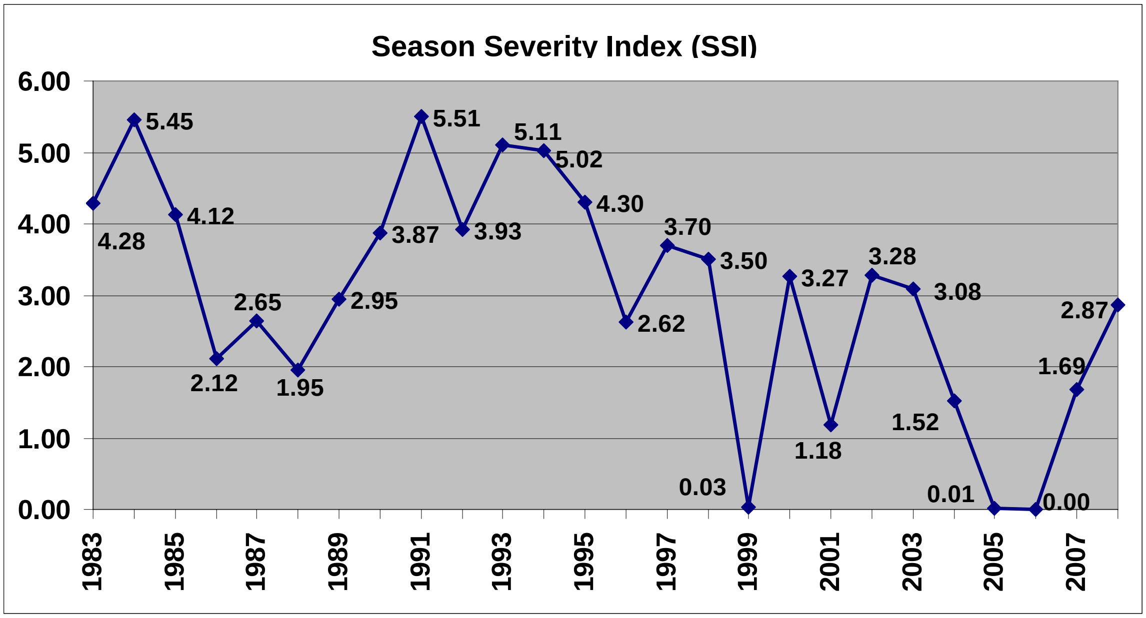

Figure 27. Iceberg Season Severity Index (SSI) for the modern IIP reconnaissance era (1983-2008) based on Futch and Murphy (2003).

References

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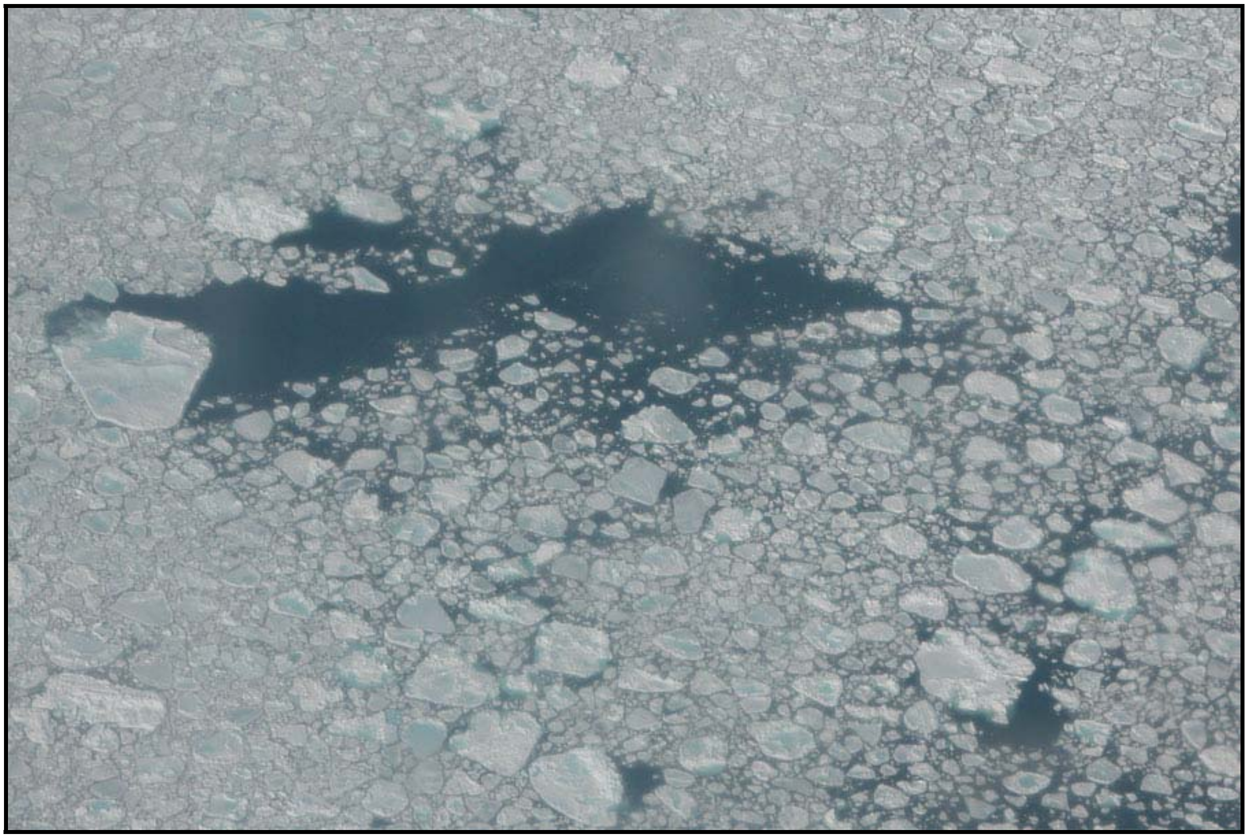
Monthly Sea-Ice Charts



