A Proposed Arctic Search and Rescue Strategy for Canada

By

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Signature Page

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The undersigned hereby certify that they have read and recommend to the Marine Affairs Program for acceptance a graduate research project entitled "*A Proposed Arctic SAR Strategy for Canada"* by William Russell in partial fulfillment of the requirements for the degree of Master of Marine Management.

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Abstract

Russell, W. (2011). A Proposed Arctic Search and Rescue Strategy for Canada. [graduate project]. Halifax, NS: Dalhousie University.

The Canadian Arctic has experienced a notable increase in maritime activity in recent years, driven in part by increased accessibility due to environmental changes as well as a growing northern cruise industry and hydrocarbon and mineral extraction projects. The present and expected future expansion of these activities has prompted concerns regarding the provision of northern government services, in particular the lack of Search and Rescue (SAR) infrastructure within the Arctic. To this end, the *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue* (ASAR) was signed at the 2011 Ministerial Meeting of the Arctic Council, requiring member states to establish an "adequate and effective search and rescue capability" (Arctic Council, 2011). Drawing upon the requirements of the recently signed ASAR Agreements, supported by a discussion regarding future northern activity projections and considerations from past Arctic SAR incidents, this study provides recommendations for a SAR strategy for the Canadian Arctic. Elements addressed include the absence of effective Strategic Management Plan for Canadian SAR, community initiatives and a discussion regarding the levels of service for SAR within the Arctic.

Keywords: Arctic, Search and Rescue (SAR), Arctic Council, Canadian Coast Guard, emergency services

Glossary

- AC- Arctic Council
- ACIA[1]- *Arctic Communications Infrastructure Assessment*
- ACIA[2]- *Arctic Climate Impact Assessment*
- AECO- Arctic Expedition Cruise Operators
- AECO- Association of Arctic Expedition Cruise Operators
- AIS- Automatic Identification System
- AMSA- *Arctic Marine Shipping Assessment*
- AMVER- Automated Mutual-Assistance Vessel Rescue System
- AOPS- Arctic/Offshore Patrol Ships
- ASAR- Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic
- CASARA- Civil Air Search and Rescue Association
- CCG- Canadian Coast Guard
- CCGA- Canadian Coast Guard Auxiliary
- CF- Canadian Forces
- Chicago Convention- *Convention on International Civil Aviation*
- CIS- Canadian Ice Service
- CSA 2001- Canadian Shipping Act
- CSS- Coordinator Surface Search
- DASS- Distress Alerting Satellite System
- DEW- Distant Early Warning Line
- DND- Department of National Defense
- DNV- *Det Norske Veritas*
- DOT- Department of Transportation
- DSC- Digital Selective Calling
- EER- Evacuation and Rescue
- EEZ- Exclusive Economic Zone
- ELT- Emergency Locator Transmitter
- EMSA- European Maritime Safety Administration
- EPIRB- Emergency Position-Indicating Radio Beacon
- F/V- Fishing Vessel
- GEM- Geo-mapping for Energy and Minerals project
- GEO Satellites - Geostationary Earth Orbit Satellites
- GMDSS- Global Maritime Distress and Safety System
- GPS- Global Positioning System
- HF- High Frequency
- HSE- Health, Safety and Environment
- IAATO- International Association of Antarctica Tour Operators
- IAMSAR Manual- *International Aeronautical and Maritime Search and Rescue Manual*
- ICAO- International Civil Aviation Organization

- ICSAR- Interdepartmental Committee on Search and Rescue
- IMO- International Maritime Organization
- JRCC- Joint Rescue Coordination Centres
- LEO Satellites- Low Earth Orbit Satellites
- LMSAR- Lead Minister for SAR
- LOS- Level of Service
- LRIT- Long Range Identification and Tracking
- M/V- Motor Vessel
- MAJAID- Major Air Disaster
- MARIN- Maritime Activity and Risk Investigation Network
- MCTS- Marine Communications and Traffic Services
- MEO satellites- Medium Earth Orbit Satellites
- MF- Medium Frequency
- NSP- National Search and Rescue Program
- NSR- Northern Sea Route
- NSS- Search and Rescue Secretariat
- NWP- Northwest Passage
- OSC- On-Scene Commander
- PLB- Personal Locator Beacon
- POB- People on Board
- RCAF- Royal Canadian Air Force
- RHIB- Rigid Hull Inflatable Boat
- S/V- Sailing Vessel
- Salvage Convention- *Convention for the Unification of Certain Rules of Law respecting Assistance and Salvage at Sea*
- SAR Convention- *International Convention on Maritime Search and Rescue*
- SAR- Search and Rescue
- SKAD- Survival Kit Air Droppable
- SOLAS- *International Convention for the Safety of Life at Sea*
- SRR- Search and Rescue Region
- SRU- Search and Rescue Unit
- UNCLOS- 1982 *United Nations Convention on the Law of the Sea*
- VHF- Very High Frequency

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A Proposed Arctic Search and Rescue Strategy for Canada

Section I- Defining the Issue

Introduction

Testifying before the Standing Senate Committee on National Security and Defence in 2010, the Canadian Chief of the Defence General Walt Natynczyk, stated that upon receiving news that a foreign military force had invaded the Canadian Arctic, his "first challenge [would be] search and rescue to help them out"(2010, 28) General Natynczyk's testimony captures the difficulties of northern operations, as well as underscoring the limited Search and Rescue (SAR) response capabilities available within the Arctic. The Canadian Search and Rescue Region (SRR) is one of the largest in the world at 15.5 million square kilometres, and nearly 40% of this area is located north of the 60th parallel (Government of Canada, 2010a).[1] The national SRR is overseen by three Joint Rescue Coordination Centres (JRCC), located in: Victoria,

Figure I- Canadian SRR Boundaries

[1] The SRR of JRCC Halifax is 4.7 million square kilometres, 80 % of which is covered by water. JRCC Trenton is responsible for nearly 10 million square kilometres, 30 % of which is covered by water, while JRCC Victoria's SRR is 1.5 million square kilometres, 32 % of which is covered by water.

British Columbia; Trenton, Ontario; and Halifax, Nova Scotia. JRCC Halifax and Trenton are responsible for marine and aeronautical incidents within the majority of the Canadian Arctic, a region spanning nearly four million square kilometres.

The 2009 *Arctic Marine Shipping Assessment* (AMSA) highlighted the limitations of existing SAR capabilities across the polar region, noting that "except in limited areas of the Arctic, there is a lack of emergency response capacity for saving lives and for pollution mitigation" (Protection of the Arctic Marine Environment [PAME], 2009, 5). The report cautioned that "future increase in human activity in the Arctic, including Arctic marine shipping and the continued over flight of the Arctic region by commercial aircraft, will place increasing demands on the SAR infrastructure" (2009, 163). To this end, in 2009 the Arctic Council (AC) agreed that member states would work "to develop and complete negotiations…of an international instrument on cooperation on SAR operations in the Arctic" (Arctic Council, 2009, 5). In May 2011, the *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic* (ASAR) was signed in Nuuk, Greenland, providing a treaty basis for addressing the development of an international Arctic SAR strategy.

The fundamental challenge facing any SAR strategy is achieving a proper balance which favours survival while economizing effort and limiting costs. Within the Canadian Arctic however, the establishment of SAR services within the region is faced with numerous challenges, not the least of which is the fact that the Yukon, the Northwest Territories and Nunavut combined account for less that 0.3% (101,310) of the total Canadian population within an immense geographic area (Department of Natural Resources Canada, 2009). Yet, as marine traffic levels rise due to resource extraction

projects and the region becomes an increasingly popular tourist destination, there is a growing demand for government services, including SAR capabilities. Provision of these services, as appropriate to the situation within this remote area is important to meeting Canada's SAR obligations under the recently signed Agreement, as well as protecting the lives of northern Canadians. Furthermore, the implementation of federal services acts as a means to demonstrate the operational capabilities and influence of the Canadian government, as "security in the Arctic comes not only from strength but from services" (Government of Canada, 2010b).

However, prior to allocating SAR resources to this area, some thought must be given to the development of an Arctic specific SAR strategy, which includes consideration of the Level of Service (LOS) which may be expected by those who both live and work within this remote environment. Defining a management strategy for Arctic SAR is increasingly a pressing issue, as both residents and industry interests operating in the Canadian North have raised concerns regarding emergency response capabilities. In 2008, the Canadian Coast Guard (CCG) *Levels of Service Review* recorded the comments of clients which indicated it was a commonly held belief that the "lengthening of the Arctic shipping season and the potential for year-round shipping associated with resource extraction will result in increased demands for the SAR program over the next five years" (Canadian Coast Guard, 2008a). Political figures and members of the marine transportation industry have called for government services within the Arctic. Amongst those advocating for additional investment in northern SAR is the former Premier of the Yukon, Dennis Fentie, who recently stated that "with the situation

developing in the Northwest Passage and all that goes with it, establishing SAR centres across the North is critical" (2010).

Permanently situating SAR resources within the Arctic is a costly proposition of limited benefit, especially given the uncertainties regarding the future expansion of shipping activities within the region. The notion of dramatic increases in Arctic traffic, now widely circulated within the media and the general public, is largely unquantified and does not accurately capture the reality of present northern industrial activity, or existing SAR capabilities. To this end, an examination of the Canadian Arctic from a SAR perspective is required in order to inform an appropriate strategic plan for further northern management and infrastructure developments.

Project Objective

The intention of this project is to contribute to future SAR response planning and other risk mitigation measures within the Canadian North. This study will provide recommendations for an Arctic SAR strategy, drawing upon the requirements of the recently signed ASAR document and supported by a discussion regarding future activity projections and past Arctic SAR incidents. It has been noted by numerous government and non-government sources that at the present time, any attempt to mount even a small scale northern SAR operation would be difficult, given the absence of basic infrastructure such as road networks, airfields, staging/supply bases, and medical facilities.

In order to accomplish the stated objective, the study will be divided into six further sections. Section II will provide an overview of the fundamental features of a SAR system, including the existing international conventions, the Global Maritime Distress and Safety System (GMDSS) and basic SAR operational elements. Following

this, Section III will discuss the Arctic from a SAR perspective, in particular considering the impact of changing environmental conditions. This discussion will include a brief description of the various types of Arctic activity, and will provide a general forecast of future Arctic developments, incorporating marine, air and regional demands.

Having established the fundamental SAR requirements and the operating conditions within the Arctic, the focus of the project will then shift towards the development of an Arctic SAR strategy. To this end, Section IV will examine the contents of the ASAR agreement, and consider the implications of this document for SAR within Canada. Subsequently, noting the requirements of the recently signed treaty, Section V will discuss the policy concerns regarding SAR within Canada. Section VI will examine deficiencies of existing Arctic SAR services based upon an evaluation of recent SAR incidents, which will form the basis for the development of a tailored, Arctic specific SAR strategy as developed in Section VII.

Area of Study

While the 60th parallel is widely regarded as the definitive Arctic boundary within Canada, in reality there is no practical geographic division which distinguishes between the northern and southern territories. The Canadian SRR under the ASAR Agreement is defined by the following boundaries:

- From the North Pole south to 82°00'00"N, 060°00'00"W;
- 78°00'00"N, 075°00'00"W;
- 76°00'00"N, 076°00'00"W;
- 65°00'00"N, 057°45'00"W;
- 63°00'00"N, 055°40'00"W;
- To the point where it intersects 60°00'00"N latitude;
- West along 60°00'00"N latitude until it intersects with land border between Canada and the United States of America;
- North along the land border to the Beaufort Sea; and
- North to the North Pole (See Appendix I).

However, this boundary neglects several key marine areas which are home to sizable populations along the coastline of Northern Quebec (Nunavik) and does not include the waters of Hudson's Bay. To this end, it is appropriate to include Ungava Bay, as well as the waters of Koksoak River from Ungava Bay to Kuujjuaq, and the waters of Feuilles Bay from Ungava Bay to Tasiujaq, as per the *Northern Canada Vessel Traffic Services Zone* regulated by NORDREG. These areas are directly adjacent to the ASAR boundaries, and should be included within any Canadian Arctic SAR strategy.[2]

[2] The definition of the boundaries of the Canadian Arctic is subject to debate. While the above definition encompasses much of the Arctic region, some have suggested that an Arctic SAR strategy should extend as far south as the 55th latitude, in order to include the waters of Hudson's Bay and ports such as Churchill, Manitoba.

Section II- SAR Basics

International SAR Governance

The practice of coming to the aid of those in distress is a long standing maritime tradition; however, it was not until the mid-twentieth century that this customary practice was given official standing within international law. The first agreement to address the legal responsibilities of ship operators to respond to maritime emergencies was the 1910 *Convention for the Unification of Certain Rules of Law respecting Assistance and Salvage at Sea* (Salvage Convention), which stipulated that "every master is bound, so far as he can do so without serious danger to his vessel, her crew and her passengers, to render assistance to everybody, even though an enemy, found at sea in danger of being lost (Salvage Convention, 1910, Art. 11).