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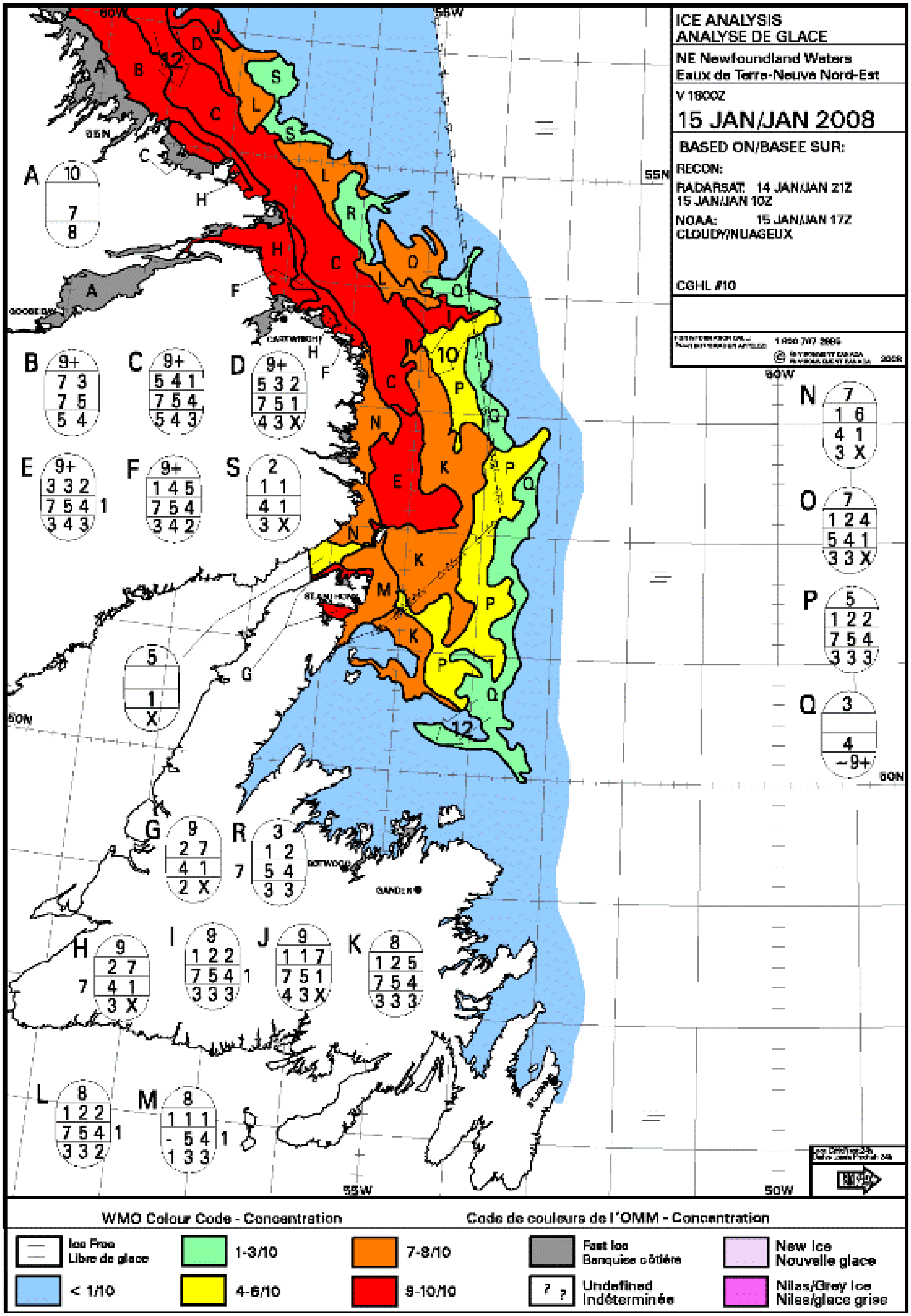
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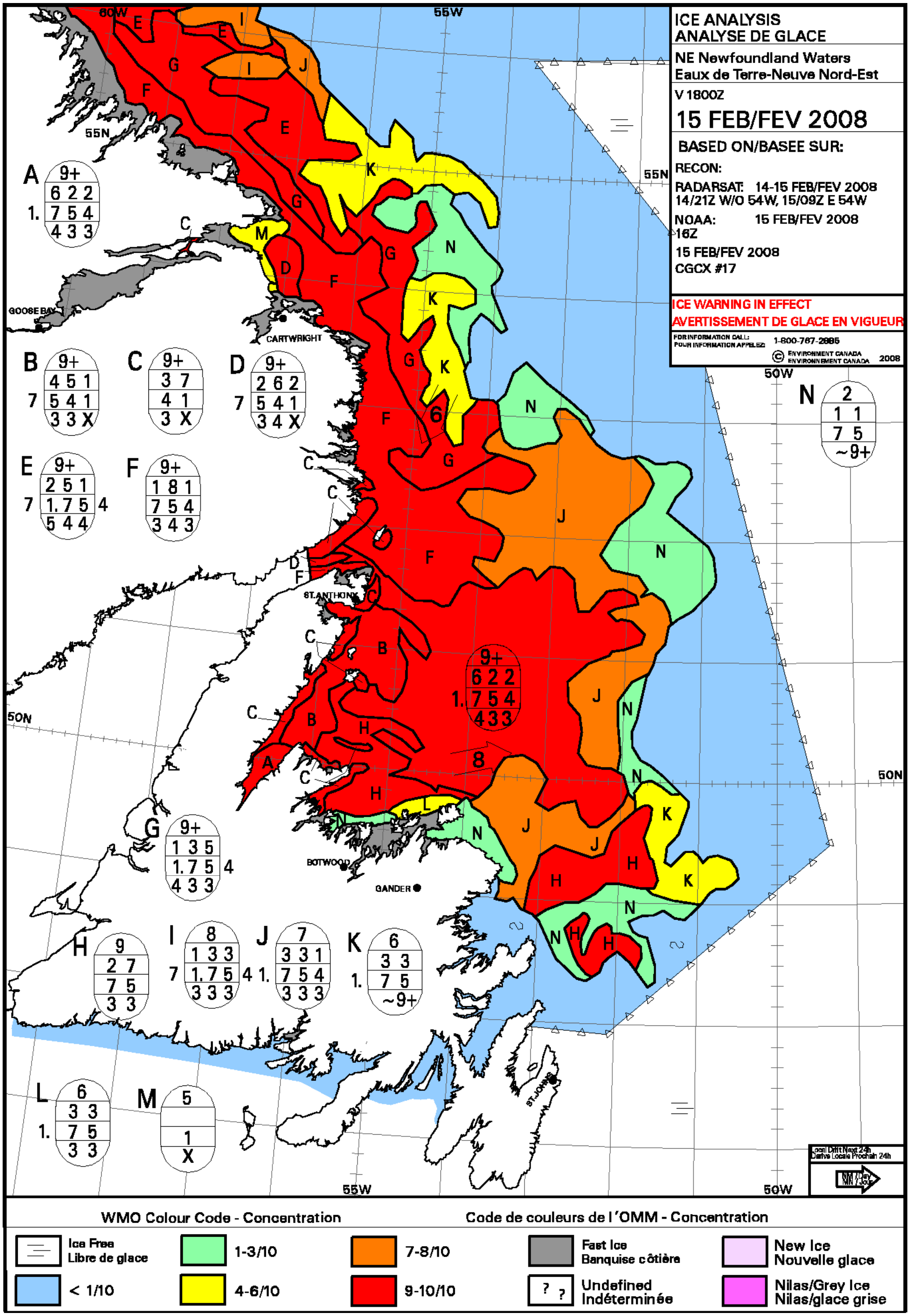
ANALYSE DE GLACE
NE Newfoundland Waters
Eaux de Terre-Neuve Nord-Est
V 1800Z
15 JAN/JAN 2008
BASED ON/BASEE SUR:
RECON:
RADARSAT 14 JAN/JAN 21Z
15 JAN/JAN 10Z
NOAA: 15 JAN/JAN 17Z
CLOUDY/NUAGEUX
CGHL #10
60W
55W
50W
55N
50N
WMO Colour Code - Concentration
Code de couleurs de l'OMM - Concentration
Ice Free
Libre de glace
< 1/10
1-3/10
4-6/10
7-8/10
9-10/10
Fast Ice
Banquise côtière
Undefined
Indéterminée
New Ice
Nouvelle glace
Nilas/Grey Ice
Nilas/glace grise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Eaux de Terre-Neuve Nord-Est
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RADARSAT: 14-15 FEB/FEV 2008
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NOAA: 15 FEB/FEV 2008
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15 FEB/FEV 2008
CGCX #17
ICE WARNING IN EFFECT
AVERTISSEMENT DE GLACE EN VIGUEUR
1-800-767-2885
GOOSE BAY
CARTWRIGHT
ST.ANTHONY
BOTWOOD
GANDER
ST.JOHN'S
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50W
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WMO Colour Code - Concentration
Code de couleurs de l'OMM - Concentration
Ice Free
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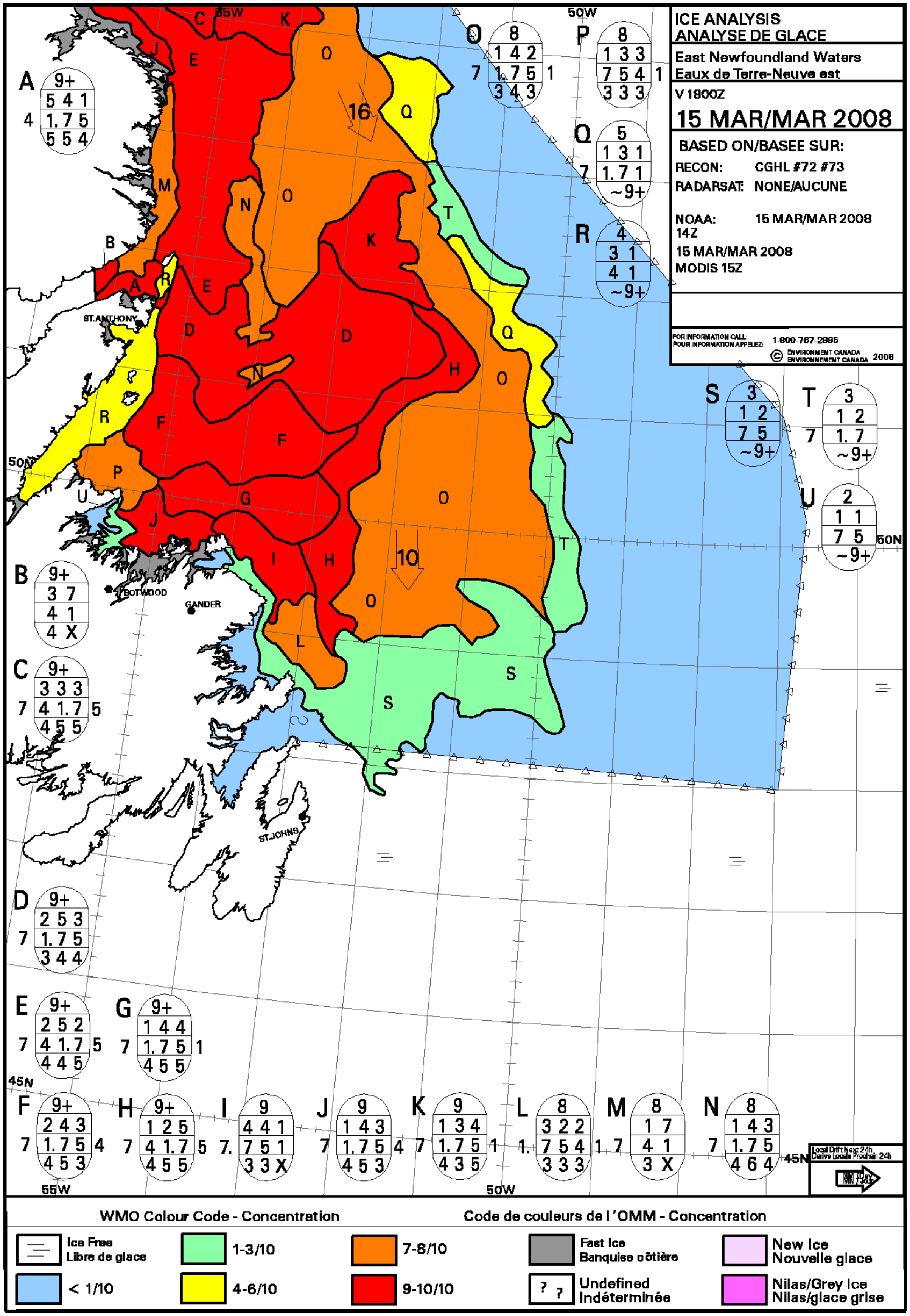
Nilas/Grey Ice
Nilas/glace grise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POUR INFORMATION APPELEZ:
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© ENVIRONMENT CANADA
ENVIRONNEMENT CANADA 2008
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WMO Colour Code - Concentration
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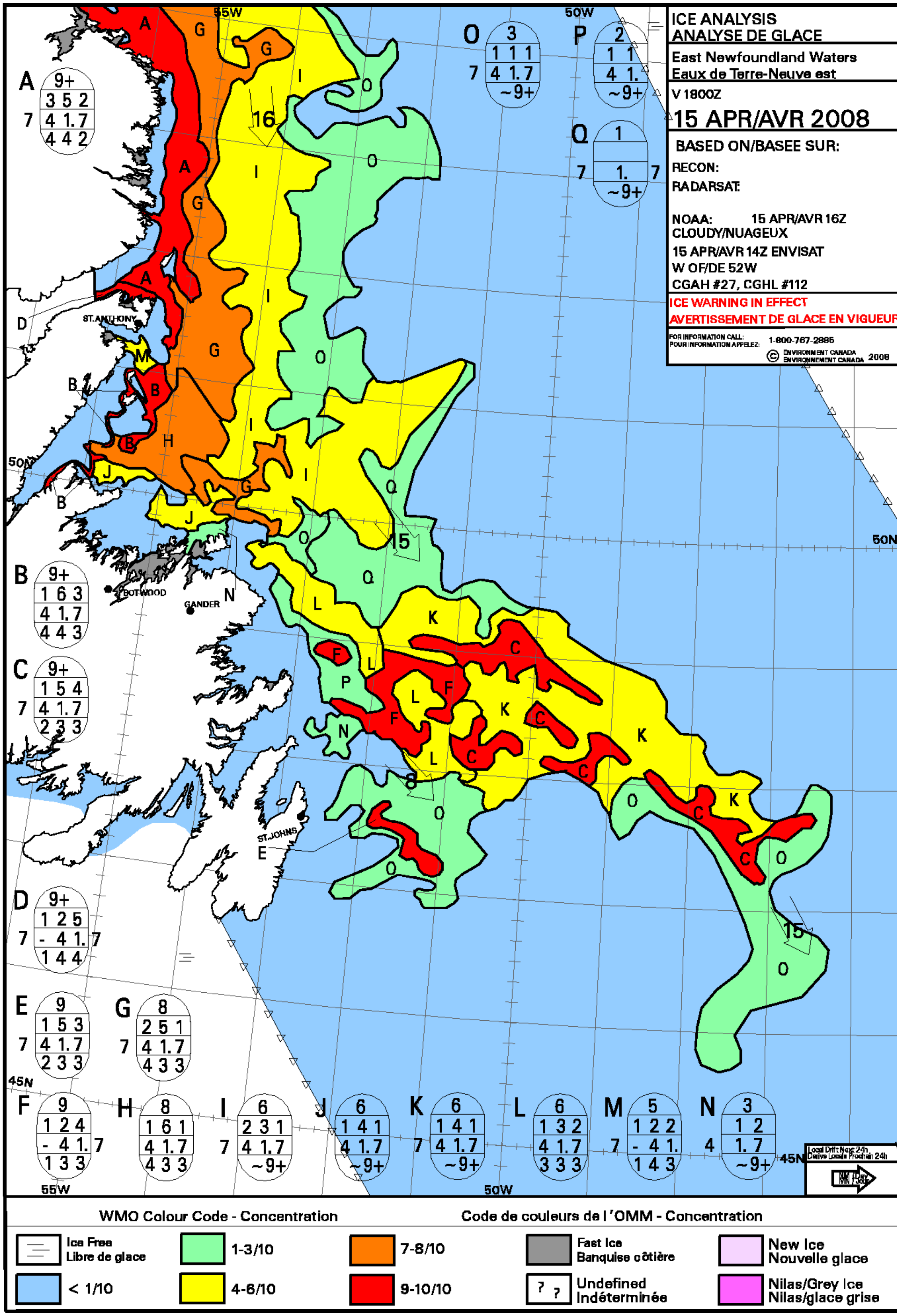
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ICE WARNING IN EFFECT
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FOR INFORMATION CALL:
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© ENVIRONMENT CANADA ENVIRONNEMENT CANADA 2008
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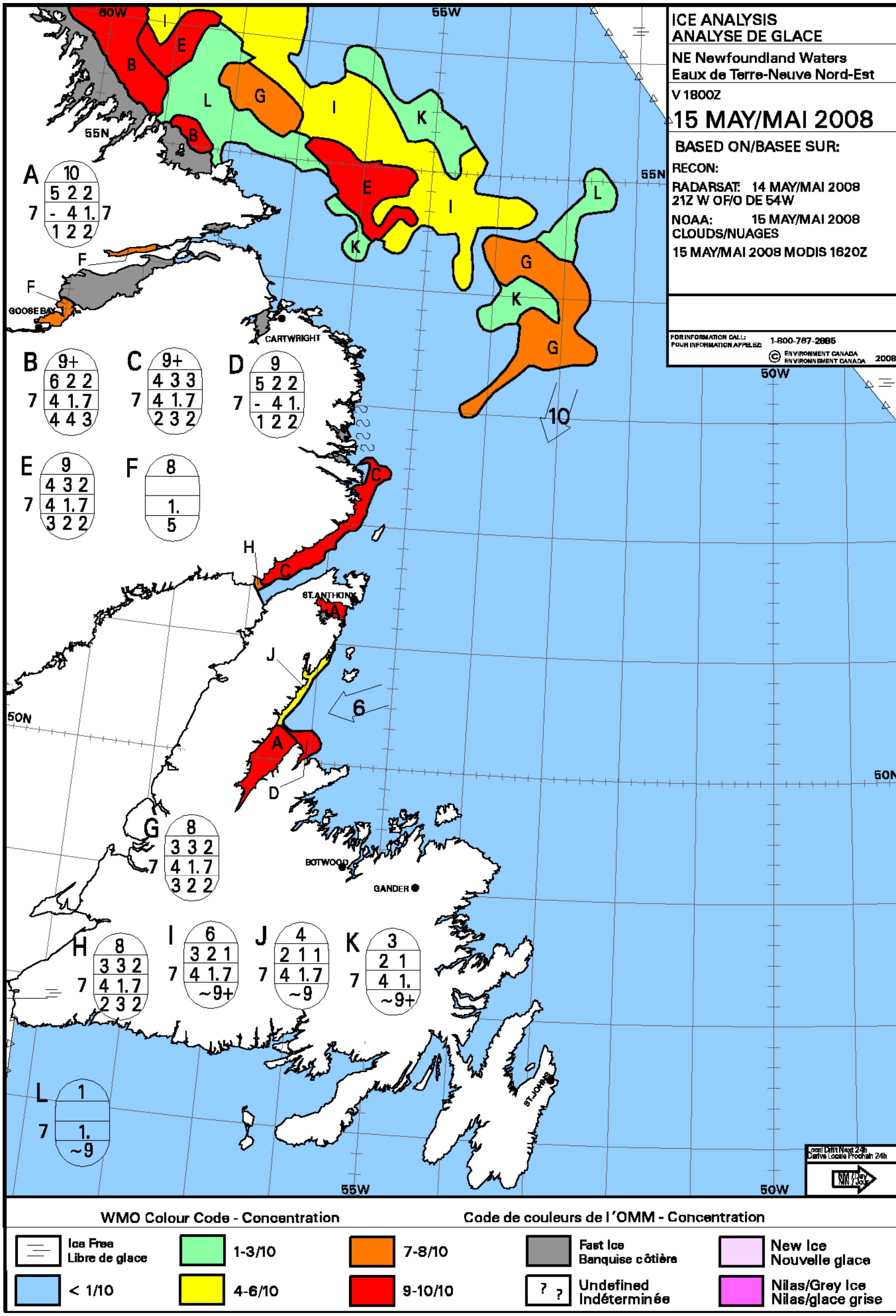

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GOOSE BAY
CARTWRIGHT
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BOTWOOD
GANDER
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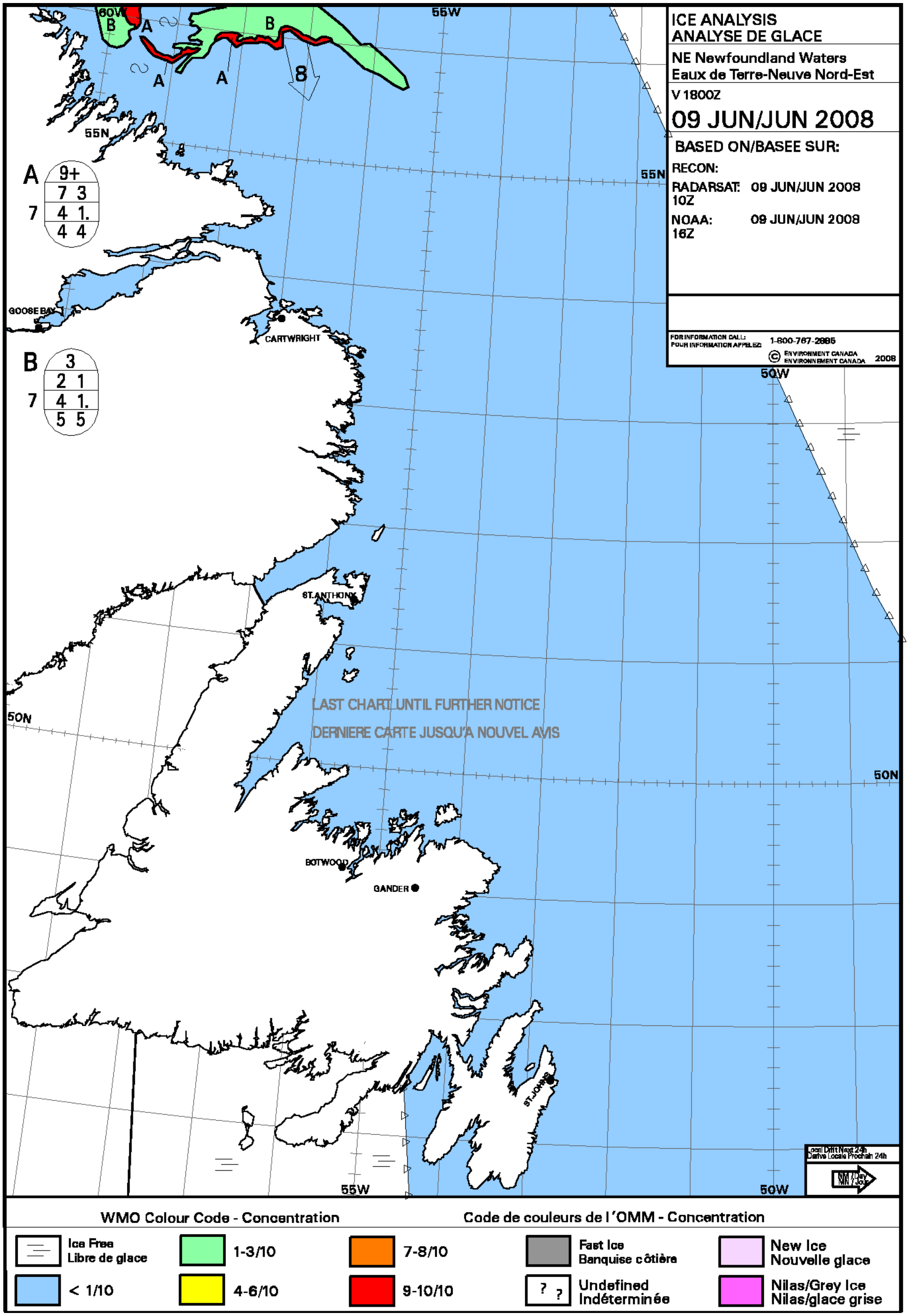
Nilas/glace grise



ICE ANALYSIS
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FOR INFORMATION CALL: POUR INFORMATION APPELEZ: 1-800-767-2885
ENVIRONMENT CANADA ENVIRONNEMENT CANADA 2008
LAST CHART UNTIL FURTHER NOTICE
DERNIERE CARTE JUSQU'A NOUVEL AVIS
GOOSE BAY
CARTWRIGHT
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BOTWOOD
GANDER
ST.JOHN'S
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Local Drift Next 24h
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Code de couleurs de l'OMM - Concentration
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7-8/10
9-10/10
Fast Ice
Banquise côtière
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New Ice
Nouvelle glace
Nilas/Grey Ice
Nilas/glace grise

Biweekly Iceberg Charts

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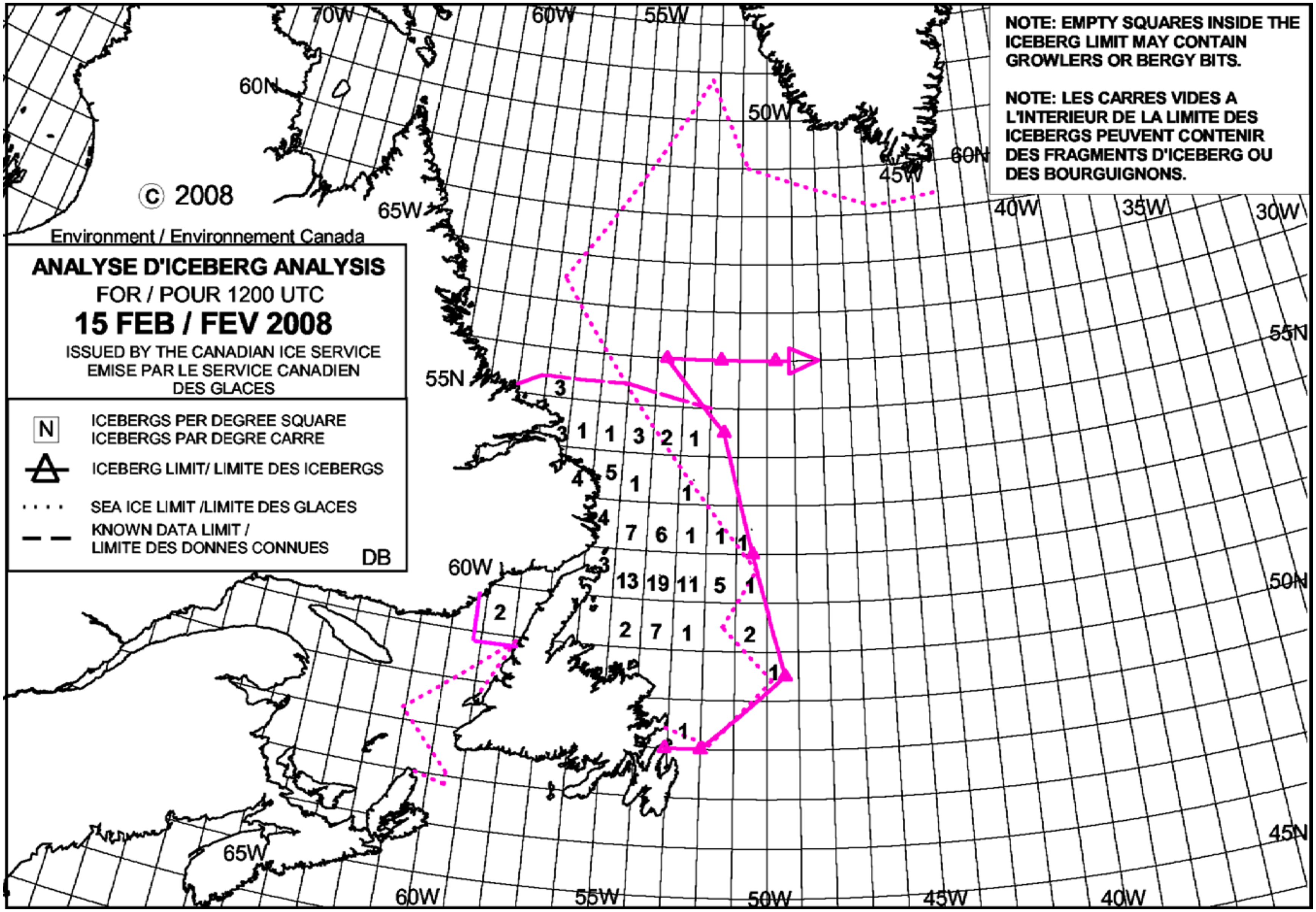
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NOTE: LES CARRES VIDES A L'INTERIEUR DE LA LIMITE DES ICEBERGS PEUVENT CONTENIR DES FRAGMENTS D'ICEBERG OU DES BOURGUIGNONS.
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FOR / POUR 1200 UTC
15 FEB / FEV 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
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LIMITE DES DONNES CONNUES
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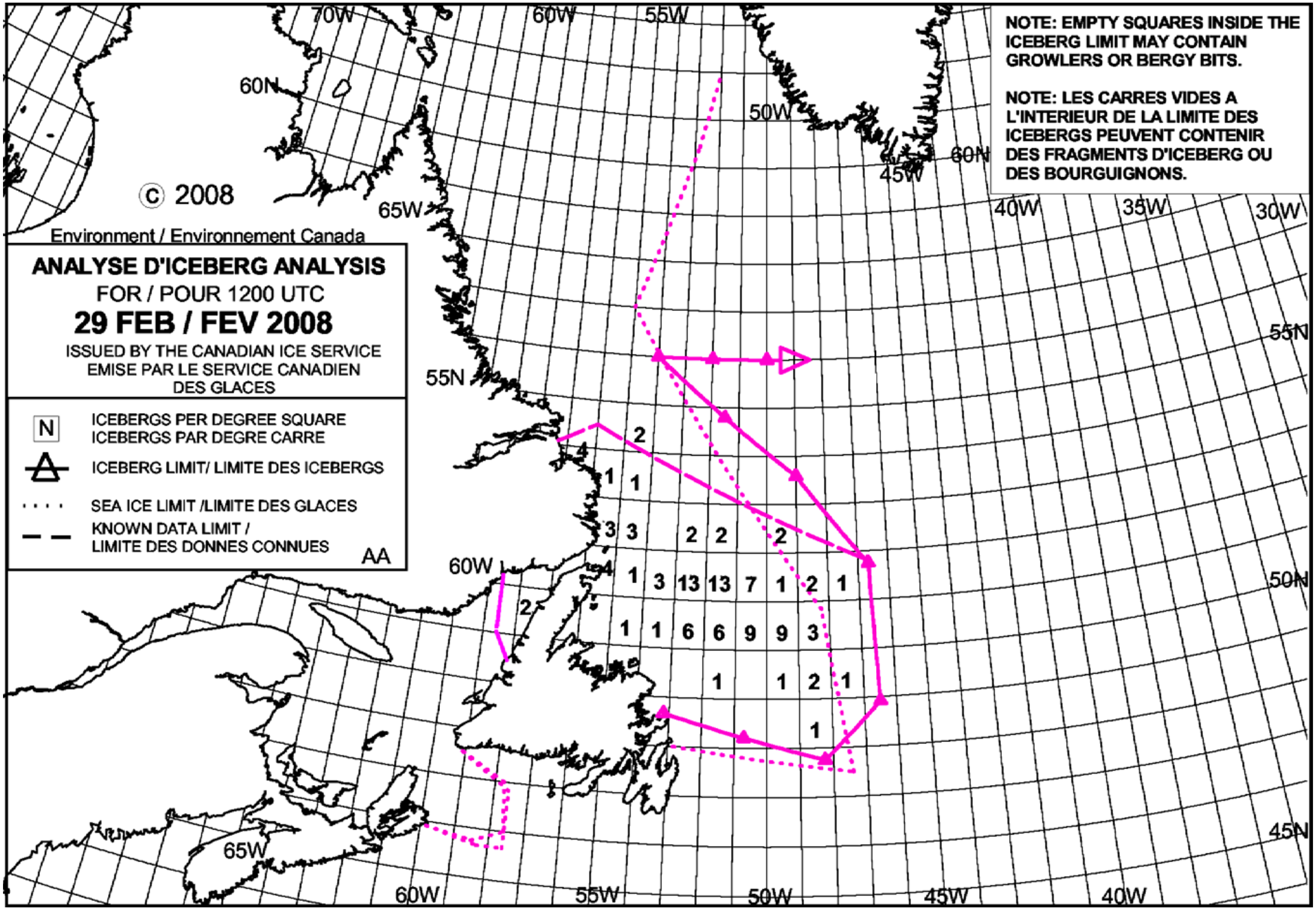
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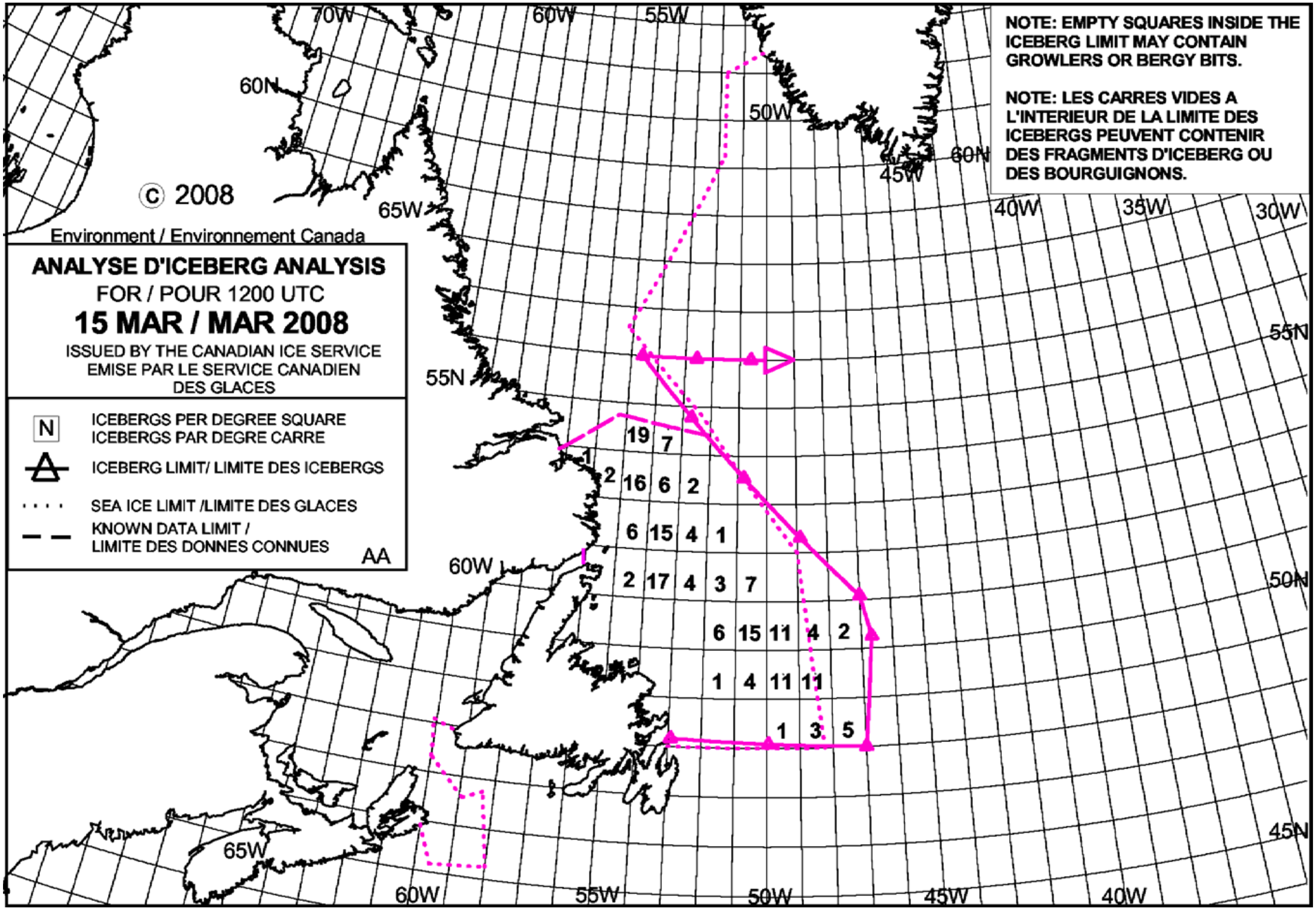

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15 MAR / MAR 2008
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EMISE PAR LE SERVICE CANADIEN DES GLACES
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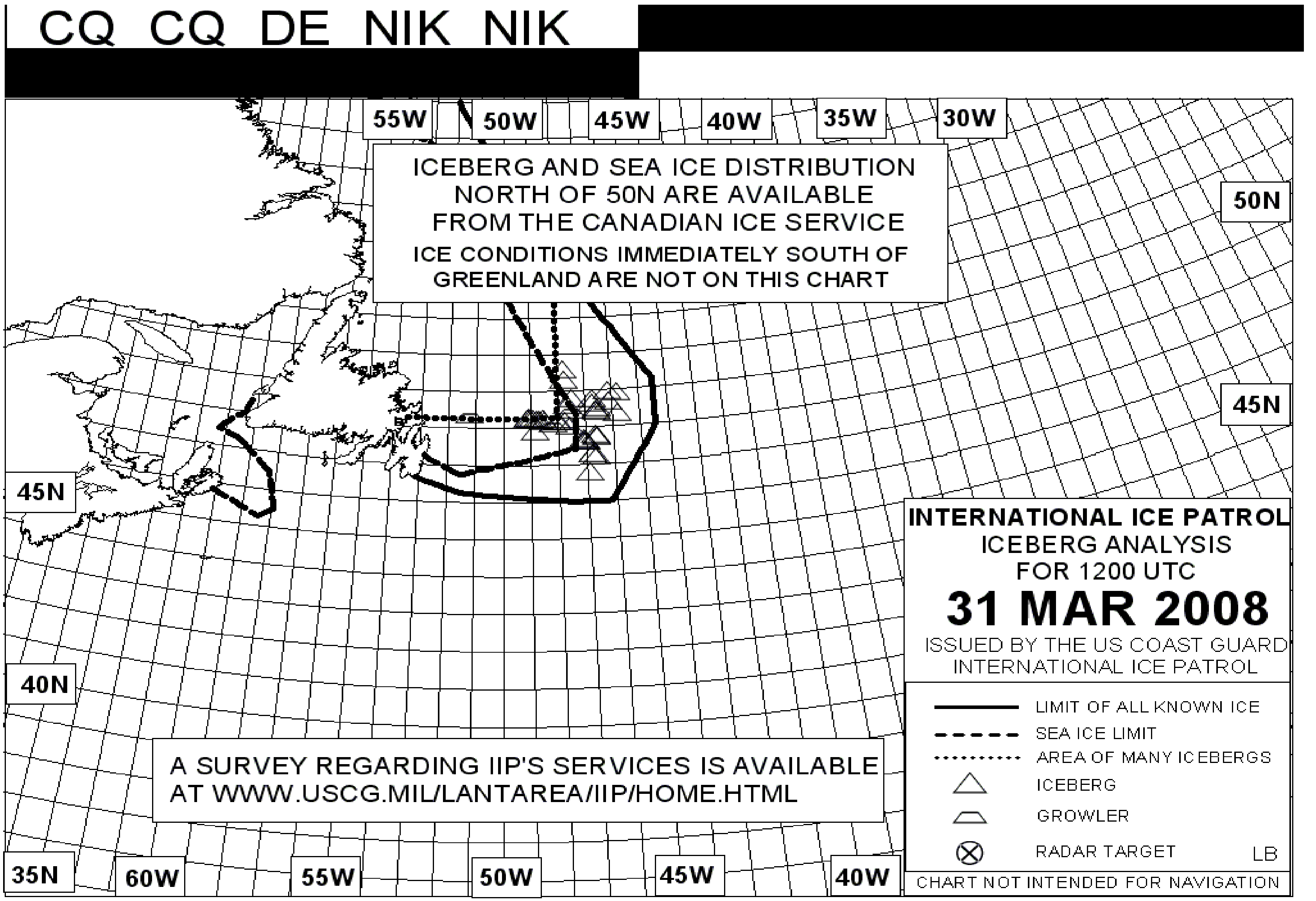
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GREENLAND ARE NOT ON THIS CHART
A SURVEY REGARDING IIP'S SERVICES IS AVAILABLE
AT WWW.USCG.MIL/LANTAREA/IIP/HOME.HTML
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ICEBERG ANALYSIS
FOR 1200 UTC
31 MAR 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
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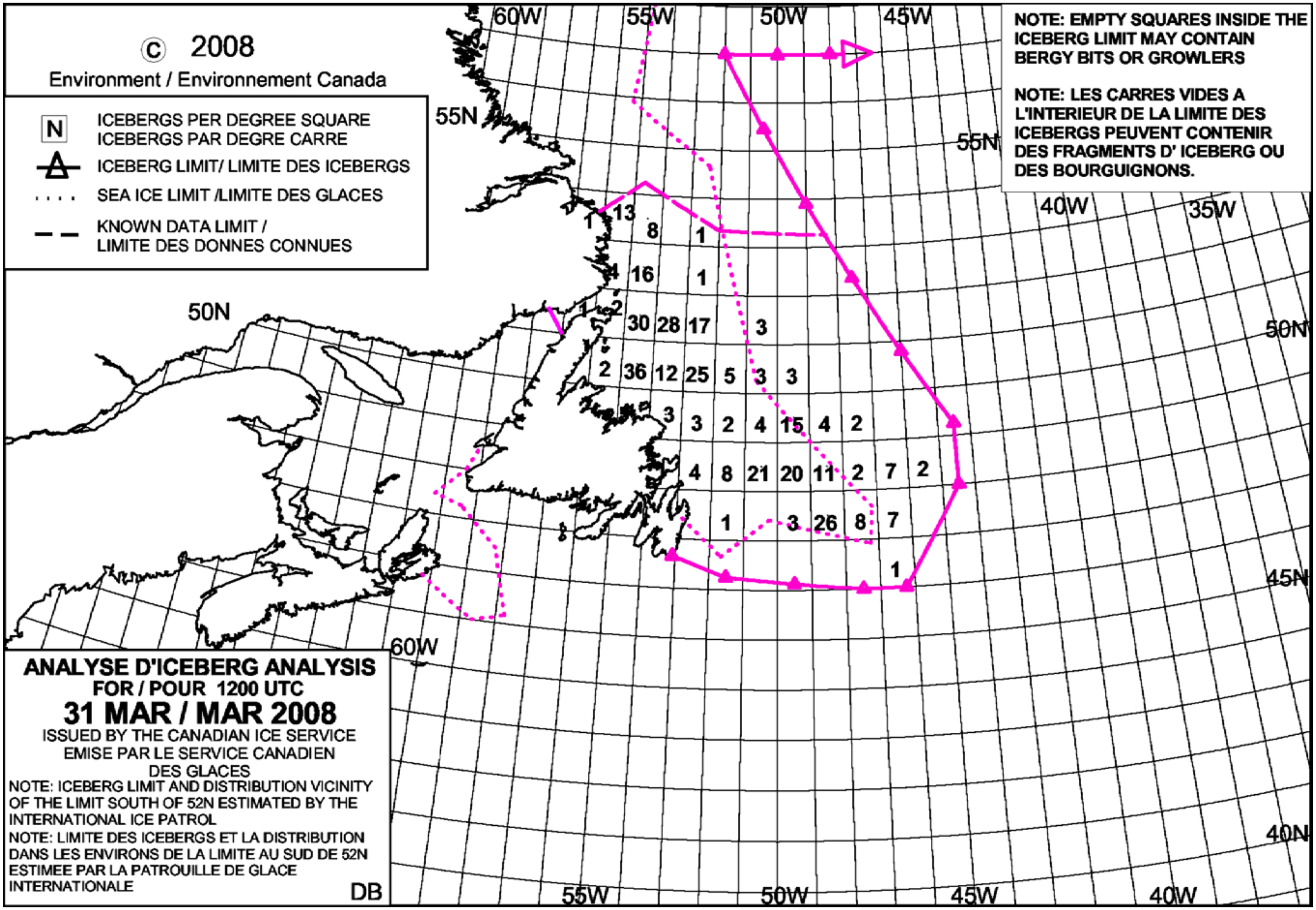