Following the 1912 sinking of the RMS *Titanic* and the loss of 1517 passengers, marine safety, including the necessity of establishing standardized SAR practices became an international priority. In 1914, the *International Convention for the Safety of Life at Sea* (SOLAS) was drafted in direct response to the *Titanic* tragedy, addressing a number of provisions regarding marine safety regulations and procedures. In addition to requiring continuous radio watches and mandating a minimum ratio of passengers per lifeboat, the agreement included stipulations for coastal states to provide SAR services (SOLAS, 2004)[3] The *Convention on International Civil Aviation* (Chicago Convention), signed in 1944, created the International Civil Aviation Organization (ICAO), and established a set

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[3] Under SOLAS Chapter V, Regulation 15, "each Contracting Government undertakes to ensure that any necessary arrangements are made for coast watching and for the rescue of persons in distress at sea round its coasts. These arrangements should include the establishment, operation and maintenance of such maritime safety facilities as are deemed practicable and necessary having regard to the density of the seagoing traffic and the navigational dangers and should, so far as possible, afford adequate means of locating and rescuing such persons."

of internationally recognized safety standards for the burgeoning aeronautical industry. The Chicago Convention, presently recognized by 190 countries, was designed to ensure that "international civil aviation may be developed in a safe and orderly manner" (Chicago Convention, 1944, Preamble). Article 25 stipulates that "each contracting State undertakes to provide such measures of assistance to aircraft in distress in its territory as it may find practicable" (1944, Art. 25).

The duty of vessels to render assistance to those in distress, and the obligation of coastal states to develop sufficient SAR capabilities were further detailed within the 1958 *Convention of the High Seas*, and later in the 1982 *United Nations Convention on the Law of the Sea* (UNCLOS).[4] However, it was not until the signing of the *International Convention on Maritime Search and Rescue* (SAR Convention) in 1979 that a comprehensive system governing the performance of maritime SAR operations was formally introduced.

Implementation of Maritime SAR

Prior to the SAR Convention entering into force in 1985, there was significant regional variance in the availability of SAR services, despite the recognized international obligations (Tauman, 2002, 11). The 1979 agreement required national authorities to establish the necessary maritime services capable of providing assistance to any person in distress at sea, regardless of nationality, status, or circumstances (IMO, 1979). In 1998,

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[4] Article 98 of UNCLOS states that it is the responsibility of Coastal states to "promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements cooperate with neighbouring States for this purpose" (UNCLOS, 1982, Art. 98).

The Canadian Shipping Act 2001 (CSA 2001) stipulates that "the master of a vessel in Canadian waters… on receiving a signal from any source that a person, a vessel or an aircraft is in distress, shall proceed with all speed to render assistance" (CSA 2001, Art. 131). Additionally, all vessels within Canadian waters must comply with orders from a designated rescue authority to assist in a distress situation. Failure to do so may result in a fine of up to $1,000,000 and/or eighteen months in jail.

substantial amendments were made to the original convention to rectify several issues which had slowed the implementation of the agreement. These changes clarified the "responsibilities of governments and put greater emphasis on the regional approach and co-ordination between maritime and aeronautical SAR operations" (IMO, 1998). As of May 2011, 98 countries were party to the convention, representing 61% of global tonnage (IMO, 2011). This document serves as the basis for the development of the global SAR system, described below.

Structure

The operational concepts necessary to create a functioning SAR system are contained within the *International Aeronautical and Maritime Search and Rescue Manual* (IAMSAR Manual). This document, jointly produced by the International Maritime Organization (IMO) and the IACO, provides "guidelines for a common aviation and maritime approach to organizing and providing SAR services" (IAMSAR-Volume I, 2010). Divided into three separate publications (Organization and Management; Mission Co-ordination; and Mobile Facilities), IAMSAR provides a uniform point of reference for SAR authorities around the world, aiding with the effective and economical delivery of these emergency services. The manuals expand upon the basic structural elements described below, establishing a standardized set of operational procedures regarding subjects ranging from reporting guidelines to search pattern techniques.

The six basic structural elements of the SAR system as described within the 1979 convention are:

1) Legal framework;
2) Assignment of a responsible authority;
3) Organization of available resources;

4) Communication facilities;
5) Coordination and operational functions; and
6) Processes to improve the service including planning, domestic and international co-ordination (SAR Convention, 1979).

While it remains the responsibility of individual nation states to establish a functional SAR system within their respective SRR, the governing principle of IAMSAR and its supporting conventions is the development of a global SAR system, "so that wherever people sail or fly, SAR services will be available if needed" (IMASAR-Volume II, 2010).

Services

There are four basic services which any SAR system must be capable of performing. These include:

- Receive, acknowledge and relay notifications of distress from alerting posts;
- Co-ordinate search response;
- Co-ordinate rescue response and delivery of survivors to a place of safety;
- Provide medical advice, initial medical assistance or medical evacuation (IAMSAR- Volume II, 2010).

The component parts required to perform the services listed above include the following operational aspects, which are crucial for the overall effectiveness of a SAR system. Communications; Rescue Co-ordination Centres; SAR resources; and support facilities are each critical elements.

International Cooperation

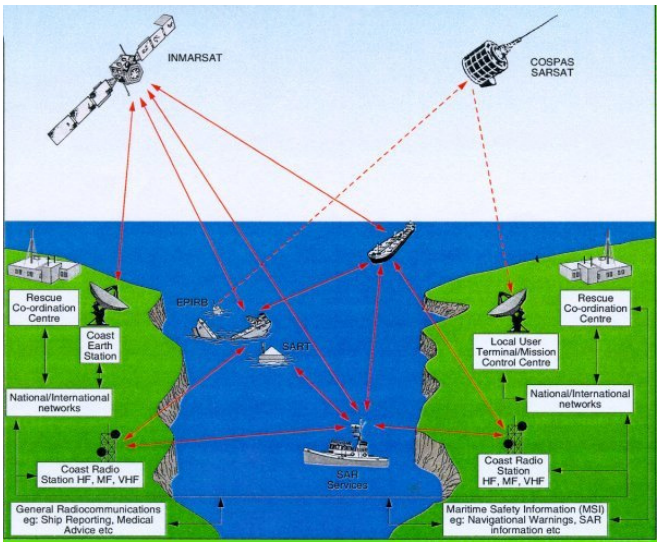
While national authorities remain legally responsible for the organization of resources and must fund these resources themselves, the SAR Convention states that "parties shall co-ordinate their search and rescue organizations and should, whenever necessary, co-ordinate search and rescue operations with those of neighbouring States" (SAR Convention, 1979, Chapter 3, Art 1.1). To this end, an area for international collaboration identified in the mid 1980s was distress communications. Essential to any

successful rescue operation, reliable, standardized communications are vital for alerting SAR authorities to a vessel or aircraft in distress, as well as for the co-ordination of assets engaged in a search.

Global SAR Communications

The 1979 conference which produced the SAR Convention also called for the development of a global communications network for the purpose of improving maritime safety, which resulted in the creation of the GMDSS in 1988. The objective of the system is to ensure that "SAR authorities ashore, as well as shipping in the immediate vicinity of the ship in distress, will be rapidly alerted to a distress incident so they can assist in a coordinated SAR operation with the minimum delay" (IMO, 1999a).[5] Under Chapter V of SOLAS, GMDSS establishes the "radio communications equipment that ships are required to carry, how this equipment shall be maintained and how it is used, and provides the context within which governments should establish the appropriate shore-based facilities to support GMDSS communications (International Mobile Satellite Organization, 2011).[6]

Figure II- SAR Communications



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[5] It is important to note that while the regulations apply specifically to vessels over 300 tons and all passenger vessels on international voyages, vessels of any size carrying radio equipment are affected by these changes.

[6] GMDSS determines the required equipment according to the area of operation and the availability of shore based services within this region. These areas are defined as:

- Sea Area A1 Within range of shore-based VHF DSC coast station (40 nautical miles)
- Sea Area A2 Within range of shore-based MF DSC coast station (excluding sea areas A1)(150 nautical miles)

Communication capabilities may be divided into two services, satellite such as COPSAS-SARSAT and INMARSAT; or terrestrial, including High Frequency (HF), Medium Frequency (MF) and Very High Frequency (VHF) requirements as well as Digital Selective Calling (DSC).[7]

Arctic Communications

The polar region is an area which has traditionally been subject to poor communication. Technological advances and continued developments in infrastructure have resulted in improvements in both alerting and communication capabilities within the Canadian North, but deficiencies remain to be addressed. The CCG provides seasonal services to marine traffic in the Arctic through two Marine Communications and Traffic Services (MCTS) Centers located in Inuvik and Iqaluit, which receive traffic reports from commercial vessels under NORDREG. The VHF coverage of these stations is restricted, and as a result, satellite based communication systems such as IRIDIUM have become increasingly popular. The CCG is responsible for the recently established NAVAREAs XVII and XVIII. Operational as of June 1, 2011, mariners in Canadian Arctic waters above 67°N latitude may now receive broadcasts regarding navigational warning messages and other relevant safety related information over the Inmarsat C satellite system (CCG, 2011).

- Sea Area A3 Within the coverage of an INMARSAT geostationary satellite (approximately 70°N to 70°S) (excluding sea areas A1 & A2)
- Sea Area A4 The remaining areas outside sea areas A1, A2 & A3 (polar regions)

[7]For details regarding the availability of communications services, please consult:
International Maritime Organization. (2011). Master Plan of Shore-based facilities for the Global Maritime Distress and Safety System. *IMO Circular 12 (1)*. Retrieved from http://www.marsat.ru/eng/
Additional means of emergency communications, though not recognized under GMDSS, include cellular phones, VHF Channel 16, and Citizen Band (CB) radio.

The existing COSPAS-SARSAT system has several issues with regards to Arctic emergency notification, in particular the lack of coverage of Geostationary Earth Orbit (GEOSAR) satellites and the limitations of the Low Earth orbit (LEOSAR). Initiatives such as the Distress Alerting Satellite System (DASS) are attempting to mitigate these concerns by using Medium Earth orbit (MEOSAR) satellites from constellations such as the Global Positioning System (GPS) to decrease notification times and allow for greater location accuracy from 406 MHz beacons (Affens *et al.*, 2011). Additional advances such as the development of the Automatic Identification System (AIS), Long Range Identification and Tracking (LRIT) and the Canadian Forces (CF) Polar Epsilon project have improved the domain awareness of national maritime authorities.[8]

This being said, the 2011 *Arctic Communications Infrastructure Assessment* (ACIA[1]) noted numerous communication deficiencies within the Canadian North which remain to be addressed. This study was born out of the difficulties experienced during the 2009 *Exercise Operation Nanook*, when "the influx of out-of-territory personnel…overloaded the local cell phone and Internet network," disrupting emergency communications (Imaituk, 2011, 15). The report noted that "robust, reliable communication tools to link the various governmental agencies at all levels are the foundation to effective emergency response," indicating that existing system within most northern communities is insufficient to supply the necessary operative communication capacity between SRUs during an emergency incident (2011, 104). Establishing a reliable communications network throughout the Arctic must be a priority for both government

[8] The ArctiCom project funded by the European Space Agency, expected to be completed in August 2011, is an "assessment of demands for and offers of communication services in the Arctic region for 2015-2020 (European Space Agency, 2011).

organizations and industry, and will require a high level of public and private cooperation. The Canadian Polar Communication and Weather is an initiative which may be expanded in the future to include international partners in order to increase interoperability and further system improvements.

Section Summary

There are several longstanding international treaties that impact upon SAR, and basic practices and procedures have been established within the IAMSAR manuals. International cooperation has been successful in implementing several key global SAR initiatives, in particular the GMDSS arrangement. As it is the responsibility of individual nation states to arrange for the provision of adequate SAR capabilities within their respective SRR, achieving a high level of interoperability between national Search and Rescue Units (SRU) remains a challenge. As the Arctic becomes increasingly travelled, Northern coastal states and international SAR organizations must confront issues such as the lack of communication capabilities and emergency resources within the region. Increased traffic and infrastructure development presents an opportunity to create a robust Arctic communications network. However, a unified strategy must be implemented in order to ensure that such developments occur in parallel with one another. The following section will consider recent environmental changes affecting the Canadian North, and will discuss the implications of these changes from a SAR perspective.

Section III- Environmental Changes within Canadian Arctic

The Changing Arctic Environment

Since the 16th century, expeditions have travelled the Canadian North in search of a northern sea route to the Pacific, or in pursuit of rumoured Arctic gold.[9] Contemporary developments are motivated by the search for increasingly scarce resources, aided by significant environmental changes, specifically a persistent decline in multi-year sea ice levels resulting from a warming trend in the average annual temperature. While controversy remains as to whether or not these variations are due to normal climate oscillations, these changes have, and will continue to have, profound impacts on northern communities, as well as on those seeking to extract resources from northern sites. The Arctic is entering an era of profound upheavals with widespread but unknown changes, which will present both opportunities and challenges for local residents, governments and industry.