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ICEBERGS PAR DEGRE CARRE
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NOTE: LES CARRES VIDES A L'INTERIEUR DE LA LIMITE DES ICEBERGS PEUVENT CONTENIR DES FRAGMENTS D' ICEBERG OU DES BOURGUIGNONS.
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
31 MAR / MAR 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
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NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
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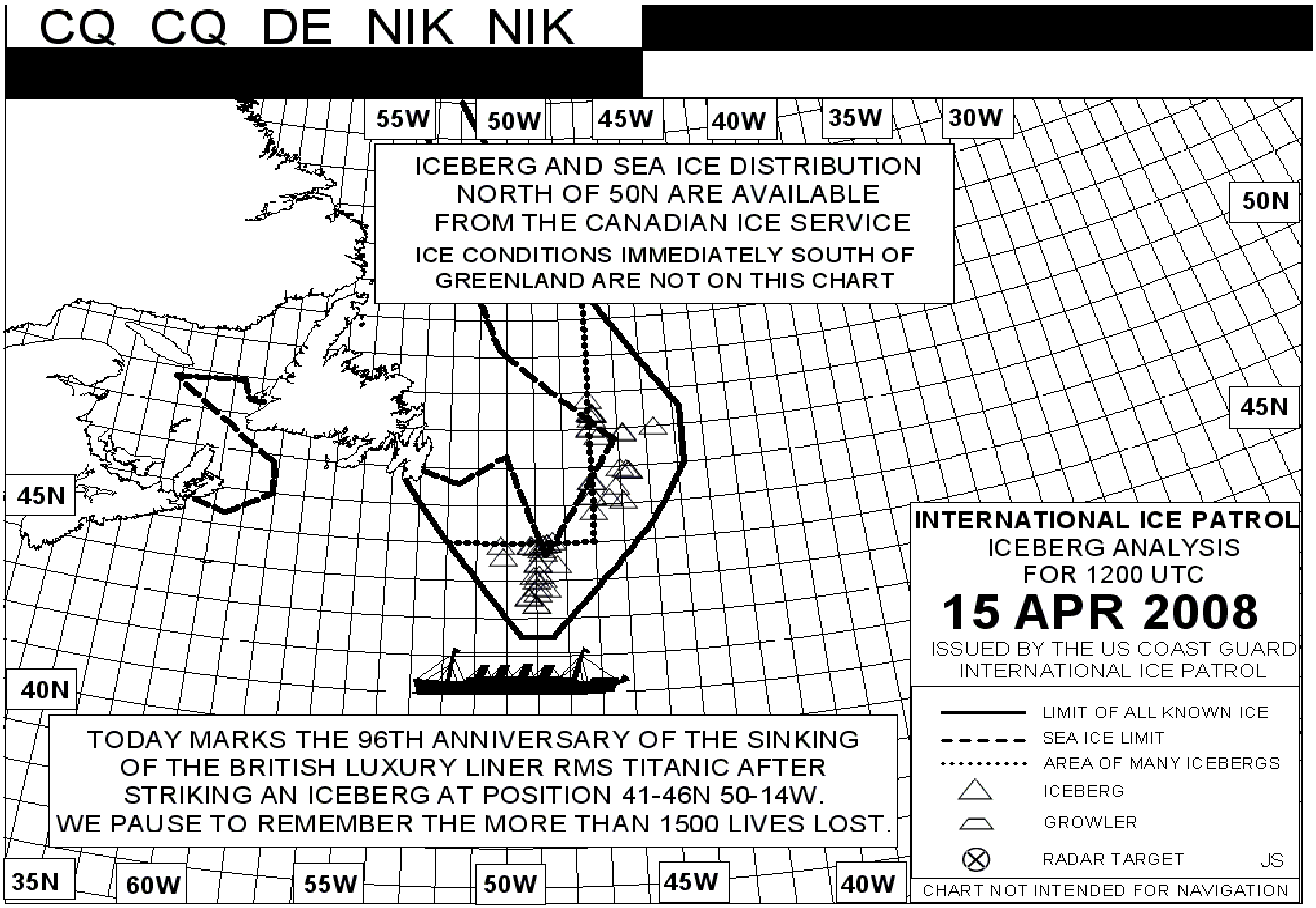
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ICEBERG AND SEA ICE DISTRIBUTION
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FROM THE CANADIAN ICE SERVICE
ICE CONDITIONS IMMEDIATELY SOUTH OF
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INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
15 APR 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
SEA ICE LIMIT
AREA OF MANY ICEBERGS
ICEBERG
GROWLER
RADAR TARGET
JS
CHART NOT INTENDED FOR NAVIGATION
TODAY MARKS THE 96TH ANNIVERSARY OF THE SINKING
OF THE BRITISH LUXURY LINER RMS TITANIC AFTER
STRIKING AN ICEBERG AT POSITION 41-46N 50-14W.
WE PAUSE TO REMEMBER THE MORE THAN 1500 LIVES LOST.
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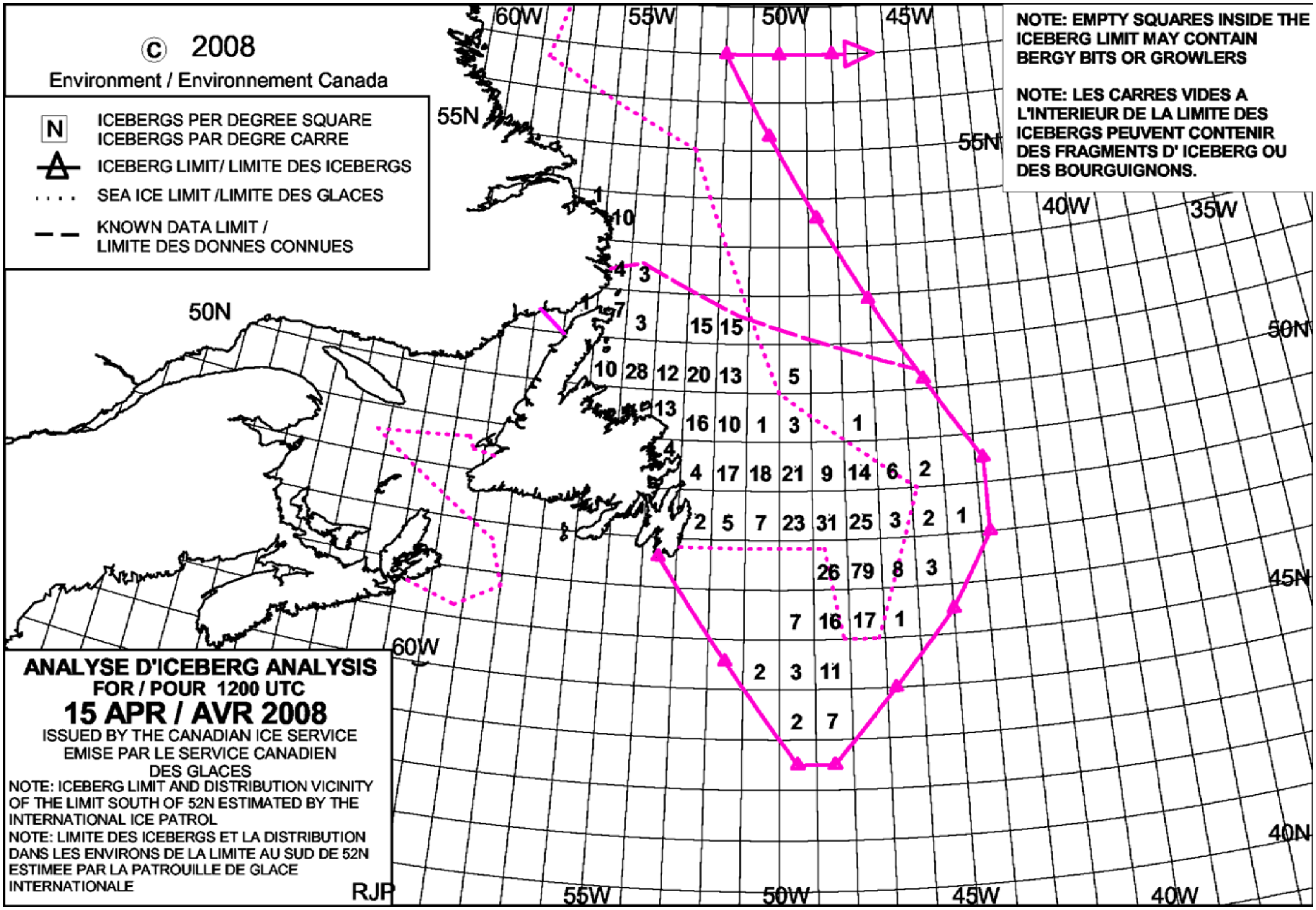
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Environment / Environnement Canada
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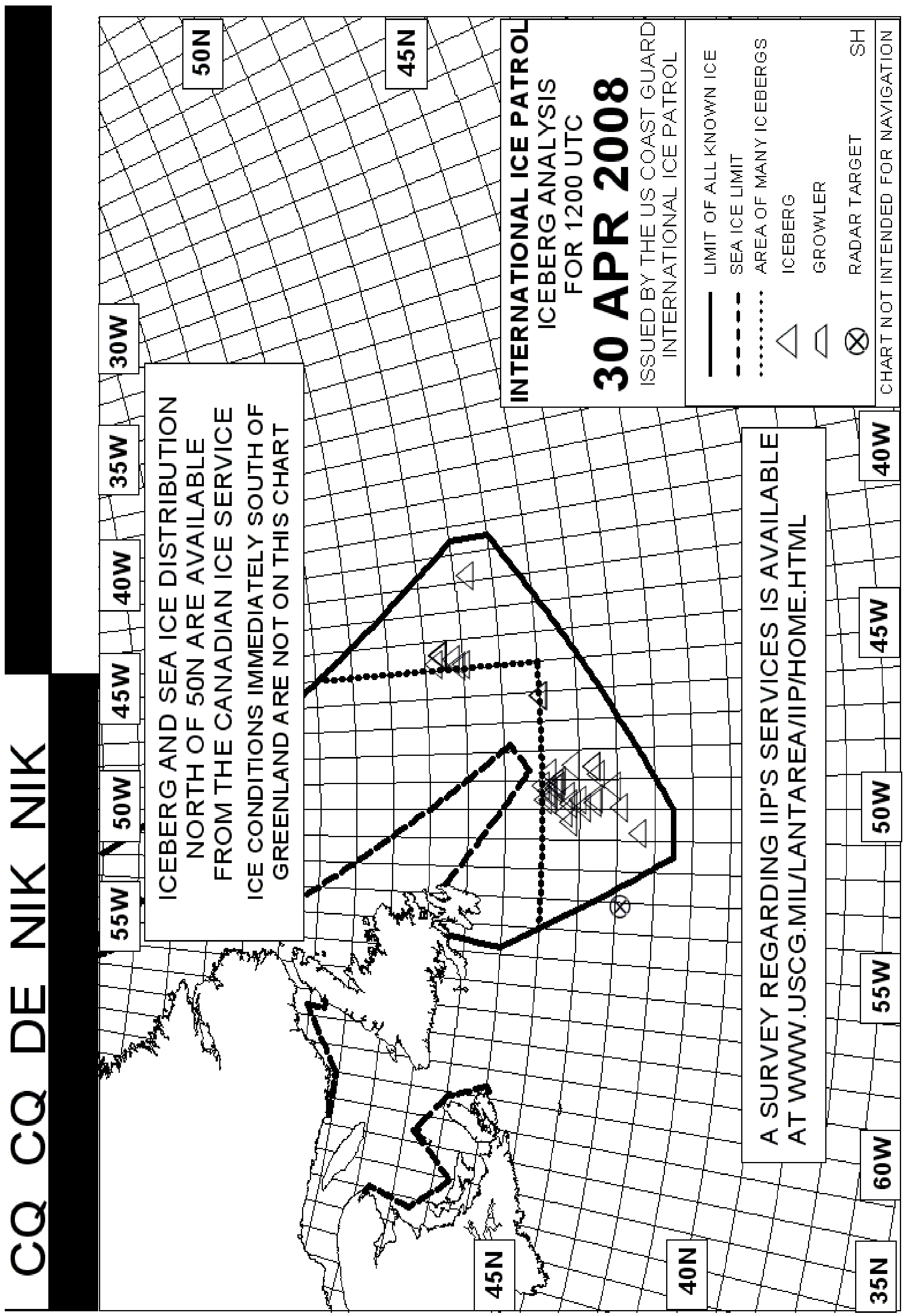
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
KNOWN DATA LIMIT /
LIMITE DES DONNES CONNUES
NOTE: EMPTY SQUARES INSIDE THE ICEBERG LIMIT MAY CONTAIN BERGY BITS OR GROWLERS
NOTE: LES CARRES VIDES A L'INTERIEUR DE LA LIMITE DES ICEBERGS PEUVENT CONTENIR DES FRAGMENTS D' ICEBERG OU DES BOURGUIGNONS.
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
15 APR / AVR 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
NOTE: ICEBERG LIMIT AND DISTRIBUTION VICINITY OF THE LIMIT SOUTH OF 52N ESTIMATED BY THE INTERNATIONAL ICE PATROL
NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
RJP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AT WWW.USCG.MIL/LANTAREA/IIP/HOME.HTML
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ICEBERG ANALYSIS
FOR 1200 UTC
30 APR 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
SEA ICE LIMIT
AREA OF MANY ICEBERGS
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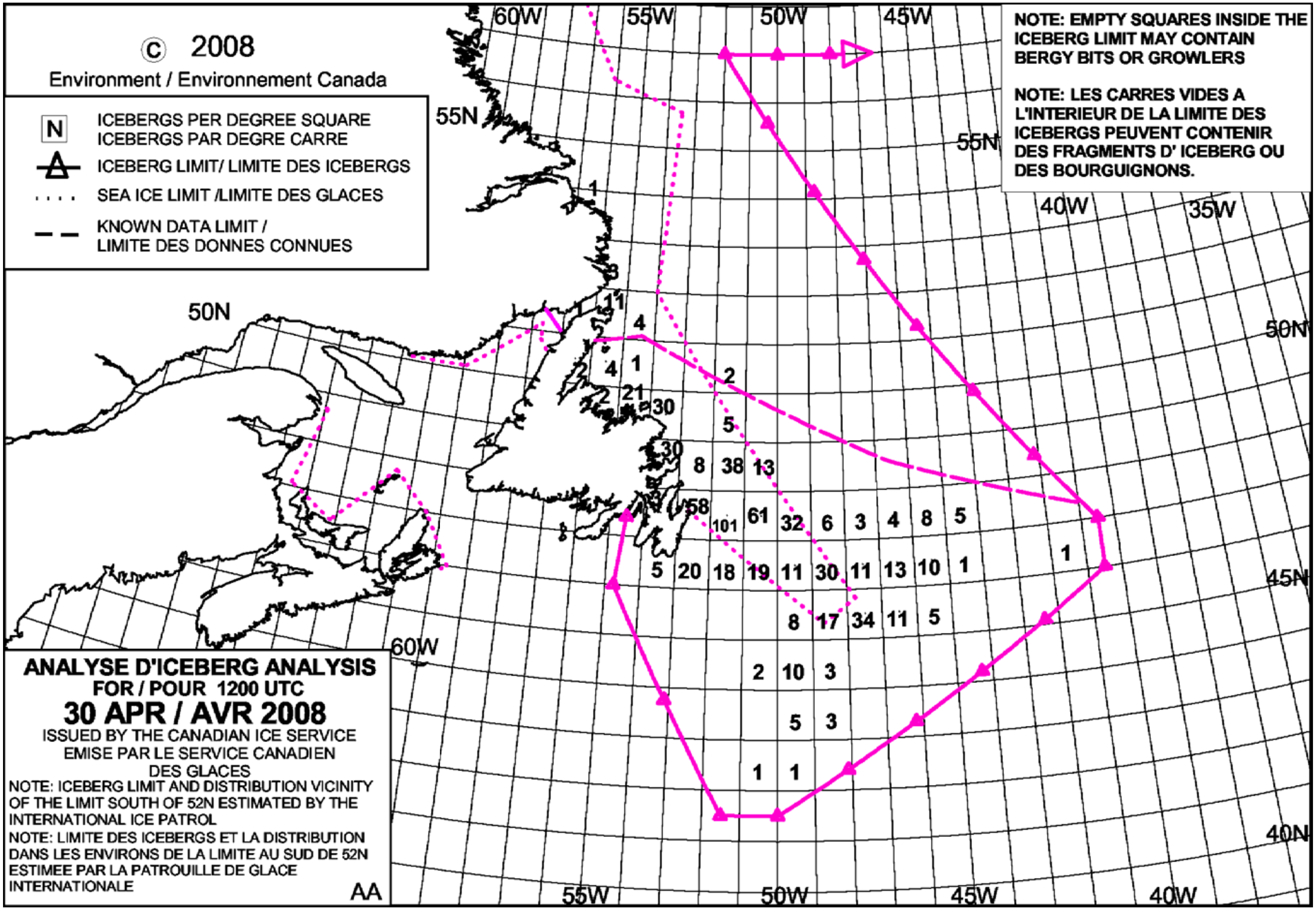