Sea Ice Decline

Records indicate that the September 2010 minimum ice extent was 1.74 million square kilometres below the 1979-2009 average, the third-lowest recorded level since 1979 (Stroeve *et al*., 2007, 2). This trend, which has resulted in the Northwest Passage (NWP) being nominally clear of ice during the summer season (July-September) since 2007, will also allow for access to the Northern Sea Route (NSR) along the Russian coast, and potentially allow for vessels to travel directly over the North Pole (Stroeve *et al*., 2008, 13). The decline in sea ice levels has fuelled speculation that an ice-free Arctic

[9] Martin Frobisher returned from his third Arctic voyage in 1578 with 1,000 tonnes of iron supposedly containing gold. It was later revealed that the mineral was in fact iron pyrite or 'fool's gold,' and completely worthless.

Sea during the summer months may be possible by 2020, though more conservative estimates predict this will occur as late as 2037 (Wang & Overland, 2009, 2).

The fabled NWP, the long sought sea route connecting the Atlantic and the Pacific has become navigable for short periods of time within recent years.[10] A study from the Kitami Institute of Technology indicated that over the last eight years, the NWP has experienced extended periods of open navigation, typically between August 6th to October 14th (Shibata *et al*., 2011, 240). The study concluded that while "both the NSR and NWP are easily navigated during summer, the precise predictions of route openings… and the possibility of navigation without an icebreaker [are] difficult to predict" (2011, 253). Therefore, claims of the NWP being ice-free during the summer in 2007 should be tempered with the understanding that these conditions are expected to experience high annual variability.

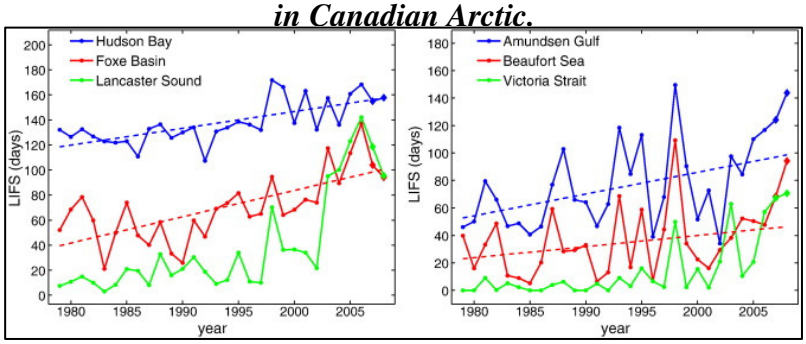
Figure III- Canadian Northwest Passage

[10] The NWP is defined by the 1994 Sailing Directions for Arctic Canada as four potential routes, each with their own depth characteristics and ice conditions (Government of Canada, 1994, 1).

Average Arctic Temperature

The 2004 *Arctic Climate Impact Assessment* (ACIA²) noted that the annual Arctic temperature has increased at twice the rate of the global average over the last fifty years, as much as 3-4 ºC in some regions of the western Arctic (Hassol, 2004, 10). Furthermore, Arctic temperatures are projected to warm a further 4-7ºC over the next century (2004, 11). As would be expected given this increase, lengthened ice-free periods for several areas of the Canadian Arctic have been recorded over the last five years, as demonstrated by Figure IV (Rodrigues, 2009, 85). The traditional 'summer' operating season has lengthened each year, as much as tripling in some areas of the Eastern Arctic since the 1980s (2009, 80).

Figure IV- Time series of the length of the ice-free season in Canadian Arctic.



Northern Operating Conditions

Decreased levels of fast ice may in fact impede the passage of marine traffic through the Canadian Arctic Archipelago in the short term. Dense, multi-year ice which war previously prevented from entering the NWP by sheets of first year ice, may be allowed to flow freely through the passage, posing a significant hazard to navigation, as "even in a generally ice free Arctic, lighter ice conditions would make the regions even more susceptible to winds and ocean currents creating locally hazardous congested areas (Falkingham *et al*., 2002, 1568). As described by Dr. Fortier, ArcticNet's Scientific Director, in the event that multi-year ice disappears completely for the Arctic, conditions within the Canadian Archipelago outside of the short summer season will come to

resemble the St. Lawrence Seaway in winter- navigable, but by no means free of risk (2008, 6).

Repeated statements of an 'ice-free' Arctic fail to accurately portray northern environmental challenges. "As we can see, there will be a seasonal ice cover in the wintertime in the Arctic," says John Falkingham, Chief of Ice Forecasting for the Canadian Ice Service (CIS). "It still gets dark and cold up there, and the ocean's going to freeze" (Falkingham, 2006). Some of the specific challenges facing crews operating in the Canadian Arctic include:

- Frigid temperatures;
- Poor Visibility, limited daylight;
- No free fall or fast descent system due to ice;
- Ice pressure, ride-up, adfreeze, pileup;
- Unpredictable ice movement;
- Adfreezing snow/ice may obstruct mechanisms, causing slippage;[11]
- Escape capsule (Lifeboat) must be capable of both ice and open water operations (Bercha, 2004).

To suggest that operating in the Arctic will not require additional training and specialized equipment exposes crews and vessels to risks for which they are not prepared.

Further Effects of the Changing Arctic Environment

Shifts in the northern climate will significantly affect indigenous communities, especially as traditional hunting areas become inaccessible due to continued sea-ice decline and seasonal timelines such as spring thaw and fall freeze up become increasingly irregular. In an era of unpredictable change, traditional knowledge amassed over generations has become increasingly unreliable. One testimonial from an elder in

[11] Adfreezing refers to when objects become adhered to each other due to an accumulation of ice on each surface.

Igloolijk, Nunavut in 2000 stated that “right now the weather is unpredictable. In the older days, the elders used to predict the weather and they were always right, but right now, when they try and predict the weather, it's always something different” (Hassol, 2004, 82). This statement expresses the variability which is the defining characteristic of the Arctic. Furthermore, extreme weather events such as the 1999 storm in the Beaufort Sea, which forced the evacuation of several local residents are expected to increase, posing a threat to both maritime activity and coastal infrastructure (Michael *et al*., 2011, 8960). The exposure of northern shorelines to increased wave and wind action will result in an average rate of erosion of 0.5 m per year, and up to 3 m per year in some regions (Lantuit *et al*., 2011).

Section Summary

A warming trend in the annual average Arctic temperature has resulted in decreased levels of sea ice over the last decade. This has allowed for increased maritime access to the polar region, though this access remains unpredictable and subject to seasonal and regional variability. A lengthening summer navigation season has been noted, disrupting seasonal timelines through early spring thaws and delayed freeze up. This has affected the veracity of traditional knowledge as conditions shift rapidly as never seen before. Extreme weather events have become increasingly commonplace. The effects of decreased sea-ice coverage within the Canadian Arctic is unknown over the long term, but accelerating levels of shoreline erosion and increased wave action have been noted in some regions.

Due to these environmental changes, industry interest in resource extraction projects as well as increasing accessibility to fishing and recreational boaters have

resulted in rising, albeit modestly, traffic levels in the Canadian Arctic. Establishing a baseline of activity is vital for any decision regarding the development of Arctic SAR, for an increase in vessel traffic is accompanied by a corresponding rise in accident risk, though this activity does provides additional response capacity in the area. The following pages will provide an overview of past and present Arctic activity and attempt to capture as accurately as possible all forms of northern Activity that impact the need for SAR services within this region.

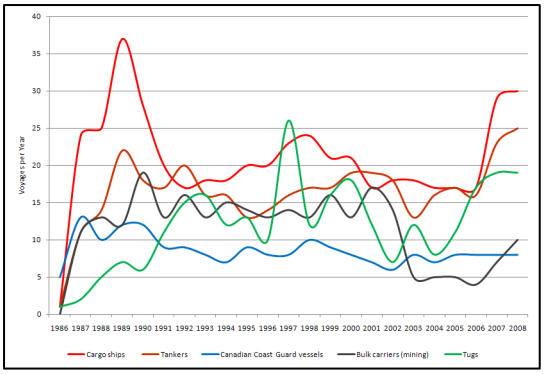
Section IV- Arctic Activity

Future Projections of Arctic Activity

Interest in the Arctic has fluctuated greatly during the twentieth century, as the strategic and economic importance of the area has mirrored the rise and fall of international tensions and the global economy. Vilhjalmur Stefansson, one of Canada's first Arctic explorers, claimed in 1921 that the Arctic was poised to become a region of great strategic and commercial importance, the 'Mediterranean of the modern age' (Stefansson. 1922). Military projects such as the Distant Early Warning Line (DEW) in the late 1950s attracted infrastructure development in the North, leading to the supposed 'the Age of the Arctic' in the mid-1980s. It was a commonly held belief that technological advances would cause the area to become a key military theatre, vital to the economic wellbeing and security of North America (Young, 1986).

Despite these expectations and the intense political rhetoric over the passage of the USS *Manhattan* in 1969 and the USCG *Polar Sea* in 1985, there was in fact limited commercial activity in the Arctic during much of the late 1980s and 1990s (Figure IV). Yet since the turn of the century there has been a resurgence of interest in the Arctic (Judson, 2010). Contemporary developments, driven by increased accessibility, technological advancements and rising commodity prices have resulted in modest yet steadily growing activity (Appendix II). The Canadian SAR system must be situated within this complex,

Figure V- Cargo, Tanker, Bulk, Tug & Coast Guard Traffic (1986-2008)



unpredictable environment- in order to determine the appropriate response to present and future activity, it is first necessary to identity these activity types and to characterize the risks associated with each.

Trans-Polar Shipping

Stefansson's notion of the Arctic Ocean serving as a northern Mediterranean was echoed nearly a century later by the Prime Minister of Iceland Ólafur Ragnar Grímsson, who declared that the NWP and the NSR are poised to become the "trans-Arctic Panama Canal (Grímsson, 2010). It is an often cited concern that sub-standard ships will soon by plying the Canadian NWP, risking their crews and the health of the northern ecosystems. However, industry experts caution, that while voyages through the NWP do shorten the distance between Seattle and Rotterdam by 2,000 miles, potential savings in fuel costs are offset by additional financial and other considerations (Seidler, C. & Traufetter, G., 2010). In 2008, survey responses from 34 companies representing 62% of the global marine transportation market share indicated that only eleven companies had any interest in using the NWP as a international shipping route, and of those interested companies, nearly all of them were North American based organizations already involved in annual Arctic sea-lift operations (Lasserre, F., 2010).

The reason for this apparent disinterest by container and bulk shipping interests revolves around the uncertain monetary advantage of using the NWP, as well as important safety issues. As Stephen Carmel, a senior executive with Maersk Line bluntly stated "the Canadian NWP will not become the next Panama Canal" (Government of Canada, 2011a, 36). The reasons for this includes insufficient maritime services available to commercial traffic, loss of fuel economy due to slower speeds, the additional costs of

constructing ice-class ships and heightened insurance premiums for Arctic voyages.[12] Carmel believes that both the fiscal burdens of Arctic shipping as well as the restrictions of the northern channels will never permit large container vessels to pass through the Canadian Arctic, thereby "destroying the economic advantage" of the NWP (Government of Canada, 2011a, 37). This statement was supported by Fednav President Tom Paterson, that a NWP versus a Panama Canal transit would produce "very little difference in the arrival times, except the vessel going via the NWP may have sustained some hull damage and had quite an adventure" (2009).

This being said, activity in the Arctic is not simply driven by the international shipping community; the lure of previously inaccessible resources, from mineral and hydrocarbon deposits to northern fish stocks has attracted the attention of coastal states and international corporations. Therefore, while the spectre of international shipping transiting through the NWP may be a red-herring, increased traffic within the Canadian Arctic is a distinct possibility within the near future.

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[12] Some have countered the position of Carmel. A 2009 study by Somanathan *et al* concluded that the NWP could be an economical alternative to traditional routes, especially due to the fact that "continued thinning of Arctic ice will further reduce the cost relative to a Panama Canal route by three factors: faster transit time, lower fuel usage, and less capital investment for a suitable Arctic class ship" (2009, 133).

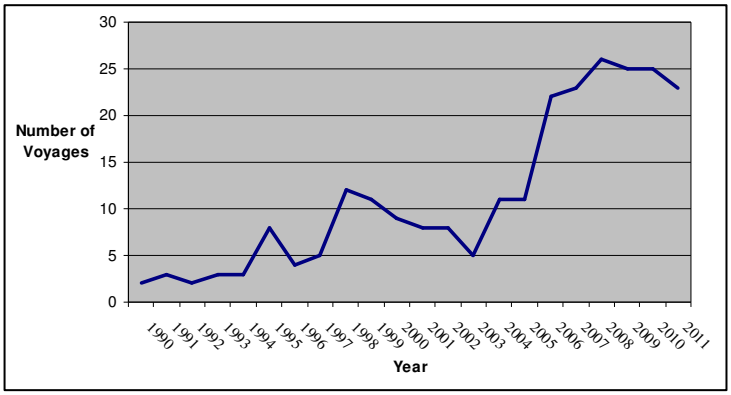
Arctic Destinational Shipping

Carmel's concerns denunciating trans-polar Arctic shipping through the NWP contrast with the claims of those who point to a rise in *destinational shipping*, which is where "a ship sails north, performs an activity in the Arctic, and goes home" (Brigham, 2010). While exact traffic levels are impossible to predict from year to year, northern maritime activity is expected to be comprised primarily of cruise ships, re-supply voyages and bulk carriers for industrial projects such as mining operations or offshore oil and gas extraction.

Cruise Tourism

Since 1984, cruise ships catering to clientele seeking an experience outside the norm have offered trips to Arctic destinations such as Mittimatalik and Pangnirtung, Nunavut, and even through the NWP. In recent years, as demonstrated *Figure VI* the number of "adventure" or "niche" cruises has increased dramatically. In 2008, over 2,400 passengers toured the Canadian North during 26 different transits (Lück *et al*., 2010, 4). This total is only expected to increase in coming years, a reason for concern given the considerable number of passengers and crew carried by these vessels and the tendency of these vessels to explore areas outside of known shipping routes (Stewart *et al*., 2005). A 2006 study by Maritime Activity and Risk Investigation Network (MARIN) titled *Cruise Ship Activity and Risk*

Figure VI- Canadian Arctic Cruise Ship Activity (1990-2011)



Analysis for Improved SAR Response Planning provides a lengthy discussion regarding areas of concern to be addressed given the particular SAR demands for cruise activity (Pelot *et al*., 2006).

The sinking of the M/V *Explorer* in 2007 off the Antarctic Peninsula marks the only instance where a cruise ship has sunk in polar waters. The ship was a veteran of the polar tourism industry; a custom built expeditionary cruise ship launched in 1969, the *Explorer* was the first commercial vessel to carry passengers through the NWP in 1984. Thankfully, there were no casualties as a result of the incident (Stewart & Draper, 2008, 225). Closer to home, in 2010, the M/V *Clipper Adventurer* ran aground in the Canadian Arctic, and though the ship was later refloated and no injuries were reported, the incident drew attention to the various safety issues surrounding northern tourism.[13] While it has been suggested that this industry has "moved beyond its infancy and is now entering a maturing phase, with increased numbers of vessels, more regular and predictable patterns of activity, and the forging of new and more demanding routes," others point to the "lengthy record and anecdotal history of groundings and other bumbles" of polar cruise organizations (Jones, 1999, 30). Incidents such as the *Adventurer* underscore the need to develop incident prevention and response measures, including the further education and regulation of Arctic crews (Stewart *et al*, 2007, 378).[14]

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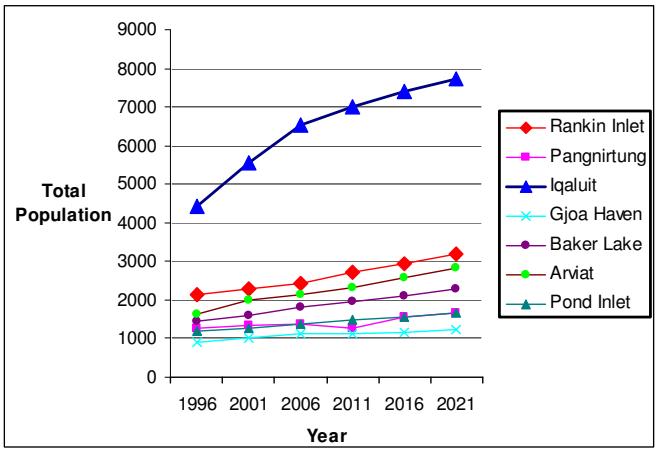
[13] In July, 2011, the owners of the *Clipper Adventurer* launched a $15 million dollar lawsuit against the Department of Fisheries and Oceans, claiming that the government "failed to put in place and maintain, or to take reasonable steps to put in place and maintain … any reasonable system for disseminating [navigational] information," which resulted in the 2010 grounding (CBC, 2011).

[14] The IMO released a circular in 2006 which provided a number of suggestions for passenger ships operating in remote areas, including the 'pairing' of vessels operating in the same general area.

Community Re-Supply

The Northern territories are home to over 100,000 Canadians, a growing demographic which expanded by nearly 20% between 1996 and 2006 (Nunavut Bureau of Statistics, 2010). With a lack of road infrastructure within much of the Canadian Arctic, transportation requirements of additional supplies must be met by either air or marine deliveries. In order to support these community re-supply efforts, from late June to early November the CCG icebreaker fleet, comprised of two heavy icebreakers, four medium icebreakers and one light icebreaker, are deployed to the Arctic, and are available as secondary SRUs.

Figure VII- Nunavut Community Population Estimates (1996- 2006) and Projections (2011-2016)



Changes to permafrost integrity due to a continued warming trend will have a negative impact on both transportation safety and the effectiveness of moving goods and people overland around the Arctic, resulting in the increased use of sea lifts for community re-supply (Doré, 2010). As noted within Stephenson *et al*, "barring construction of new all-weather road networks, and contingent upon sufficient river levels, late-fall ground traffic in the inland Arctic may increasingly take the form of river vessels rather than automobiles" (Stephenson *et al*., 2011, 157). The future of the northern transportation network and the demands of the communities it supplies will be

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International Maritime Organization. (2006).Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR Facilities, *IMO Circular 1184*. Retrieved from www.imo.org

forced to adapt in the face of the changing Arctic environment. Inland transportation losses will be offset by increased accessibility for marine transportation, as the region from Iqaluit, Nunavut to Nome, Alaska, is expected to become 30% more accessible to vessels capable of operating in medium first year ice by mid-century (Appendix III).

Oil and Gas Exploration

While industry experts note that "the economics of producing any oil or gas from possible discoveries is uncertain, at least at current oil and gas prices," the estimated 618 billion barrels of oil and the 1547-2990 trillion cubic feet of gas located under the Arctic Ocean will continue to draw the attention of international oil corporations (Blaizot, 2011; Gautier *et al*., 2009). Current estimates regarding hydrocarbon resources available in the Arctic vary widely, as various studies place the offshore potential between 3-25% of the total remaining global supply. The exploration and development of these resources is considerably more expensive than traditional sources. These factors include:

- Specialized pollution prevention equipment due to the environmental fragility of local ecosystems;
- Specially designed equipment capable of withstanding frigid temperatures;
- Limited transportation access;
- Long supply lines;
- Additional operating costs due to ice-pack conditions; and
- Specialized requirements for support infrastructure (Hong, 2011).

Despite the additional expenses are accrued as a result of these challenges, exploration efforts are currently underway off the west coast of Greenland, where Cairn Energy PLC has undertaken seismic testing efforts and the drilling of exploratory wells for the past two summer seasons, with the 2011 project consisting of the drilling of four exploration wells (Cairn Energy, 2011a). The *Ocean Rig*, a dynamically positioned drillship and the *Leiv Eiriksson*, a semi-submersible drilling rig are accompanied by a significant support fleet, including: six ice management vessels; two emergency response and rescue vessels;

and one freighter (Cairn Energy, 2011b). Furthermore, in 2010, there were 177 helicopter flights from Ilulissat, Greenland in support of Cairn's offshore operations. This activity is of concern to domestic SAR authorities due to the fact that several of Cairn's wells fall within the Canadian SRR.

Speculation regarding potential oil and gas reserves contained within the seabed under the Canadian Exclusive Economic Zone (EEZ) has prompted renewed interest in offshore Arctic exploration, particularly in the Beaufort Sea. Between 1972 and 1989, 86 wells were drilled in this region, and though nearly two decades have passed since the last commercial offshore operation, oil corporations have paid millions for exploratory licences over the last few years.[15]At present there are no projects underway within Canadian waters.

Regardless of the status of offshore exploration, the Canadian oil industry will have an impact upon Arctic maritime activity. There have been proposals to use the port of Churchill to expedite the delivery of oversized loads to Albertan oil rigs, in addition to developing the 'Arctic Bridge' route between Canada and Murmansk, Russia. OmniTRAX, which owns both the port and the connecting railway, has suggested that corporations facing legal and logistical challenges of shipping pre-fabricated, oversized modules through the United States consider an alternative route, using maritime transportation to deliver supplies through the Panama Canal and Hudson's Bay (Russell, 2011).

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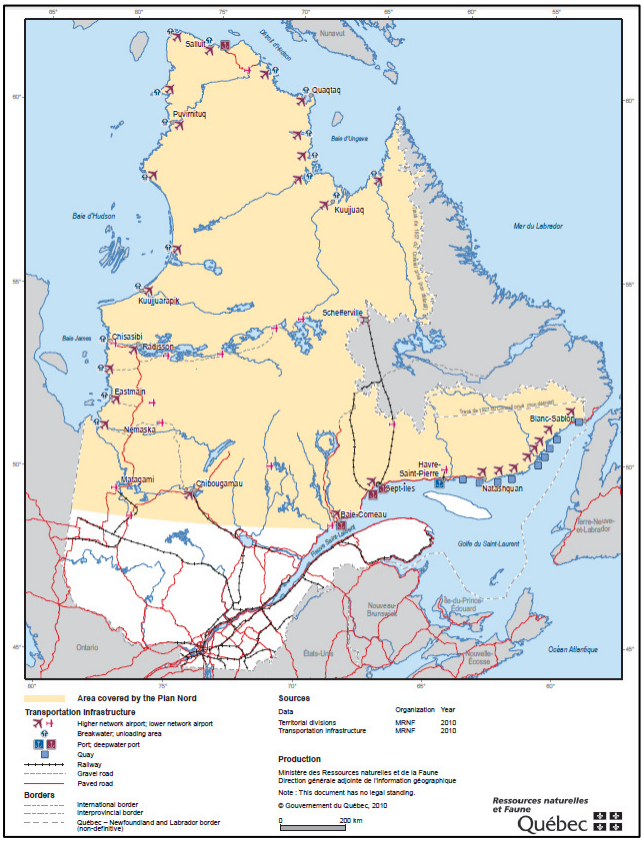
[15] The three major bids within recent years were: Imperial Oil (2007) $585 million, BP Exploration (2008) $1.2 billion, Chevron Canada (2010) $100 million. The report notes that unlike previous initiatives in the 1970s when the Canadian government provided financial incentives for northern offshore exploration efforts, these bids have been paid for entirely by the corporations themselves (Matthews, 2011).

The dangers of offshore oil exploration are well known to Canadian SAR authorities. The 1982 *Ocean Ranger* tragedy as well as the more recent crash of a Sikorsky S-92 off the coast of Newfoundland are two of the more widely known incidents. Given this past record, and the additional risks associated with northern extraction operations, a specific safety regime will have to be developed in cooperation between industry and government authorities to address the particular demands of this activity.

Mineral Resources

Oil and gas deposits are not the only resources attracting increasing attention, as both private and government funded mineral based initiatives have been announced in recent years. Projects such as the Ekati, Diavik and Snap Lake diamond mines have operated in the western Arctic for nearly a decade, and the Raglan mine in Quebec and the Voisey Bay mine in Labrador have both produced nickel for several years (Costello & Senkow, 2011). The province of Quebec recently announced its development strategy for the northernmost reaches of its territory, appropriately titled *Plan Nord*. With a budget of

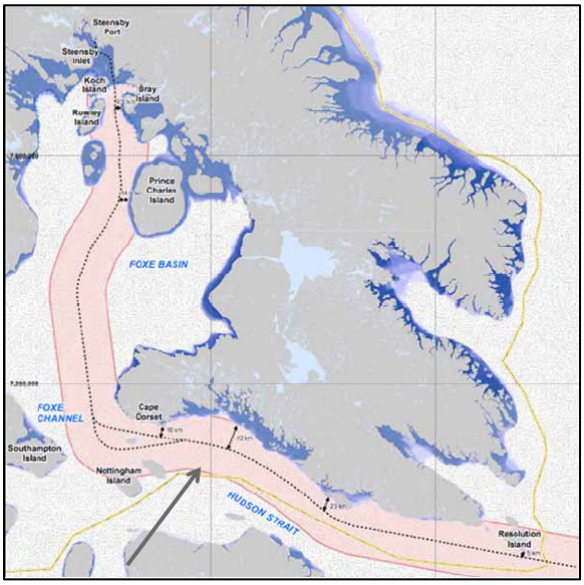
Figure VIII- Plan Nord Transportation Infrastructure Developments



$1.625 billion over the next five years, the strategy will invest in numerous infrastructure development projects, including the potential construction of a deep-water port in Whapmagoostui-Kuujjuarapik (Eastern Hudson Bay) and the expansion of maritime and air services along the Northern Québec coast (Simon, 2011).

The feasibility of developing mineral deposits within the Arctic such as iron ore, nickel, copper, zinc, cobalt, antimony and rare earth metals are in the process of being evaluated, including projects in Doris River (Gold), Thelon Basin (Uranium) and Chidliak (Diamond). In total, there were 82 active projects within Nunavut in 2010, and this total is expected to increase, especially as present developments are brought online (Costello & Senkow, 2011). One project which is due to commence regular shipments in 2013 is Baffinland's Mary River Iron Ore Mine, which are estimated to require 141 transits annually to Steensby Inlet and through the Hudson Strait in order to transport the projected three million tonnes of iron ore (Knight Peisold Consulting, 2008). Achieving this capacity will require a fleet of nine 190,000 dwt, Polar Class 4 ships operating twelve months a year, supported by an additional 104 flights for resupply and crew replacement (Hampton, 2011).