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ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
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NOTE: EMPTY SQUARES INSIDE THE ICEBERG LIMIT MAY CONTAIN BERGY BITS OR GROWLERS
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FOR / POUR 1200 UTC
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NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
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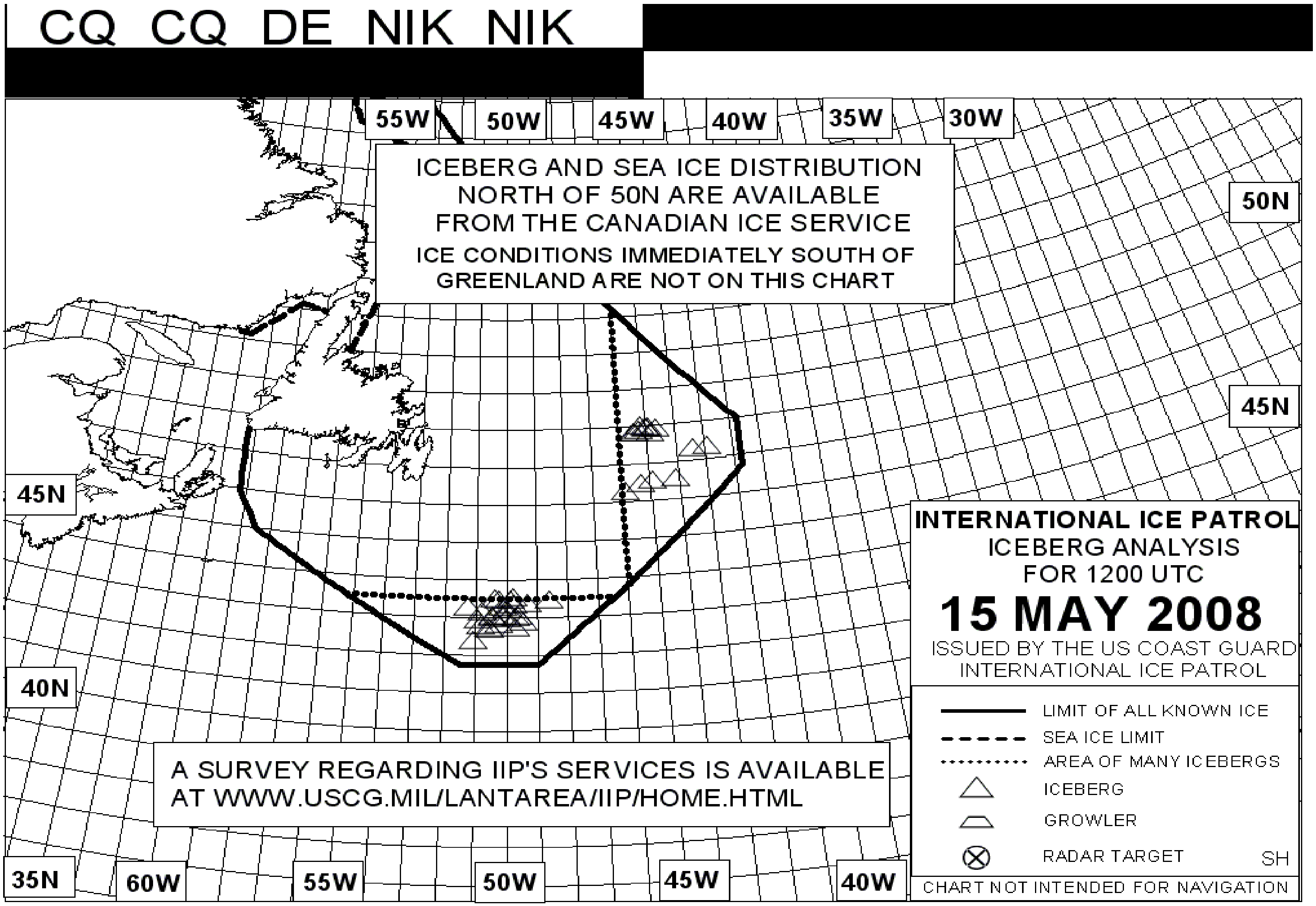
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INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
15 MAY 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
SEA ICE LIMIT
AREA OF MANY ICEBERGS
ICEBERG
GROWLER
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A SURVEY REGARDING IIP'S SERVICES IS AVAILABLE
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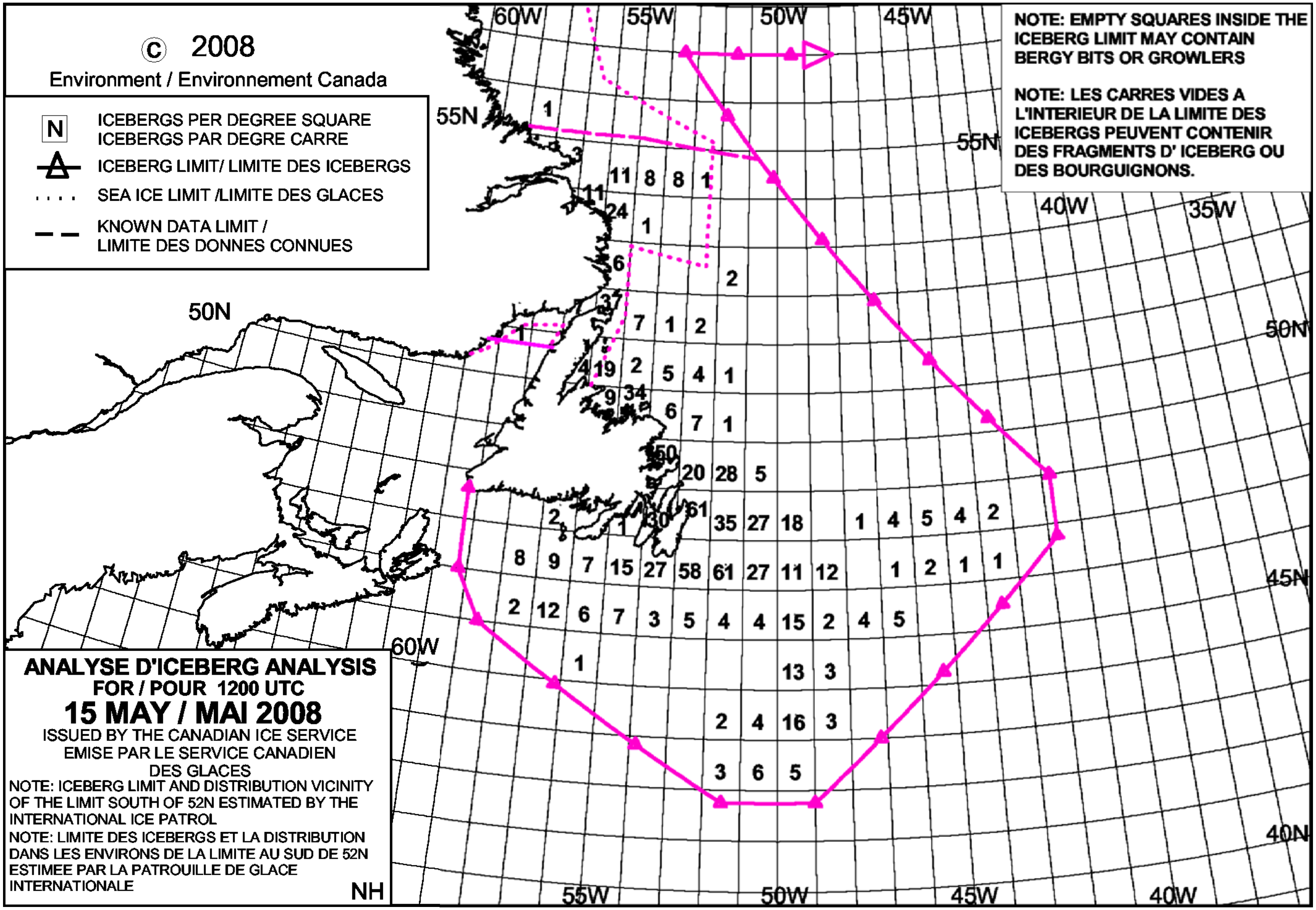
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N ICEBERGS PER DEGREE SQUARE
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NOTE: EMPTY SQUARES INSIDE THE ICEBERG LIMIT MAY CONTAIN BERGY BITS OR GROWLERS
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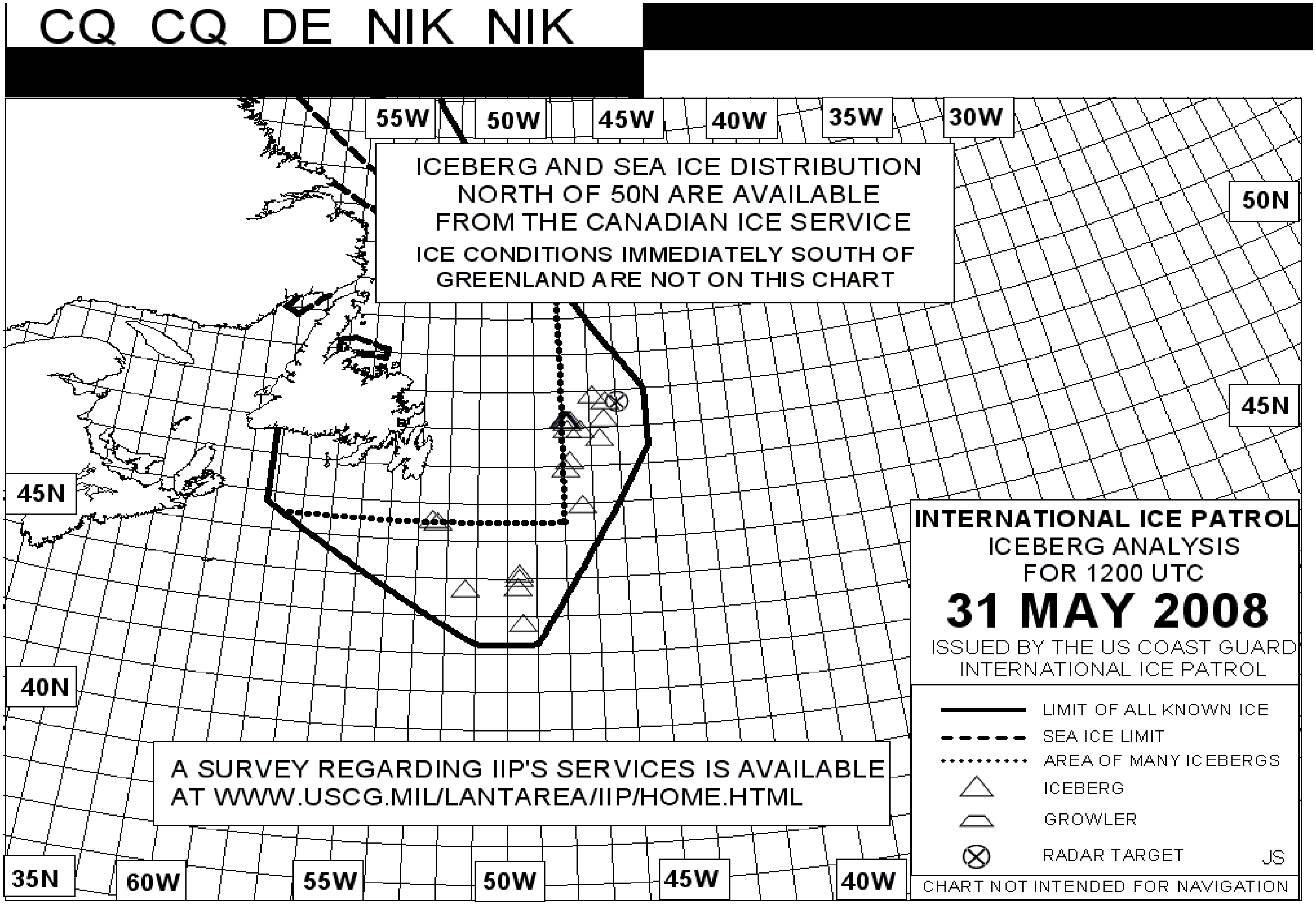
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
15 MAY / MAI 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN
DES GLACES
NOTE: ICEBERG LIMIT AND DISTRIBUTION VICINITY OF THE LIMIT SOUTH OF 52N ESTIMATED BY THE INTERNATIONAL ICE PATROL
NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
NH