Figure IX- Proposed Shipping Route from Steensby Inlet



During the 1980s and 1990s there were a significant number of incidents involving bulk carriers, both globally and with the Canadian SRR. Between 1990 and

1997, 99 ships were lost, resulting in the deaths of 654 sailors (IMO, 1999b). In 1997, the IMO adopted amendments to *Chapter XII - Additional Safety Measures for Bulk Carriers* to SOLAS in order to address the common failings of bulk carriers, in particular recognizing the importance of minimizing structural fatigue caused by operational stresses (IMO, 1999b). Regardless of this improved performance within recent, the possibility of large cargo vessels transiting the Arctic year-round is concerning, not only for the risks posed to the ships themselves, but also due to the potential persistent impacts the passing of these vessels may have for northern communities. The Voisey's Bay *Winter Shipping Program* is an industry-community collaboration designed to mitigate any hazards from year-round marine operations by using a system of markers to indicate ship routes and installing pontoon bridges to allow for safe transit of these channels (Sikumiut, 2009).[16]

Arctic Fishery

The primary commercial fisheries are catches of Northern Shrimp and Greenland Turbot in the Davis Strait, with the North Atlantic Fisheries Organization Subarea 0 (Fisheries Resource Conservation Centre, 2010). In 2010, there were eighteen commercial licenses issued to operators for this region, including the Baffin Fisheries Coalition and the Qikiqtaaluk Corporation. The fishery is primarily offshore, utilizing vessels typically greater than 180' in length. The catch of Greenland Turbot in particular has increased significantly in recent years, well over doubling to nearly 25,000 tons per annum from the pre 1998 levels (2010). According to the CEO of Baffin Fisheries

[16] For further information regarding the impact of winter shipping upon northern communities, see: Voisey Bay Nickel Company. (1997). Volume III- Biophysical Assessment**,** Chapter 9- Ice. *Voisey's Bay Mine/Mill Project Environmental Impact Statement*. Retrieved from http://www.vbnc.com

Coalition, in 2010 vessels from his organization operated in northern waters for ten months of the year, and with the continued success of offshore0 operations, his company is investigating the development of an inshore fishery (Ward, 2011).[17]

These fisheries are expected to increase, as the ACIA² from 2005 stated that even "moderate warming will improve the conditions for some of the most important commercial fish stocks," and that "such changes could also lead to extensive expansions of habitat areas for species such as cod and herring" (Vilhjálmsson & Hoel, 2005, 692). As these fisheries become more established, the seasonal provision of additional SAR coverage, such as that provided currently for specific high risk fisheries such as the opening of the southwest Nova Scotia lobster fishery may be required.

Due to the nature of the industry, many SAR incidents involving fishing vessels are medical evacuations of crew members. A recent incident involving a seriously injured fisherman off Northern Labrador was safely resolved with the assistance of a nearby Danish naval vessel, which was able to transport the patient to Nuuk, Greenland for treatment. The alternative strategy considered would have involved the chartering of a private helicopter from Greenland, at an estimated minimum cost of $10,000/hour. Additional concerns regarding fishing vessels operating within the Arctic were described in the Transportation Safety Board of Canada's investigation into the

Figure X- Fishing Vessel Saputi

[17] Ward highlighted the successful development of a small craft harbour in Pangnirtung, Nunavut, and noted plans to develop seven additional harbours to serve a commercial in-shore fishery (2011).

sinking of the F/V *Avataq* in 2000. It was noted that at less than 5% of small fishing vessels operating in the Arctic had been properly inspected by TC, and that many crews were ill-trained and poorly-equipped for northern conditions (Transportation Safety Board of Canada, 2000).[18]

Commercial Aviation

An often mentioned issue is the possibility of an incident involving a commercial airliner crashing in the high Arctic. Though the skies over the Canadian North have witnessed an increase of civil aviation traffic in recent years, the likelihood of a serious incident remains minimal. Between 2000-2009, there were 189 hull loss accidents worldwide with over 21.6 million departures, only 32 of which involved Canadian and American operators (Boeing Commercial Aviation, 2011, 16). During this same period, the 10-year accident rate per million departures was 1.02, with greatest risk of fatal accidents being during take-off (21%) and landing (34%) (Boeing Commercial Aviation, 2011, 21). The accident rate at cruise altitude, the typical activity of commercial over flights of the Arctic was substantially less, at only 10%. For this reason, though it is recommended that a contingency plans for Major Air Disaster (MAJAID) be developed, the consideration of this activity within a northern SAR strategy is ancillary.

Northern Cruisers (Pleasure Craft)

The expedition cruises noted above provide many adventurers the opportunity to visit the Arctic, yet for some such commercial offerings are insufficient. The widely circulated reports of the 'ice free' northern waters have given rise to an increasing number of pleasure craft visiting the Canadian North. In 2009, 12 privately owned

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[18] An additional case which highlighted some of the concerns regarding the operation of small vessels in the Arctic was the TSB's 1994 report (M94H0002) regarding the sinking of the M/V *Qasaoq*.

vessels transited the NWP, followed by 17 vessels the following year (Colvin, 2011). This traffic was comprised of a variety of vessel types, including vessels such as the S/V *Glory of the Sea*, a Hurricane MACH II Rigid Hull Inflatable Boat (RHIB) and even a single-handed rowboat. The volume of this activity is difficult to quantify from year to year, but it is reasonable to expect that this traffic will increase as the region becomes increasingly accessible to recreational traffic.

Such activity presents a serious concern to Canadian SAR authorities. Traditionally, recreational boaters comprise a larger proportion of annual SAR incidents within Canada. As noted in Appendix III, unprepared and ill-equipped northern bound adventures place an additional strain upon the SAR system due to the lengthy transits required to reach remote locations, displacing SRUs from regions of high activity. Furthermore, most recreational vessels do not fall under existing Arctic legislation such as NORDREG, allowing for vessels to enter the NWP unknown to Canadian authorities.

Summary Section

During the lengthening summer navigation season, the Canadian Arctic has experienced an increase in maritime traffic. Unlike earlier periods of activity, contemporary developments are driven only in part because of high resources prices, as they are also supported by accessible waterways and technological developments. This traffic is composed of a wide range of activity, from expedition cruises to bulk carriers, re-supply vessels to recreational yachts. Accommodating all of these potential users of the Canadian SAR system will demand the creation of balanced strategy which includes provisions for increased maritime services within the Arctic as well as requirements for self-rescue and extended survival capabilities by northern bound vessels.

Any successful strategy will require close collaboration between federal SAR agencies, local communities and industrial projects. Initiatives such as the Mary River Project, Quebec's *Plan Nord* and the proposed naval fuel facility in Nanisivik represent an opportunity to strengthen the Northern SAR system. These efforts and the accompanying infrastructure developments will aid in addressing current deficiencies within the Arctic, such as through the use of industry assets as secondary SRUs, the strengthening of the northern communications network and the enhancement of polar situational awareness.

As the ultimate responsibility for the provision of SAR services resides with national actors, the development of an international treaty regarding Arctic SAR is a critical first step in the creation of an effective strategy. The signing of the ASAR Agreement will provide the necessary structure for the future cooperation of Arctic coastal states in regards to the development of emergency services within the polar region. The following section will examine this treaty, and consider the implications of the document for the Canadian SAR system and northern emergency services.

Section V- Agreement on Cooperation on Aeronautical and Maritime Search and Rescue (ASAR)

The Arctic Council and SAR

In May 2011, senior ministers from the eight member states of the AC gathered in Nuuk, Greenland to sign the ASAR agreement.[19] Returning from the summit, Leona Aglukkaq, Canada's representative, stated that "the signing of this agreement is a pivotal event in the evolution of the Arctic Council, [underscoring] the capacity of the Council to address emerging Arctic issues" (Alstyne, 2011). The document was the product of a series of five negotiations, co-chaired by Russia and the United States, involving representatives from each of the AC member states. Though the signing does represent the first successful international treaty involving all members of the AC, the practical application of this document remains very much in question. The following section will provide a brief overview of the ASAR Agreement, as it pertains to the Canadian SAR system.

Overview of ASAR Agreement

The ASAR Agreement is a compact, region specific document which serves as an extension of the two primary international treaties concerning global SAR arrangements, namely the aforementioned SAR and Chicago Conventions. These treaties, in addition to the IAMSAR Manual provide the accepted terms, definitions and management guidelines for international rescue operations, and the ASAR Agreement does not attempt to supplant or add any additional provision to the procedures detailed within these documents.

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[19] The eight member states of the Arctic Council are: Canada; Denmark; Finland; Iceland; Norway; Russia; Sweden; and the United States.

The agreement provides a formal accord between Arctic states, designed to "strengthen aeronautical and maritime search and rescue cooperation and coordination in the Arctic" (AC, 2011). This builds upon the existing legal and humanitarian obligation of Coastal States to provide adequate SAR services as required by the 1979 SAR Convention. The inclusion of aeronautical and marine incidents under a single document is of note, as these incident types have previously been treated as distinct entities within international SAR treaties, though not in the IAMSAR Manuals.

The defined SRR of the ASAR Agreement and the designated national areas provides explicit boundaries in a region which had previously enjoyed loosely defined limitations in regards to national SRR.[20] The southern limitation of the Canada SRR is the 60th parallel, which skirts the opening of Ungava Bay, Quebec, but does not include the inner waters. As suggested earlier, normalizing the boundaries as indicated by the ASAR agreement to correspond with geographic features and the existing domestic SAR sub-areas would be necessary within any Canadian Arctic SAR strategy.

The listed Competent Authority, the Department of National Defense (DND) and the Responsible Agencies, the CF and the CCG are required to "promote the establishment, operation and maintenance of an adequate and effective search and rescue capability" for the designated region (AC, 2011, Art. 3).[21] Canada is the sole signatory

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[20] Given the ongoing territorial disputes within the region, the agreement makes explicit mention of the fact that the "delimitation of search and rescue regions is not related to and shall not prejudice the delimitation of any boundary between States or their sovereignty, sovereign rights or jurisdiction." (Art. 3)

- [21] It remains the discretion of the national SAR agencies to determine what constitutes *adequate and effective* SAR capabilities, as no definition is provided within the Agreement. Providing an acceptable definition of the service standard for SAR within the Canadian Arctic is a key policy development which must be addressed in order to

which lists a military organization as the Competent Authority responsible for SAR- every other nation lists a civilian agency. The sole Canadian centre listed is JRCC Trenton, and while the majority of the designated territory does lie within Trenton's SRR, a significant portion does fall within the jurisdiction of JRCC Halifax. The establishment of an Arctic SRR which overlaps existing national SRR boundaries could result in confusion over command responsibility in the future. As such, the re-alignment and updating of the domestic SRR to reflect the newly defined regions will be necessary.

Internationally, only two signatories do not have RCCs located north of 60°, namely Canada and Sweden. Denmark, the Russian Federation, Finland and the United States list multiple points of contact, as they operate separate centres for aeronautical and maritime operations, while the remaining countries utilize joint coordination centres. The differing institutional arrangement may present difficulties in the event of a major incident involving assets from multiple jurisdictions.[22] The Ministry of Emergency

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establish a viable strategy for the region. Norrington *et al*. have indentified nine variables critical to an effective SAR operation, namely:

- Favourable weather
- Competency of resources (SAR personnel)
- Acceptability of response time
- Number of concurrent incidents
- Severity of incident
- Location known
- Effective communications
- Competency of MRCC (Incident coordination) staff
- Casualty situation (2008)

[22] Though not addressed within the document, an additional complication is that of language. While the IAMSAR manual states that all "RCCs should plan to have staff with a working knowledge of English to enable timely and effective communications with aircraft, vessels, and other RCCs" and utilizes the *Standard Marine Navigation Vocabulary* in order to standardize terminology, there remains some concern regarding communication difficulties due to language differences (IAMSAR- Volume I, 2007). No provision has been made for the arrangement of translation services with ASAR. In additional to presenting issues during operations, language differences will be of concern in regards to the differences in geo-referencing by various organizations.

Situations from the Republic of Sakha recently suggested that a RCC situated in the Eastern Arctic would be necessary in order to further the development of institutional knowledge and familiarity regarding the peculiarities of northern emergency operations (2009).

The ASAR Agreement provides a formal mechanism for the elimination of trans-boundary jurisdictional concerns regarding the entry of foreign SAR assets into neighbouring territories, as well as for the notification of the appropriate RCC in the event of an emergency. Furthermore, should the responsible nation have insufficient SAR resources available to respond to an incident, the commanding RCC may request assistance from other signatory nations. In the event that foreign SAR assets must enter the SRR of another state, the ASAR stipulates that they are required to contact the relevant RCC, for permission. Such regional arrangements for SAR purposes are not uncommon. In fact, Canada has two longstanding bilateral agreements with the United States regarding jurisdictional limitations during emergency incidents.[23] The potential opening of international waters in the Arctic may require further agreements regarding maritime traffic concerns, such as the establishment of clearly defined procedures for ports of refuge for disabled vessels.

The critical clauses of the ASAR Agreement are found within Article 9, concerning cooperation between the Arctic nations. Paragraph 2 requires that the Arctic

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[23]The first agreement allows for "public aircraft of Canada or the United States which are engaged in emergency Air Search and Rescue operations, be permitted to enter or leave either country without being subject to the immigration or customs formalities" (Government of Canada, 1949).

The second agreement allows vessels of either country to render assistance in specified border waters, such as the Great Lakes and the St. Lawrence, and within 30 NM from the international marine boundary on both the Atlantic and Pacific Coasts (Government of Canada, 1908).

countries "exchange information that may serve to improve the effectiveness of search and rescue operations," including:

- Communication infrastructure;
- Information about search and rescue facilities;
- Lists of available airfields and ports and their refuelling and resupply capabilities; and
- Knowledge of fuelling, supply and medical facilities.

The development of a comprehensive database of Arctic SAR resources is a vital but challenging task, one which may be more reasonably addressed on a bi- or multi-lateral basis between neighbouring RCCs, or through a jointly manned centre. To facilitate the development of this database, it may be necessary to establish broad regional SAR zones- such as Arctic East and Arctic West- which overlap national SRRs.

Paragraph 3 examines national cooperation for the improvement of SAR services within the Arctic, which includes the sharing of pertinent information, arranging joint training exercises and allowing for personnel exchanges. Joint Arctic training exercises (Arctic SAREX) have been ongoing since 1993, involving units from various Canadian, Russian and American agencies in simulated mass casualty incidents (Manney, 2007). Both table-top and operational exercise should be undertaken in the future, to familiarize national forces with the capabilities of neighbouring units, address issues of organization, command structures, communication and operational limitations, in addition to aiding the development of strategies for major incidents involving either disabled aircraft or passenger ships.[24] Article 11 recommends that all SAR agencies involved in any joint exercise should conduct a detailed review of the operation in order to identify any possible deficiencies to be improved upon in the future.

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[24]A model to be considered is the Combined Antarctic Naval Patrol, an annual extended operation through the Antarctic involving forces from both the Chilean and Argentinean Navies. (Merco Press, 2007).

Further areas of collaboration identified within ASAR to be developed include:

- The sharing of real-time meteorological and oceanographic observations analyses, forecasts, and warnings;
- Using ship reporting systems for search and rescue purposes; and
- Sharing national positions on search and rescue issues of mutual interest (AC, 2011, Art. 9).

Accordingly, the ASAR agreement may be used as an avenue for further inter-state cooperation, following upon the success of several models for international cooperation such as the European Maritime Safety Administration (EMSA) and its instruments.[25] There was no mention of cooperation with non-government organizations, industry coalitions or local populations, though undoubtedly any solution will require collaboration with such interests.

The final Articles of the agreement cover matters regarding amendments, settlement of disputes and funding. Of note is the unspecified "internal procedures" which must be completed by each of the contracting parties. As of yet, there has been no further explanation given as to what these procedures will entail, or when this agreement is expected to come into force.

Section Summary

The ASAR Agreement is the first step towards the development of an effective SAR system for the Arctic. The various articles establish avenues for international cooperation required for the advancement of northern response capabilities, especially in the face of increasing interest and activity within the region. This being said, there remain several practical obstacles which must be overcome, in particular the issue of

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[25] Two key instruments from the EMSA are: The Bonn Agreement, which coordinates international pollution surveillance efforts in the North Sea, and has proven to be effective since its implementation in 1969, and; the SafeSeaNet traffic monitoring system, aids in the collection, dissemination and harmonised exchange of maritime data within the EEZ of the European States (SafeSeaNet, 2010).

coordinating an international response with a multitude of management systems and differing technological capabilities, not unlike any other SAR incident.

Having an established treaty basis for international SAR cooperation, it nevertheless remains the responsibility of national SAR centers to address concerns such as communication deficiencies, which will require the coordination of multiple national and government agencies. Leading from the stipulations of regional cooperation contained within the ASAR agreement, to the creation of an integrated Arctic strategy which has access to up-to-date information regarding northern activity and available SAR resources, the possibility of situating RCCs in the Arctic should be considered. Furthermore, efforts should be taken at the international level to develop preventive legislation and standards for northern-bound vessels, as well as the involvement of local communities in order to strengthen the emergency response framework. The following will move from an examination of the general contents of the ASAR to an examination of the various policy and logistical considerations which must be taken into account in order to arrive at a viable Arctic SAR strategy.

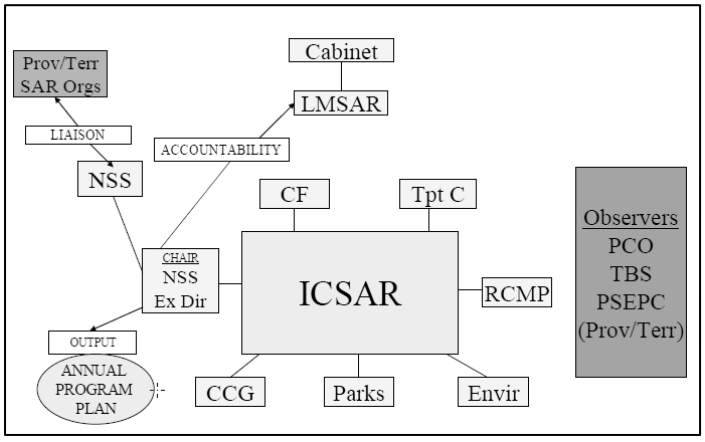
Section VI- Governance Considerations for an Canadian Arctic SAR Strategy

In the wake of several recent high profile incidents, a push for the definition of an Arctic SAR capacity has occurred both internationally and nationally. Due to the identified environment challenges, the geographical and climatic characteristics as well as the composition of northern activity, the creation of a tailored SAR strategy for the region is clearly desirable, encompassing both response arrangements stemming from the ASAR Agreement and risk management measures. Though the 2007 CCG *SAR Needs Analysis* stated that a study would be launched with the purpose of establishing SAR service criteria specific to the Arctic region, this effort has yet to be completed. The following will address several considerations such as the organization of SAR within Canada and the definition of a LOS for SAR which must be included within any northern SAR strategy.

Canadian SAR Governance Arrangements

In examining SAR within Canada, a study would be negligent if it failed to briefly address concerns regarding the general institutional, structural and procedural arrangements governing this service. Despite being bounded by three oceans and encompassing over 15 million square kilometres of territory, the 2007 CCG Needs Analysis concluded that between 2000 – 2004 the SAR system within Canada was functioning effectively, saving 96.2% of lives at

Figure XI- National SAR Program Management



risk.[26] However, the overall efficiency of this program, especially the division of responsibilities amongst the various Canadian SAR partners, remains an area of concern, as various federal, provincial, territorial and regional authorities all assume varying degrees of responsibility for SAR services and SAR policy with a range of equipment, training and capabilities. The interoperability of the Canadian SAR system has been an issue in several recent cases, as discussed in Appendix III.

Surprisingly, there is no specific legislative basis for the organization and provision of SAR services within Canada. Under the 1867 *British North America Act*, rescue services are a provincial responsibility, while the federal government has authority over concerns such as navigation and shipping safety. Due to this constitutional arrangement, Canadian legislation presently allows for "more than one level of government has the power to make legislation concerning SAR" (Chaffey, 2006).

History of Canada's SAR Arrangements

The origin of the current Canadian SAR system began in 1947, when, as a result of the signing of the Chicago Convention, responsibility for aeronautical SAR incidents was assigned to the Royal Canadian Air Force (RCAF). The RCAF was later given the additional mandate of the coordination of maritime incidents in 1951.[27] Following the

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[26] This rate of effectiveness was determined by dividing the percentage of lives saved out of the total number of lives at risk during all incidents within Canada between 2000-2004. (Government of Canada, 2007).

[27] Under this organizational structure, DND, through Canada Command, is the lead agency responsible for the "overall effective operation of the federal coordinated maritime and aeronautical search and rescue system." Additional federal SAR partners include:

- Canadian Coast Guard
- Environment Canada, Meteorological Service of Canada
- Parks Canada Agency
- Royal Canadian Mounted Police
- Transport Canada. (Government of Canada, 2009).

formation of the CCG in 1962 under the Department of Transportation (DOT), the responsible Minister was given limited authority regarding SAR, with marine SAR incidents becoming the exclusive responsibility of the CCG. In 1976, the Minister of Defence was designated as the Lead Minister for SAR (LMSAR), and remains the Minister responsible for the Canadian SAR system. Under the *CSA* 2001, the Minister of Fisheries and Oceans may "designate persons as rescue coordinators to organize search and rescue operations" (CSA 2011, Art. 130). This minister is responsible for "provision of coast guard and hydrographic services to ensure the facilitation of marine trade, commerce and safety, including the "marine component of the federal SAR program" under the 1996 *Oceans Act*, the sole legal basis for SAR within Canadian legislation (Government of Canada, 1996, 41, 1b).[28]

In an effort to coordinate the efforts of the Canadian SAR partners, the National Search and Rescue Secretariat (NSS) was founded in 1986 stemming from the recommendations of the Royal Commission of Enquiry into the Ocean Ranger disaster. The Secretariat was intended to serve as the "central coordinating point for the National Search and Rescue Program (NSP) for the federal element of search and rescue" (National Search & Rescue Secretariat, 2010). However, the NSS and the Interdepartmental Committee on Search and Rescue (ICSAR) has been able to affect little change in regards to the development a comprehensive SAR strategy for Canada, in

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Two volunteer SAR organizations are the Canadian Coast Guard Auxilary (CCGA) and the Civil Air Search and Rescue Association (CASARA). Operating in every province and territory, these organizations play an important role within the Canadian SAR system as secondary SRUs. In 2010, the CCGA had 3,979 members and 1,133 vessels, while nationally, CASARA had 375 aircraft and 2596 certified pilots, navigators and spotters available for SAR taskings.

[28] While the *Oceans Act* does stipulate what are considered to be *coast guard services*, there is no formal definition of role and responsibilities of the Canadian Coast Guard.

particular addressing the shortfalls of the cumbersome institutional arrangement. The 1999 *Review of SAR Response Services* highlighted numerous concerns with the structural and managerial arrangement of SAR services within Canada, noting that:

> Overall, there continues to be a lack of SAR program coordination, planning and direction at the program level. The result is a federal program that has been, and continues to be, the aggregate of the programs of individual participating departments. *Effective multi-jurisdictional strategic management* is the first and most fundamental step towards improving SAR response services (NSS, 1999, 25).

While the above section focused on SAR from a Canada wide perspective, the discussion is directly relevant to the development of Arctic SAR, as any operable strategy will require increased inter-departmental cooperation. At present, there is a relative lack of cooperation between federal agencies regarding SAR policy development through the NSS and ICSAR. According to Rear-Admiral (ret.) Forcier, there "is no whole-of-government strategic direction body that provides coherent direction and guidance in matters of maritime issues" (2011). The need for effective multi-jurisdictional strategic management is a concern which will become increasingly vital as the Canadian SAR system comes under an additional burden, as it is forced to respond to incidents further and further afield from the traditional areas of activity with limited financial support. In order for the domestic SAR services to run efficiently, effectively, and economically, the development of a clearly defined management structure is of utmost importance.

Canada's Northern Strategy

Any discussion regarding the development of government services in the North must be cognizant of the political and media attention which this region has attracted in recent years. The northern operating capacity of the Canadian government is often questioned, largely in light of the sovereignty issue. In the 2011 Throne Speech, the

Conservative government declared that it "has made Canada's North a cornerstone of its agenda. The strongest expression of our sovereignty comes through presence and actions, not words. Our Government will continue to exercise leadership in the stewardship of northern lands and waters (Government of Canada, 2011). All told, while there continues to be political support and public willingness for the development Arctic SAR infrastructure, substantive capital investments have yet to proceed, and should not move forward before a defined rationale for such developments has been established.

The development of the Nanisivik Naval Facility, the proposed construction of 6-8 Arctic/Offshore Patrol Ships (AOPS) under the *National Shipbuilding Procurement Strategy* and the PC-1 icebreaker under *John G. Diefenbaker National Icebreaker Project* all seemingly point to the commitment of the federal government to support continued Arctic activities. These projects however, have been dogged by significant delays, and the purchase of fixed wing SAR aircraft first announced in the 2004 federal budget has yet to occur. In May 2011, it was revealed that the $3.1 billion dollar program was a top procurement priority for the CF, though the details of the initiative have not been released. A 2010 survey by *Ekos Research Associates* concluded that Canadians "see the Arctic as [the] foremost foreign policy priority and one which should be resourced accordingly," ranking the importance of developing the necessary capacity to respond to SAR incidents as a top concern [91% by northern Canadian respondents and 85 % by southern respondents] (14). By the same

Figure XII- CF Arctic/Offshore Patrol Ship Concept

token, only 40% of northern respondents indicated that the existing SAR capacity within the Canadian North was adequate (28).