CQ CQ DE NIK NIK
ICEBERG AND SEA ICE DISTRIBUTION
NORTH OF 50N ARE AVAILABLE
FROM THE CANADIAN ICE SERVICE
ICE CONDITIONS IMMEDIATELY SOUTH OF
GREENLAND ARE NOT ON THIS CHART
A SURVEY REGARDING IIP'S SERVICES IS AVAILABLE
AT WWW.USCG.MIL/LANTAREA/IIP/HOME.HTML
INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
31 MAY 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
SEA ICE LIMIT
AREA OF MANY ICEBERGS
ICEBERG
GROWLER
RADAR TARGET
JS
CHART NOT INTENDED FOR NAVIGATION
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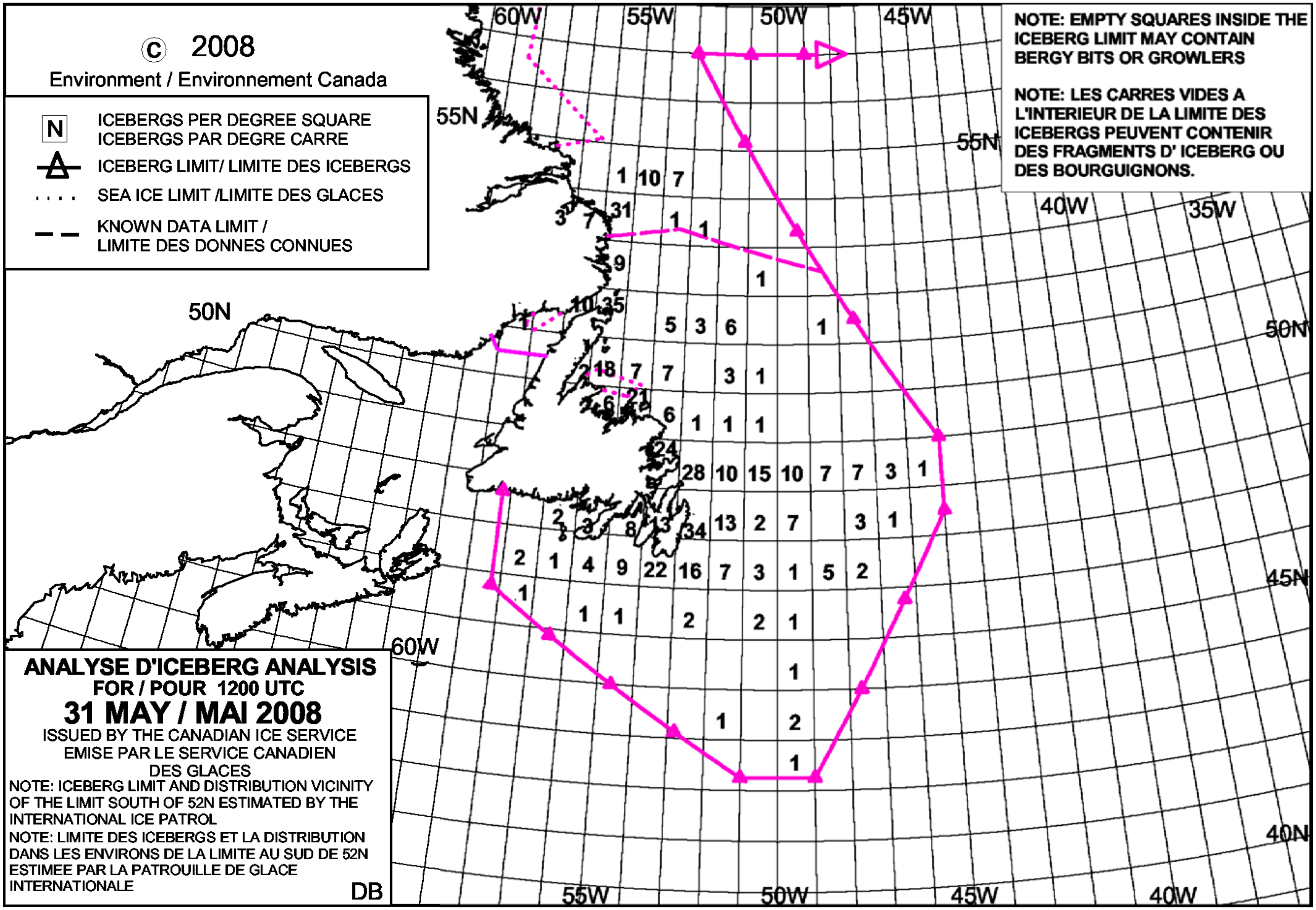