While support for the further development of SAR services in the Arctic is clearly evident, it is necessary to exercise restraint and not simply take action for the sake of being seen to take action. As discussed in the 1996 *Task Force on Horizontal Issues* "…if we wait until a policy problem moves onto the public agenda – until there is public pressure or urgency for problem resolution – there is often insufficient time for the reflective work needed to make real progress" (Government of Canada, 1996, 21). While the construction of additional Polar Class vessels will aid in the delivery of Arctic SAR services, the characteristics of northern operations will limit the effectiveness of maritime SRUs due to the distances involved and the limited charted areas allowing for safe navigation. The construction of ice-capable SRUs such as the AOPS and the purchasing of further FWSAR resources is an initial step towards the strengthening of Canada's northern SAR system, but alone these developments remain insufficient. The transit distances, environmental conditions and remote nature of the Arctic necessitate further SAR policy development. There is especially a need to balance the expectations of the Arctic SAR system with the limitations of existing infrastructure and resources, in particular emphasizing the need for self-rescue procedures and the need for extended survival capabilities.

Education regarding SAR Services

The perception of the inadequacy of SAR resources in the Arctic has been propagated by the sensationalized media accounts of several recent incidents, most notably the grounding of the M/V *Clipper Adventurer* and the M/V *Nanny* in 2010.

Despite the safe conclusion of these two incidents with no loss of life or environmental damage, media reports questioned the response time of the CCG (Cohen, 2010).[29] This incident is touted as displaying the inadequacies of the Northern SAR response system, rather than highlighting the failings of the crew of the *Adventurer* who struck a known obstacle, and whose passengers were never considered to be in any distress, or recognizing that that *Nanny* suffered no damage, no injuries to the crew and did not release any pollutants.

The misinformation regarding *Adventurer* incident is indicative of a widespread misunderstanding regarding the reality of Arctic operations, and the corresponding challenges facing SAR authorities. As noted by the 1992 *Auditor General's Report*, the "times and locations of distress situations are not predictable, and no amount of resources can guarantee that all people will be saved" (Office of the Auditor General, 1992, 8.2). However, the expectation of immediate rescue is simply not feasible within the Arctic, given that the immense geographic scale and relatively low activity levels are prohibitive to the basing of SRUs in the region. Though conversations regarding the Arctic are typically dominated by political rhetoric and hyperbole leading to a general misperception of the reality of northern conditions, the expectations of rescue services above 60º N must be clearly defined, and the requirement for self rescue emphasized.

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[29] The M/V *Nanny* is a 3000 DWT tanker under the Swedish flag which was carrying 9.5 million litres of diesel fuel to northern communities. On September 1st, 2010 the vessel struck an uncharted sandbar while travelling to Gjoa Haven. The CCGS *Henry Larsen* was 180 NM from the incident, and was initially given the tasking as a SAR incident, However, as the crew and vessel were in no danger, the *Larsen* was stood down from the SAR tasking as the incident was now an Environmental Response (ER) concern.

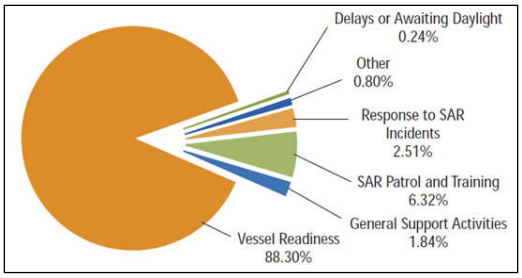
Distress Patterns

While distress patterns within southern Canada are consistent with the location of centers of population and predominantly involve recreational boaters, Arctic traffic will likely be characterized within the near future by destinational commercial traffic. Vessels will either follow consistent routes to and from northern sites such as the Mary River project, or within less defined areas, as cruise ships and northern adventures explore further afield. Appendix IV demonstrates that while marine casualties between 1975 and 2008 occurred throughout the Canadian Arctic, the majority of distress incidents were concentrated within three areas, namely the Mackenzie River delta, Lancaster Sound and Hudson Strait (Judson, 2010). However, with ice coverage within the region continuing to diminish, it is reasonable to conclude that this incident density will decrease as waterways outside the traditional channels become more available. This is especially a concern as many of these regions are unchartered and may not be accessed by larger SRUs.

Northern Based SRUs

It is a commonly leveled criticism of the Canadian SAR system that there are no primary air or marine SRUs located above 60°N of latitude (Wilson, 2010). Primary SRUs in southern Canada are positioned in areas of high activity, but nevertheless even with the busiest of regions, the majority of working days delivered to SAR within Canada consist of vessel readiness. Image XIII from the *2009 CCG Fleet Annual Report* shows the Service per SAR Activity (2009-2010) as a percentage of total Operational Days, and demonstrates that CCG SAR assets are actively engaged in responding to emergency incidents for 2.5% of their total activity over the course of a year. It is unrealistic to expect dedicated resources to be situated within the North, awaiting emergency incidents on a year round basis given the low volume of total traffic (Government of Canada, 2010). To this end, an Arctic SAR strategy must address the issue of LOS for the North. This will provide the general public and maritime corporations with a realistic perspective as to what may be expected in terms of response in remote areas, and will allow for the identification and evaluation of potential service deficiencies.

Figure XIII- Service per SAR Activity as % of Total Operational Days (2009-2010)



Levels of Service

A discussion regard LOS is not meant to suggest that the government will abandon its responsibilities to the residents and vessels travelling to the Arctic or elsewhere in the Canadian SRR. The national SAR objective is to "support the search for, and the provision of aid to, persons, ships or other craft which are, or are feared to be, in

distress or in imminent distress," and despite the expanding theatre of operations, this objective will remain (Government of Canada, 2011). The current CCG service standard for SAR dictates that:

1. Search and rescue mission co-ordination services are provided on a 24/7 basis.
2. All reported SAR alerts/incidents will be investigated and assessed.
3. Search and rescue preparedness and response services are provided on a *risk* basis during the *normal local* navigation season. (Government of Canada, 2011).[30]

Though the Canadian Arctic is remote, it should be expected that the provision of coordination services will not change, nor will the assessment of incidents be affected. The true challenge and the question which must then be asked is whether or not SAR services can be established in a financially responsible manner which will provide the necessary coverage, and who should bear the burden of providing this service. The MCTS stations in Iqaluit and Inuvik operate on a limited seasonal basis- therefore, is it valid to expect that the LOS for SAR during the summer should be superior to during the shoulder season and winter months? Given that Arctic operating conditions constitute a known additional risk, what, if any, additional burden beyond the requirement for specialized equipment should be placed upon commercial and recreational users? A potential avenue would be requiring cash-bonds or insurance for northern-bound traffic- particularly expedition cruises, though the enforcement of such a regime would be difficult. While a user fee for SAR services is widely regarded as inappropriate or even

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[30] What constitutes a "*risk* basis during the *normal local* navigation season" is not defined within this document, nor is there any distinction made for remote SAR operations. The National SAR Manual does allow "Commanders of SRRs [to] realign SAR standby periods so that they coincide with periods of greatest SAR activity, particularly during summer months. At a minimum, primary SRUs "must continue to provide 30 minute SAR standby… for a minimum of 40 hours per week (Government of Canada, 2000, 4.8).

counter productive, commercial vessels subject to increased risk exposure should be expected to bear some of the burden, potentially through a similar arrangement to the Ship-source Oil Pollution Fund (SOPF).

Within the 2007 *CCG Needs Analysis,* it was noted that Arctic SAR incidents should not be termed 'conventional incidents,' and should instead be classified as 'difficult incidents,' were a 50**+** % LOS would be acceptable (Government of Canada, 2007). This same study found that overall northern LOS was largely sufficient, being 81.48% for the eastern Arctic Area and 93.10% for the Nunavut Area. (Government of Canada, 2007). However, the calculation of these rates- that is the percentage of lives saved out of the total number of lives at risk- is an inadequate measure by which to evaluate the effectiveness of the Canadian SAR system. A more appropriate rate should be comprised of a comprehensive evaluation regime with a suite of indicators, allowing for clear and substantive analysis of program performance. Potential indicators could include standards such as:

- Timeliness of response;
- Response performance against existing or developed standards by incident type;
- Nature and type of incidents (causes, class, severity rating);
- Type of response;
- Resources used;
- Human resources used;
- SAR program costs; and
- Risk assessment analysis (NSS, 1999).

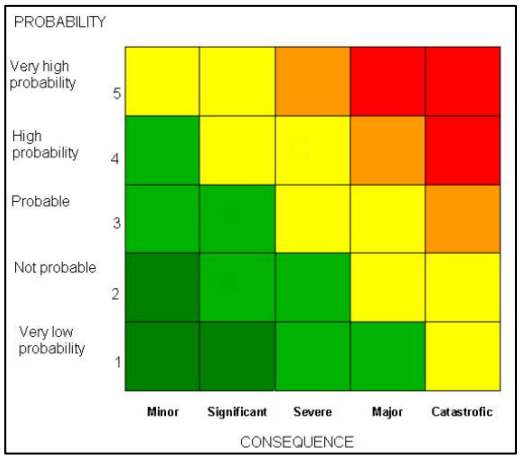
In order for SAR service standards in the Arctic to be defined, it is necessary to improve the performance measures by which the effectiveness of this program is evaluated. The 2001 *Ice Breaking Level of Service*, which "provides clear definitions of icebreaking services that clients can expect to be provided with as well as delivery targets" details the

expectations and client costs associated with the CCG program (Government of Canada, 2001). The determination of an appropriate LOS for SAR is important in order to establish the rationale for future infrastructure and strategic policy development efforts of Canadian SAR authorities.

Minimizing Risk

It must be understood that the increase in northern activity in turn increases the accident risk, and understanding this exposure is critical to the development of an appropriate SAR strategy. The commonly accepted definition of Risk (R) is equal to Probability (of an event occurring) x Consequence (if the event occurs). For the most part, a major incident involving maritime and aeronautical traffic represents low probability, high consequence event, as the likelihood of a catastrophic incident such as the sinking of a cruise ship or the crash of a trans-Arctic flight, is relatively low. Accommodating these activities will require the introduction of new initiatives in order to reduce the consequences of such an incident, necessitating the creation of an Arctic Safety policy which includes SAR response.

Figure XV- Risk Matrix

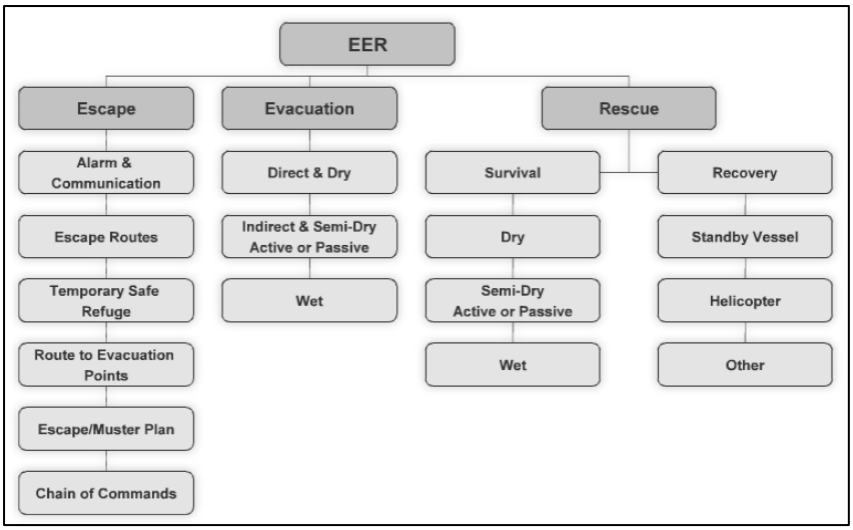


Appropriate risk-management strategies designed to reduce the probability of the occurrence of an emergency incidents and the development of technological capabilities will play a critical role within an Arctic safety strategy, and would aid in minimizing loss of life during northern SAR incidents. Internationally there are continued efforts for the

development of a mandatory Polar Code through the IMO and its member states, which should be published in late 2011. The IMO released a Circular in 2006 titled *Enhanced Contingency Planning Guidance for Passenger Ships Operating in Areas Remote from SAR Facilities*, which suggested measures which should be taken into account during remote operations, including SAR co-operation planning arrangements and vessel 'pairing' in order to provide mutual assistance (IMO, 2006). *Det Norske Veritas* (DNV), a leading classification society introduced *Rules for Winterization* in 2006, which provide specified requirements for two class notations, depending upon the intended operating conditions. In addition to specifying standards for the ice strengthening of hull and approved low temperature grade materials, these rules include stipulations for ship safety arrangements, icing and personnel protection for operations in polar environments (Det Norske Veritas, 2006, Pt.5 Ch.1 Sec.6).

Industry led initiatives regarding northern safety requirements currently surpass the legislative standards established by the polar states. In regards to introducing strategies in the event of a catastrophic marine event, particular attention should be given to the Escape, Evacuation and Rescue (EER) model similar to that proposed within the Barents 2020 document, which considered concerns

Figure XV- Suggested Framework for EER Activities



regarding existing offshore Health, Safety and Environment (HSE) standards and made recommendations for future oil and gas operations in the Barents Sea (Det Norske Veritas, 2010, 50). Yet despite every effort for accident prevention, incidents do and will occur, as demonstrated by the record of recent northern SAR cases.