© 2008
Environment / Environnement Canada
ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
KNOWN DATA LIMIT /
LIMITE DES DONNES CONNUES
NOTE: EMPTY SQUARES INSIDE THE ICEBERG LIMIT MAY CONTAIN BERGY BITS OR GROWLERS
NOTE: LES CARRES VIDES A L'INTERIEUR DE LA LIMITE DES ICEBERGS PEUVENT CONTENIR DES FRAGMENTS D' ICEBERG OU DES BOURGUIGNONS.
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
31 MAY / MAI 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
NOTE: ICEBERG LIMIT AND DISTRIBUTION VICINITY OF THE LIMIT SOUTH OF 52N ESTIMATED BY THE INTERNATIONAL ICE PATROL
NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
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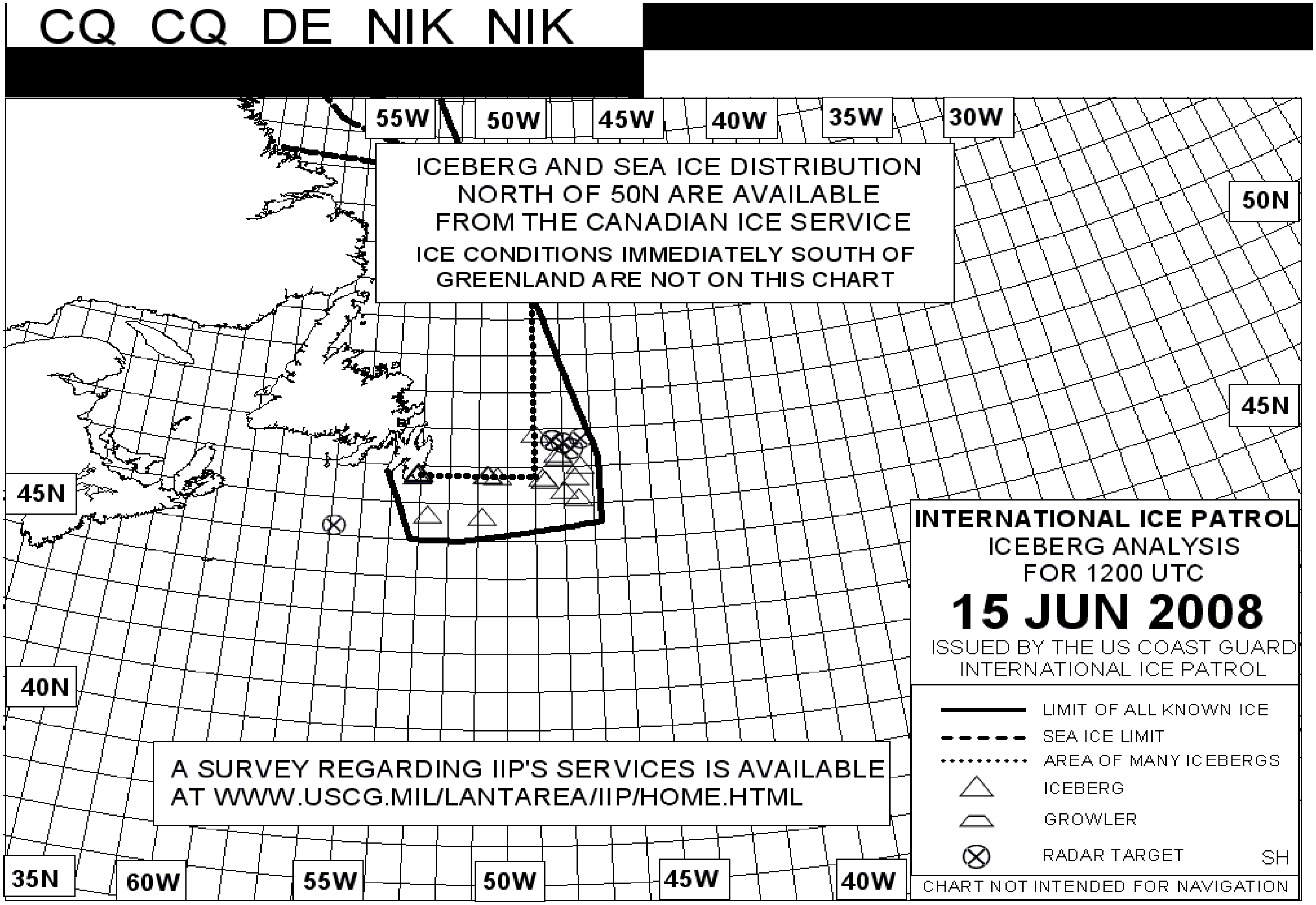
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ICEBERG AND SEA ICE DISTRIBUTION
NORTH OF 50N ARE AVAILABLE
FROM THE CANADIAN ICE SERVICE
ICE CONDITIONS IMMEDIATELY SOUTH OF
GREENLAND ARE NOT ON THIS CHART
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A SURVEY REGARDING IIP'S SERVICES IS AVAILABLE
AT WWW.USCG.MIL/LANTAREA/IIP/HOME.HTML
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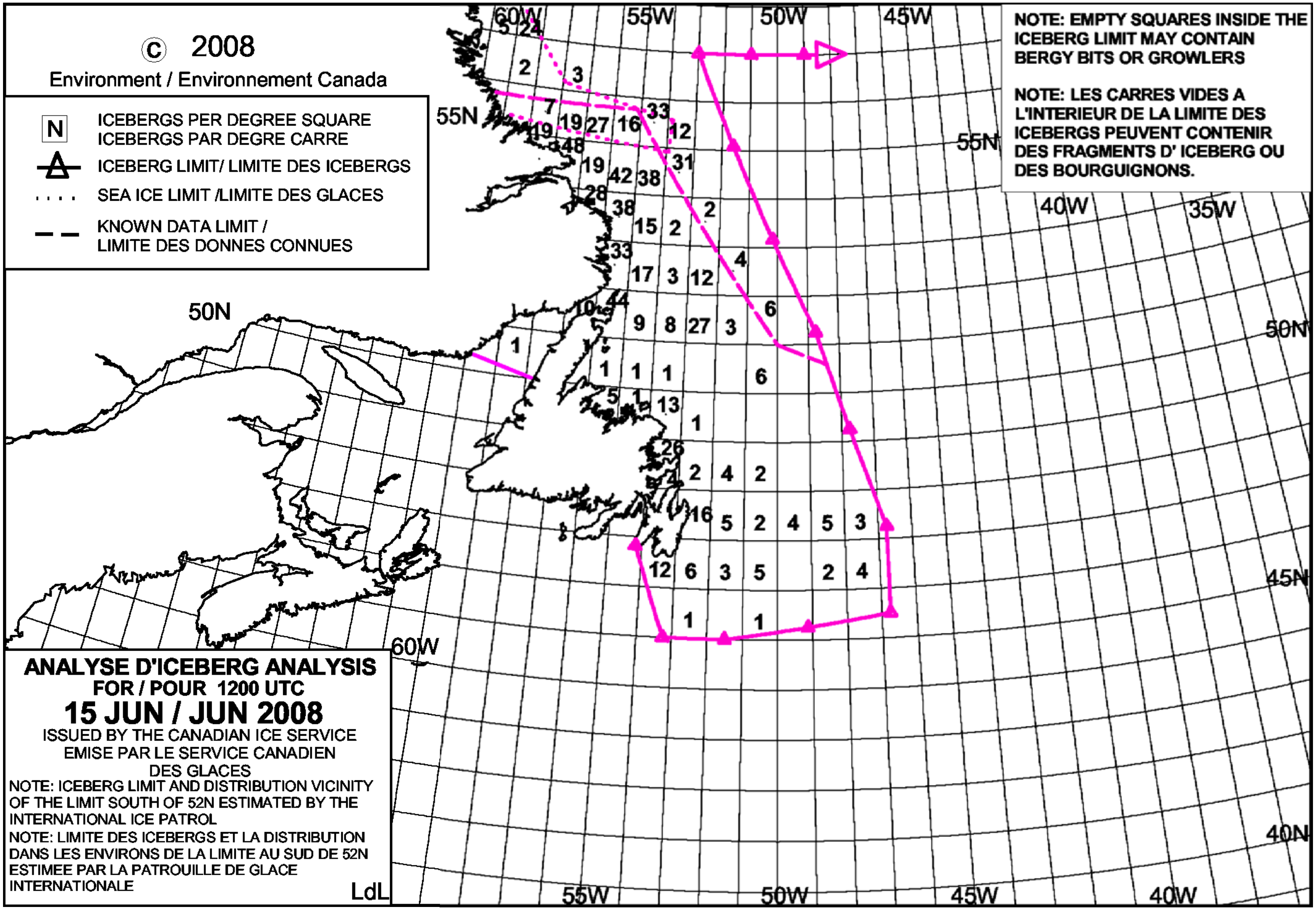
INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
15 JUN 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
SEA ICE LIMIT
AREA OF MANY ICEBERGS
ICEBERG
GROWLER
RADAR TARGET
SH
CHART NOT INTENDED FOR NAVIGATION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Environment / Environnement Canada
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
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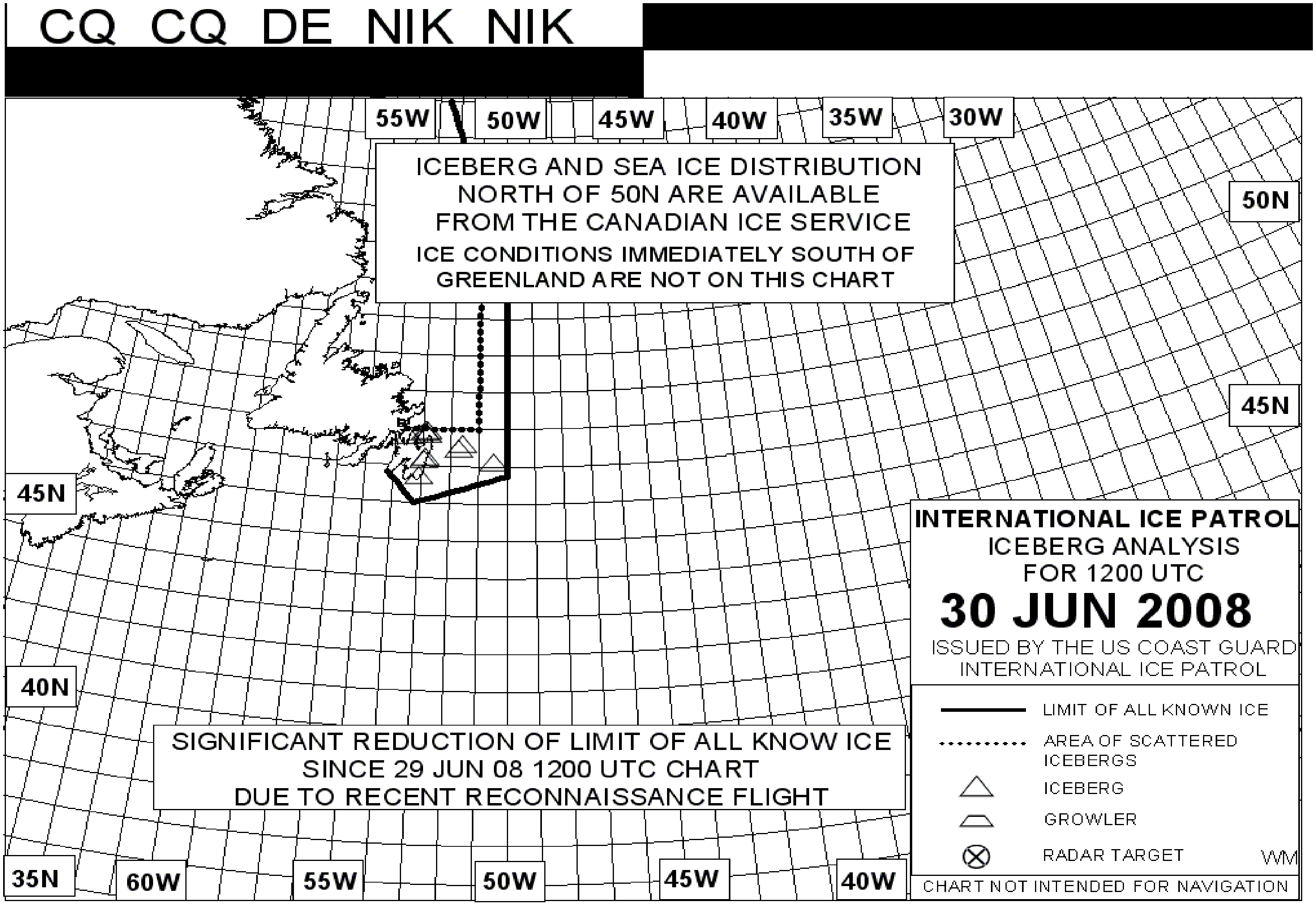
ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
15 JUN / JUN 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
NOTE: ICEBERG LIMIT AND DISTRIBUTION VICINITY OF THE LIMIT SOUTH OF 52N ESTIMATED BY THE INTERNATIONAL ICE PATROL
NOTE: LIMITE DES ICEBERGS ET LA DISTRIBUTION DANS LES ENVIRONS DE LA LIMITE AU SUD DE 52N ESTIMEE PAR LA PATROUILLE DE GLACE INTERNATIONALE
LdL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ICEBERG AND SEA ICE DISTRIBUTION
NORTH OF 50N ARE AVAILABLE
FROM THE CANADIAN ICE SERVICE
ICE CONDITIONS IMMEDIATELY SOUTH OF
GREENLAND ARE NOT ON THIS CHART
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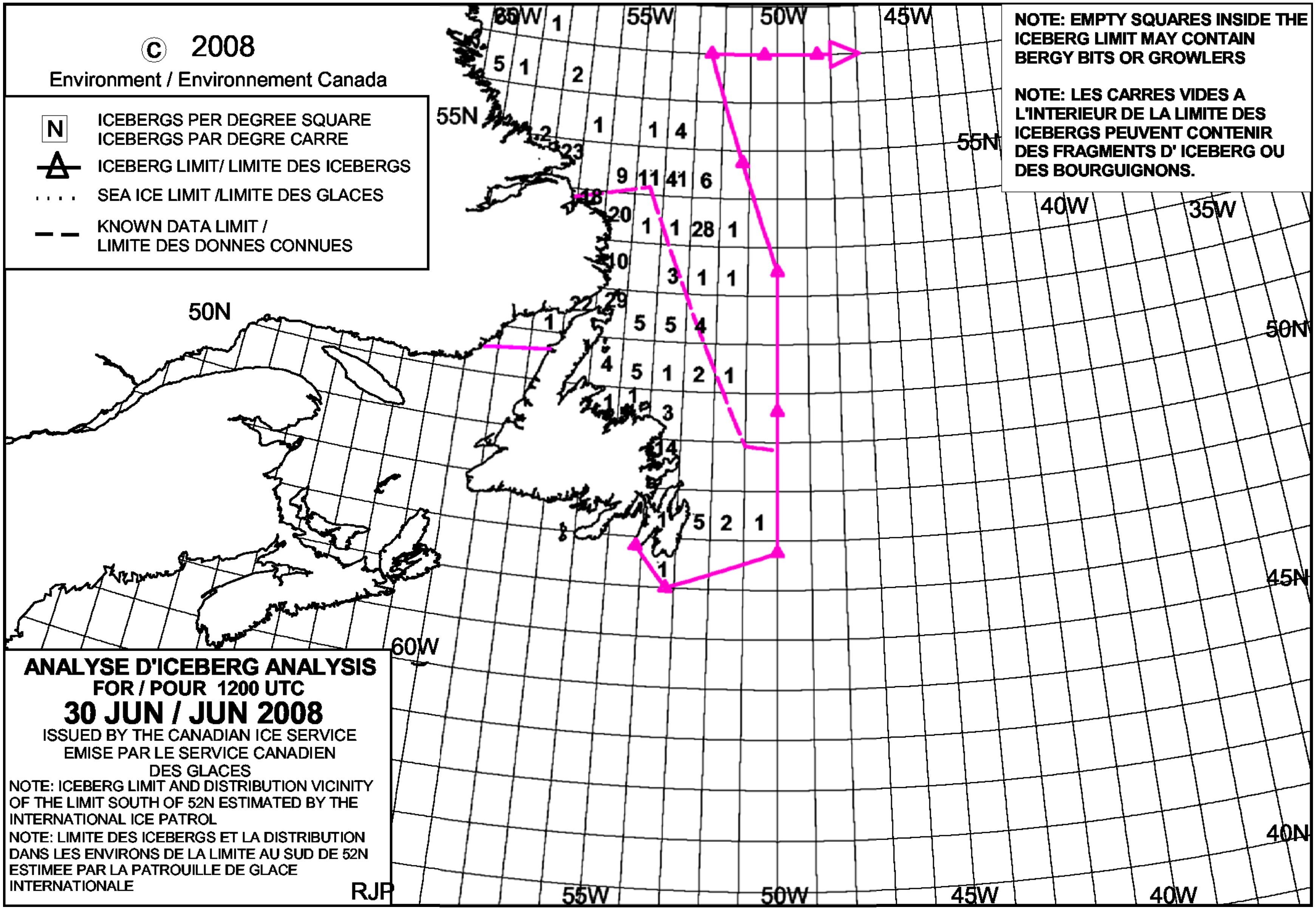
SIGNIFICANT REDUCTION OF LIMIT OF ALL KNOW ICE
SINCE 29 JUN 08 1200 UTC CHART
DUE TO RECENT RECONNAISSANCE FLIGHT
INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
30 JUN 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
AREA OF SCATTERED ICEBERGS
ICEBERG
GROWLER
RADAR TARGET
WM
CHART NOT INTENDED FOR NAVIGATION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Environment / Environnement Canada
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
KNOWN DATA LIMIT /
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ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
30 JUN / JUN 2008
ISSUED BY THE CANADIAN ICE SERVICE
EMISE PAR LE SERVICE CANADIEN DES GLACES
NOTE: ICEBERG LIMIT AND DISTRIBUTION VICINITY OF THE LIMIT SOUTH OF 52N ESTIMATED BY THE INTERNATIONAL ICE PATROL
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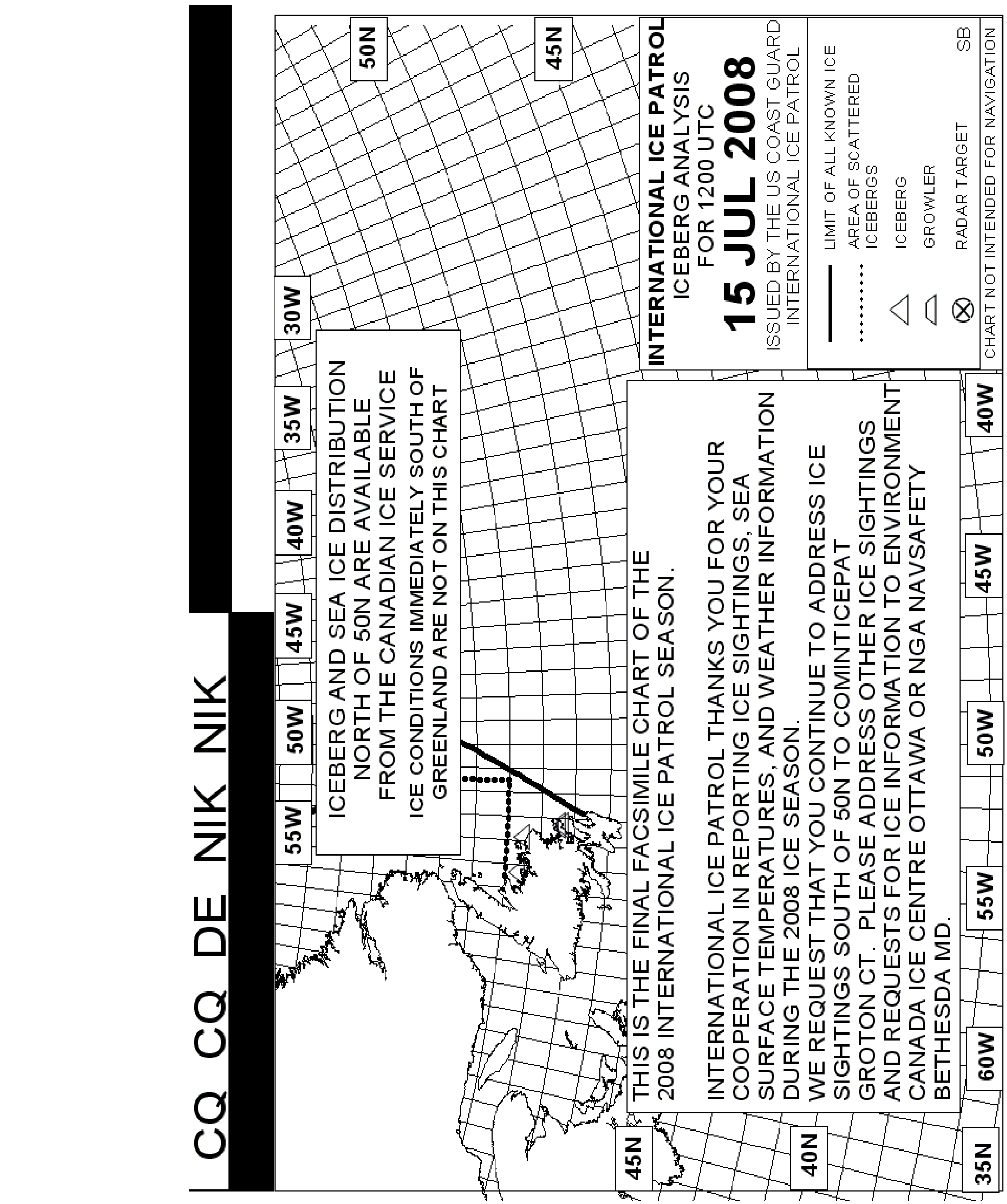
CQ CQ DE NIK NIK
ICEBERG AND SEA ICE DISTRIBUTION
NORTH OF 50N ARE AVAILABLE
FROM THE CANADIAN ICE SERVICE
ICE CONDITIONS IMMEDIATELY SOUTH OF
GREENLAND ARE NOT ON THIS CHART
THIS IS THE FINAL FACSIMILE CHART OF THE
2008 INTERNATIONAL ICE PATROL SEASON.
INTERNATIONAL ICE PATROL THANKS YOU FOR YOUR
COOPERATION IN REPORTING ICE SIGHTINGS, SEA
SURFACE TEMPERATURES, AND WEATHER INFORMATION
DURING THE 2008 ICE SEASON.
WE REQUEST THAT YOU CONTINUE TO ADDRESS ICE
SIGHTINGS SOUTH OF 50N TO COMINTICEPAT
GROTON CT. PLEASE ADDRESS OTHER ICE SIGHTINGS
AND REQUESTS FOR ICE INFORMATION TO ENVIRONMENT
CANADA ICE CENTRE OTTAWA OR NGA NAVSAFETY
BETHESDA MD.
INTERNATIONAL ICE PATROL
ICEBERG ANALYSIS
FOR 1200 UTC
15 JUL 2008
ISSUED BY THE US COAST GUARD
INTERNATIONAL ICE PATROL
LIMIT OF ALL KNOWN ICE
AREA OF SCATTERED ICEBERGS
ICEBERG
GROWLER
RADAR TARGET
SB
CHART NOT INTENDED FOR NAVIGATION
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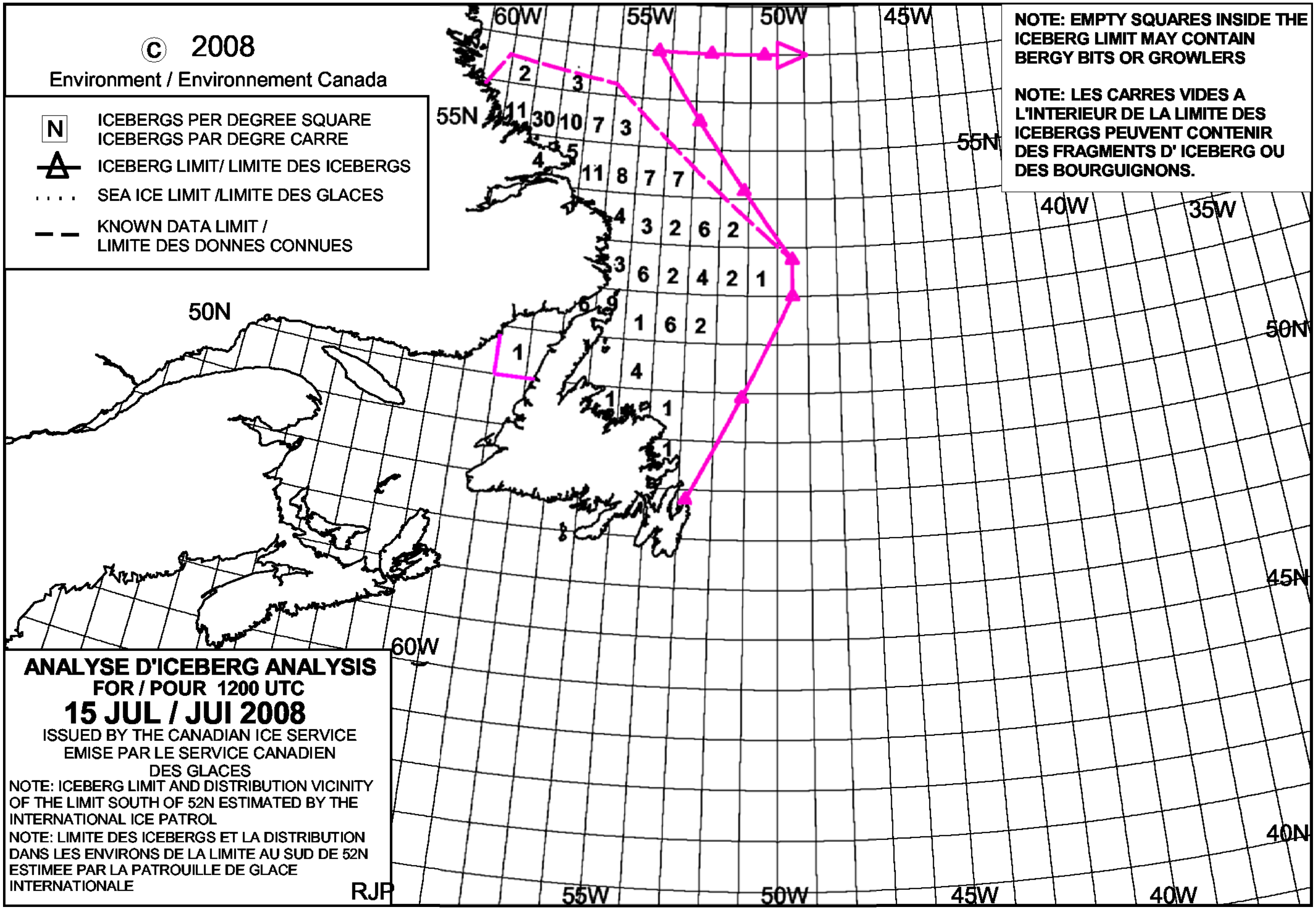
© 2008
Environment / Environnement Canada
N ICEBERGS PER DEGREE SQUARE
ICEBERGS PAR DEGRE CARRE
ICEBERG LIMIT/ LIMITE DES ICEBERGS
SEA ICE LIMIT /LIMITE DES GLACES
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ANALYSE D'ICEBERG ANALYSIS
FOR / POUR 1200 UTC
15 JUL / JUI 2008
ISSUED BY THE CANADIAN ICE SERVICE
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RJP

Acknowledgements

Commander, International Ice Patrol acknowledges the following for providing information and assistance:

C-CORE
Canadian Coast Guard
Canadian Forces
Canadian Ice Service
Canadian Maritime Atlantic Command Meteorological and Oceanographic Center
Department of Fisheries and Oceans Canada
German Federal Maritime and Hydrographic Agency
National Geospatial-Intelligence Agency
National Ice Center
National Weather Service
Nav Canada Flight Services
Provincial Aerospace Limited
U.S. Coast Guard Air Station Elizabeth City
U.S. Coast Guard Atlantic Area Command Center
U.S. Coast Guard Atlantic Area Staff
U.S. Coast Guard Automated Merchant Vessel Emergency Response System
U.S. Coast Guard Communications Area Master Station Atlantic
U.S. Coast Guard Operations Systems Center
U.S. Coast Guard Research and Development Center
U.S. Naval Atlantic Meteorology and Oceanography Center
U.S. Naval Fleet Numerical Meteorology and Oceanography Center

It is important to recognize the outstanding efforts of the personnel assigned to the International Ice Patrol during the 2008 Ice Season:

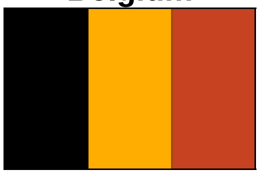
CDR S. D. Rogerson
LCDR G. G. McGrath
Dr. D. L. Murphy
Mr. G. F. Wright
Mrs. B. J. Lis
LT W. C. Woityra
LT K. M. Nolan
LTJG S. R. Houle
MSTCS J. M. Stengel
YN1 D. C. Phillips
MST1 H. L. Brittle
MST2 W. W. Mendenhall
MST2 S. B. McClellan
MST2 J. N. Sherrill
MST2 G. J. Woolverton
MST3 S. J. Weitkamp
MST3 S. A. Baumgartner
MST3 S. P. Kasper
MST3 W. N. Moran

International Ice Patrol staff produced this report using Microsoft® Word 2003 and Excel 2003.

Appendix A

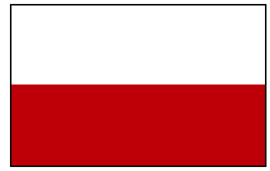
Nations Currently Supporting International Ice Patrol

Belgium

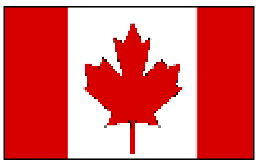


Greece

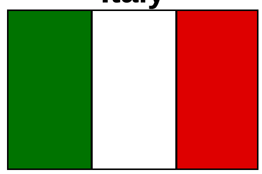
Poland



Canada



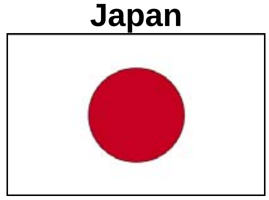
Italy



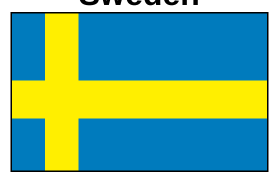
Spain

Denmark

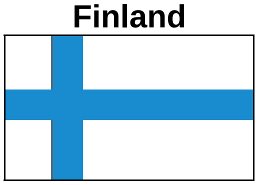
Japan



Sweden



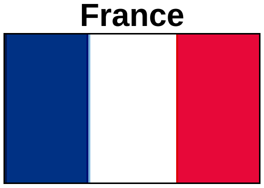
Finland



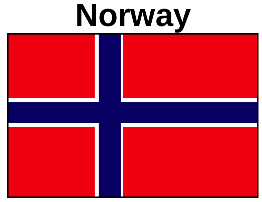
Netherlands

United Kingdom

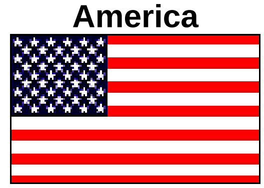
France



Norway

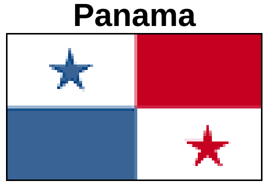


United States of America



Germany

Panama



Appendix B

Ship Reports for Ice Year 2008
(Oct 1st, 2007 – Sep 30th, 2008)

Ships Reporting By Flag	Reports
ANTIGUA & BARBUDA	
BELUGA ELEGANCE	1
BELUGA ENTERPRISE	2
BELUGA FEDERATION	7
BELUGA FLIRTATION	1
CELIA	3
HANSE EXPLORER	10
HOLMFOSS	1
PUFFIN	1
THEKLA	5
BAHAMAS	
ALIDA GORTHON	3
APOLLON	1
ARIADNE	1
ATLANTIC CARTIER	38
BALDOCK	3
BREMEN	1
CLIPPER LEADER	1
DAVIKEN	2
EXPLORER	2
FEDERAL FUJI	1
FEDERAL POLARIS	2
GENIE	1
JAEGER ARROW	4
KYEEMA SPIRIT	5
SWIFT ARROW	1
TOISA VALIANT	19
BARBADOS	
FEDERAL SAGUENAY	1

Ships Reporting By Flag	Reports
BELGIUM	
LOWLANDS LONGEVITY	10
BERMUDA	
CANMAR VICTORY	1
ENDURANCE	2
OTTAWA EXPRESS	4
STENA CONQUEST	1
STENA PERROS	17
CANADA	
ALGOEAST	2
ALGOSCOTIA	2
ARCTIC	22
ATLANTIC EAGLE	1
ATLANTIC HAWK	4
BIRCHGLEN	1
BURIN SEA	4
CABOT	6
CAPE NEDDICK	1
CCGS ANN HARVEY	2
CCGS DES GROSEILLIERS	7
CCGS HENRY LARSEN	31
CCGS LEONARD J. COWLEY	1
CCGS MATTHEW	3
CCGS PIERRE RADISSON	2
CCGS TERRY FOX	4
CCGS W. JACKMAN	1
DIAMOND STAR	1
DUTCH RUNNER	1
HMCS GOOSEBAY	1

Ships Reporting by Flag	Reports
CANADA cont.	
INUKSUK I	1
JADE STAR	2
KATHRYN SPIRIT	4
KOMETIK	10
MAERSK NASCOPIE	1
MAERSK PLACENTIA	1
MARIA DESGAGNES	3
MATTEA	42
NORTHERN ENTERPRISE	1
OCEAN DELTA	3
OCEANEX AVALON	4
OCEANEX SANDERLING	1
ROYAL MARINER	1
SARAH DESGAGNES	3
TUVAQ	4
UMIAK I	28
VEGA DESGAGNES	1
CAYMAN ISLANDS	
ICE CRYSTAL	2
ICE STAR	19
INTUITION II	1
JILL JACOB	1
CHINA, PEOPLES REPUBLIC	
LIAN SHENG HU	2
CROATIA	
ORSULA	1
CYPRUS	
ADRIANPOLE	3
BBC ONTARIO	3
BLUEBILL	2
BLUEWING	1
CMA CGM MATISSE	3

Ships Reporting by Flag	Reports
CYPRUS cont.	
CMA CGM UTRILLO	27
DARIA	10
FEDERAL PATROLLER	2
INGRID GORTHON	3
IRAN YAZD	9
IRMA	1
ISA	5
ISADORA	34
ISOLDA	3
KONDOR EXPLORER	1
MANDARIN	1
NORDMARK	11
ONEGO ZONDA	7
PRIMOYRE	5
SEABOARD PIONEER	2
DENMARK	
GREAT SWAN	1
FINLAND	
STENA POSEIDON	10
FRANCE	
THALASSA	1
GERMANY	
MARIA S. MERIAN	9
NORTHERN JOY	5
GIBRALTAR	
BBC NORDLAND	5
TRANSHAWK	8
GREECE	
AEGEAS	1
BYZANTION	3

Ships Reporting By Flag	Reports
GREECE cont.	
CAP DIAMANT	7
CAP LAURENT	81
CAP LEON	34
CAPE PROVIDENCE	1
FANTASY	4
MILO	2
MSC TUSCANY	1
MSC YOKOHAMA	2
VASOS K	1
VENETIA	3
HONG KONG	
DARYA RADHE	1
FEDERAL NAKAGAWA	4
FEDERAL SETO	2
FEDERAL VENTURE	2
FORTUNE RAINBOW	2
FRONT SHANGHAI	1
FULL COMFORT	1
GADWALL	1
GENCO LONDON	1
GOLDEN MERCHANT II	1
GRAND WAY	25
OOCL BELGIUM	5
OOCL FORTUNE	1
OOCL MONTREAL	2
SAGA JANDAIA	2
TIAN YU FENG	6
WHISTLER	1
IRAN	
IRAN AZARBAYJAN	1
ISLE OF MAN	
BRITISH COURTESY	1
MARK C	1

Ships Reporting By Flag	Reports
ITALY	
BBC FINLAND	1
LADY AMY	1
LAGUNA D	9
LIBERIA	
BAFFIN	1
EVA N	22
GRAND ESMERALDA	1
HEDWIG OLDENDORFF	18
HIGH PROGRESS	1
INDEPENDENT VENTURE	2
JULIAN N	3
KEMERI	2
MONTROSE	10
PERKA	1
SCF PECHORA	2
ST. PAUL	1
TARANG	3
ZIEMIA CIESZYNSKA	2
LITHUANIA	
BORGIN	1
STARIS	1
MALAYSIA	
SELENDANG INTAN	8
MALTA	
CAMOGLI STAR	4
CATRIENA	3
LIANO	1
PATRIARCH	9
POLLUX	2
SICHEM PADUA	4
UNFAIR LADY	1

Ships Reporting By Flag	Reports
MARSHALL ISLANDS	
GLOBAL TRIUMPH	1
KANDAVA	3
NAVIGA8 STEALTH II	1
OVERSEAS AMBERMAR	1
SICHEM DEFIANCE	2
SKS SINNI	1
TASMAN CAMPAIGNER	10
VALDIVIA	8
NETHERLANDS	
ASIABORG	2
AVATAQ	2
EDISONGRACHT	2
EGELANTIERSGRACHT	1
FLINTEREEMS	1
GENCA	1
KEIZERSBORG	1
MAASDAM	2
MAERSK PALERMO	18
MAERSK PENANG	5
MAINEBORG	14
MARLENE GREEN	3
METSABORG	3
MOEZELBORG	2
ONEGO MERCHANT	3
ORANJEBORG	1
SLUISGRACHT	3
SPAARNEGRACHT	1
STADIONGRACHT	1
VICTORIABORG	1
NETHERLAND ANTILLES	
KROONBORG	11
MEDEMBORG	2

Ships Reporting By Flag	Reports
NORWAY	
BERGE ATLANTIC	51
BERGE NORD*	161
BOW SIRIUS	1
CATHERINE KNUTSEN	1
HOEGH TREKKER	5
JACO TRIUMPH	1
NCC RIYAD	1
NORDIC HELSINKI	2
TURID KNUTSEN	7
VERITAS VANTAGE	1
PANAMA	
BW ARCTIC	9
CHANG HO	2
COSGRAND LAKE	9
CREST TRADER	6
EVER BLOSSOM	1
FEDERAL KATSURA	1
FEDERAL SHIMANTO	1
FRIO POSIEDON	1
GLOBAL OCEAN	1
GLORY I	13
GSI PACIFIC	1
INGOLSTADT	9
JIMRICH	2
LOWLANDS OPAL	2
LUCIA BULKER	1
MSC DYMPHNA	2
MSC JORDAN	22
MSC NIKITA	20
MSC SABRINA	7
MSC SERENA	3
NAVIGATOR II	3
NORNA N	2
ORIENTAL KERRIA	3

Ships Reporting By Flag	Reports
PANAMA cont.	
PRINCESS MARISOL	5
SICHEM MUMBAI	2
TRITON EAGLE	1
WORLD TRADER I	1
RUSSIA	
KUZMA MININ	2
MAROANJOCA	2
SINGAPORE	
ALAM MESRA	1
ALAM PERMAI	7
CAPE CATHAY	1
MOOR	13
OSHIMANA	2
SICHEM BEIJING	8
SICHEM CHALLENGE	2
SICHEM EVA	1
SICHEM MARSEILLE	1
SICHEM ONOMICHI	21
SICHEM PEARL	4
STAR SIRANGER	18
SWEDEN	
FINNFIGHTER	4
FINNWOOD	3

Ships Reporting By Flag	Reports
SWEDEN cont.	
STENA PRIMORSK	12
TRANSMAPLE	8
TRANSOAK	9
SWITZERLAND	
MARTIGNY	1
SILVRETTA	1
TURKEY	
EYLUL K	1
UNITED KINGDOM	
ANVIL POINT	9
BARMBEK	23
FLOTTBEK	9
JEAN CHARCOT	2
MAERSK PATRAS	10
MONTREAL EXPRESS	14
UNITED STATES OF AMERICA	
KNORR	15
UNKNOWN	
UNKNOWN SHIP	101

***Denotes 2008 Carpathia Award Winner**

*

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TECHNOLOGY ADMINISTRATION
NATIONAL TECHNICAL INFORMATION SERVICE

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