Section Summary

The above section focused on matters pertaining to both the Canadian SAR system as well as specifically for service within the Arctic. With regard to nation-wide SAR concerns, the key issue is the developments of *effective multi-jurisdictional strategic management* for SAR, including a comprehensive review of the governance structure of the program within Canada and the departments charged with providing primary SRUs.

The demands of the Canadian Arctic necessitate the development of region specific management policies. There has been criticism of the existing Canadian SAR capabilities within the region by both media and industry groups, and as evidenced a recent lawsuit launched by the owners of the *Clipper Adventurer*, Canadian authorities face the prospective of costly legal challenges due to the lack of northern maritime services. Instituting appropriate Arctic marine safety measures to minimize accidents and loss of life, educating pleasure craft operators on the dangers of northern navigation and completing the promised ship building projects all play a role with an Arctic SAR strategy. However, it is important that this system be informed by a rational, measurable service standard with verifiable performance indicators to direct the development of SAR services and act as a measure by which to evaluate the effectiveness of this program.

In order to inform this service standard and create an Arctic SAR strategy, it is therefore necessary to consider the past record of northern incidents to identify existing operational and procedural deficiencies. To this end, the following section will examine Special Operations Reports (SAROPS) and case logs from incidents which occurred between 2003-2011.

Section VII- Lessons Learned from Recent Arctic SAR Operations

The governing principle of the global SAR system is to ensure that "wherever people sail or fly, SAR services will be available if needed" (IAMSAR- Volume II, 2010, 1). As previously discussed, traffic levels and activity type play a critical role in the determining what constitutes appropriate SAR capabilities. Examining past incidents is necessary in order to identify potential inadequacies and areas for improvement of an existing system. The following section utilizes case logs and SAROPS from incidents dating from 2003-2011 which occurred within the northern Canadian SRR as defined by the ASAR Agreement. These documents highlight some of the operational challenges faced during recent SAR incidents, and were selected as they are representative of the full range of past and expected future northern traffic, from fishing vessels to solitary adventurers. These cases, each summarized in Appendix III, form the basis of the identified deficiencies discussed below, which must be addressed within a Canadian Arctic SAR strategy.

Transit Time

Presently, there are no primary marine or aerial SRUs based within the Canadian SRR under the ASAR Agreement. Marine units with SAR capabilities are tasked to other duties during the summer navigation season, and may only be considered as being secondary SRUs. When tasked to an Arctic incident, CF units must cover long distances to reach northern incident locations, requiring that a second Cormorant crew be transported north to relieve the initial flight crew which had delivered the aircraft. The location of marine SRUs is largely contingent upon other CCG programs such as icebreaking in support of the re-supply of northern communities or scientific research.

Increased commercial activity has increased the number of potential vessels/aircraft of opportunity, though with the exception of a few year-round operations, marine resources are predominantly available only during the brief summer season.

Delayed Reporting

The "economy of sharing" with Inuit communities in the Arctic, as described by Wenzel in 1999, includes a "high level of interdependence within the extended family unit and a strong sense of collective community responsibility and mutual aid" (Ford *et al*., 2007, 155). This culture of self-sufficiency undoubtedly contributes to the delayed notification of SAR resources, as search efforts tend to be initiated at the community level prior to government authorities being contacted. The assistance of local residents has proven critical in a number of Arctic searches, though the reluctance/delay in contacting SAR authorities has contributed to fatalities. Differing cultural attitudes towards emergency services between northern and southern residents is often a source of conflict, especially when the search efforts run contrary to the wishes of the community.

Logistical Challenges

The harsh environment of the Arctic presents unique operational challenges, such as the icing of aircraft components. Searches have been delayed due to the mechanical failures as a result of Arctic conditions, further compounded by the lack of available facilities with the proper equipment required to address mechanical issues or to house crews. Inadequate hangar locations, lack/inaccessibility of refuelling stations and issues with interoperability between SRUs and local assets limits the effectiveness of SAR efforts within the Arctic. The inexperience of flight crews with the unique demands of northern operating environment is of additional concern.

On-scene Coordination

The Canadian SAR Manual allows an RCC to "designate an on-scene commander (OSC) or a coordinator surface search (CSS) to enhance co-ordination," if there is more than one SRU engaged in the search. The CSS or OSC has a range of responsibilities which include: maintaining a detailed record of the operation; maintaining communications with the RCC; monitoring weather and sea conditions; and, recommending modifications to the search plan as facilities and on-scene conditions dictate (Government of Canada, 2000, 23). Given the lack of primary SRUs, appointing an appropriate CSS with a sufficient communications platform and required longevity is difficult. While most incidents do not necessitate the appointment of a Searchmaster, organizing secondary SAR assets and liaising with the local community from a distance presents a challenge, undermining both the performance of rescue operations and negatively affecting the perception of SAR authorities.

Local Knowledge/Domain Awareness

There is little navigational information available for many Arctic waterways, which limits the effectiveness of marine SRUs. Confusion regarding differing place names (geo-referencing) negatively affects the performance of SAR operations in remote regions, especially during the initial phases of an incident. Present reporting requirements allow for smaller ships to enter the Canadian Arctic Archipelago unannounced, presenting serious concerns in the event of a reported overdue vessel.

Communication Difficulties

There is a lack of communications infrastructure within the Arctic, both for communication between southern RCCs and SRUs, as well as bandwidth from mobile sites. Satellite systems are becoming increasingly serviceable, but as of yet there has been

no reliable communications network established which permits all SAR partners, both federal and territorial, clear lines of communication during an emergency incident. In the event of a large SAR incident within the Canadian Arctic, most local communities do not have the necessary technical or logistical capacity to support sustained operations.

Section Summary

The above discussion has noted a range of deficiencies from recent Arctic SAR incidents. The logistical challenges of delivering SRUs to northern search areas, the variability of weather conditions and the importance of community liaisons are clearly evident within these incidents. The deficiencies as identified above, in conjunction with the general concerns regarding the Canadian SAR program discussed earlier, form the basis for the following section, which will present recommendations for a region specific SAR strategy for the Canadian Arctic.

Section VIII- Proposed Arctic SAR Strategy

The Canadian Arctic represents one of the most difficult operating environments anywhere in the world. In addressing the SAR needs of the indigenous populations of northern Quebec (Inuvik), Nunavut, the Northwest Territories and the Yukon as well as the burgeoning commercial activity within the region, an area specific strategy must be adopted. A recently published Arctic Operating Concept for the Canadian Forces recommended that any northern strategy must include "sufficient capacity to carry out mandated *routine operations* while maintaining a ro*bust, rapid response* capability that can meet specific contingencies and emergencies as they may arise throughout the region" (Balasevicius, 2011). This concept, initially directed towards Canadian military operations, is nevertheless a useful definition for the development of a federal Arctic SAR management strategy, in which secondary SRUs and community resources play a leading role in northern SAR operations. In short, while situating additional primary SRUs in the Arctic would be ineffective and fiscally irresponsible, and is not a comprehensive solution for northern SAR, some amount of infrastructure and procedural development is required. As noted throughout the earlier discussions, a capable SAR system is comprised of numerous components, including co-ordination centers, communication facilities and a governance structure, all which must be addressed in Canada's Arctic SAR strategy.

It is the position of this paper that in regards to the Canadian North, increased education efforts, accident prevention measures, community involvement, secondary SRUs and extended survivability capabilities are indispensible parts within Arctic SAR. To this end, the following will detail elements of a region specific strategy designed to

address the particular environmental, operational and demographic challenges of the Canadian Arctic.

Considerations impacting an Arctic SAR Strategy

The above sections have discussed numerous aspects of the evolving situation in the Canadian Arctic, from the shifts in the northern climate to the increasing interest in the development of resource extraction projects. Considerations which must be taken into account in creating an effective Arctic SAR strategy include:

- The Canadian Arctic is an immense territory with a low population density. The northern demographic tends to congregate in small communities located in coastal regions.
- Though there is a limited volume of incidents per year within the region, these incidents tend to involve increased loss of life, in part due to the harsh environmental conditions and the distance which must be travelled by SRUs. A decreased survival time requires the carriage of specialized emergency equipment.
- Cultural differences/mistrust of federal authorities has delayed the alerting of RCCs of emergency incidents, and a lack of clear lines of communications with local communities may complicate search efforts.
- Variable climate trends will result in unpredictable weather patterns, decreasing the validity of local knowledge and disrupting traditional activities.
- An increase in the annual average temperature will cause a shift in the northern transportation network, forcing an increased reliance on marine shipping and diminishing the use of over-land transportation such as ice-roads
- Decreased shore-fast first year ice will allow for greater wave action, increased storm surge events and accelerated coastal erosion rates. Decreased shore-fast FY ice will allow for the entry of multi-year ice (growlers, bergy bits) into the NWP and other inner Arctic waters, posing a threat to maritime traffic.
- Increased commercial activity will result in a higher level of traffic within the Canadian Arctic, particularly within the Eastern Arctic region. This traffic is expected to be destinational in nature, rather than trans-polar passages. Industrial projects will dramatically increase the number of marine and aerial units operating within the region. Furthermore, this activity will strengthen the northern transportation and communication capabilities through the construction of deep-sea ports, as well as improving existing airfields.
- Commercial activity will be accompanied by an increase in recreational boaters, commercial passenger vessels and expeditions visiting northern destinations.

- Further population growth and the expansion of an offshore and inshore fishery will increase the demand for medevacs.
- Aerial SRU's are located in southern Canada, necessitating long transit flights which require additional crews to be delivered to northern bases due to mandated rest periods.
- CCG vessels operating in the Arctic on a seasonal basis are secondary SRUs-Vessels are multi tasked in support of scientific research projects, ice-breaking and community re-supply efforts.
- A growing number of community based resources (CCGA vessels, CASARA and Rangers) available to assist during a SAR operation, who may serve as spotters and sources of local knowledge.
- Minimal support infrastructure for Arctic SAR operations, including refuelling depots, repair facilities, communication capabilities and widely dispersed medical facilities.
- Lack of local knowledge at RCCs, limited navigational charts and geo-referencing negatively affect search coordination and rescue efforts.
- Communication capabilities remain problematic, but emerging technological developments such as the DASS and satellite systems such as Iridium will improve northern communications, including emergency notification capabilities.
- Projects such as the Polar Elipson initiative will increase the surveillance capacity and maritime domain awareness of Canadian authorities, supplementing the existing RADARSAT-2 system.
- Absence of an Arctic Marine Safety program requiring mandatory training requirements for northern crews, no mandatory Polar-class safety or construction standards for all vessel types.

SAR Management

The development of northern safety infrastructure must be a cooperative effort between private and government (federal and territorial) partners. The re-alignment of coordination services has once again spurred a public debate regarding the delivery of SAR services within Canada, and has highlighted the lack of a clearly defined management strategy. Deficiencies of organization structure and management of the Canadian SAR system were raised in the 1982 *Cross Report*, and many of the strategic policy recommendations contained within this document remain valid to-date. The fractured command structure and divided responsibilities have resulted in the 'orphaned'

status of SAR within the various federal and provincial departments responsible for providing response services, and the absence of definitive legislation and service standards governing SAR within Canada has further affected program efficiencies and prevented effective performance evaluations.

Given the multitude of interests involved, the need for a simplified command structure is of utmost priority in order to ensure clear lines of communication and the efficient positioning and utilization of resources. It was recently reported that Alternative Service Delivery options were being considered for SAR response resources, a report which was met with mixed reviews. While utilizing industry resources to supplement federal and provincial capabilities and to address gaps within SAR coverage is necessary within remote areas, a consideration of an alternative model for SAR must follow from a clearly articulated multi-jurisdictional strategic management plan.

Recommendations

- A comprehensive, nationwide evaluation of the Canadian SAR system should be completed, including SAR partners from every level. In particular, the organization structure of the Canadian system should be considered, in addition to the role and powers of the NSS being evaluated.

Level of Service for the Canadian Arctic

At present, the LOS for SAR within Canada is lacking a clearly articulated measure. Developing an appropriate service standard, especially in the face of increased demand for SAR in the Arctic, is a necessity, as the absence of a definitive benchmark prohibits the development of an effective SAR strategy. The suggestion of the 2007 *CCG Needs Analysis* that Arctic cases be as classified as 'difficult incidents,' with a 50% LOS, is not a valid indicator. A recommended northern LOS must utilize the operational standards as presently dictated by the CCG, namely 24/7 coordination through the RCCs,

investigation and assessment of all incidents and the provision of SAR response services.

In reference to the Canadian Arctic, the geographic, environmental and demographic characteristics demand that certain assumptions be made, as potential clientele of the SAR system are knowingly operating within a remote area which possesses additional known risks. Therefore, extended survival capabilities including robust emergency communication equipment and the capacity for self rescue must be considered mandatory within any service standard (Government of Canada, 1982, 156). The timeliness and the nature of the SAR response should be contingent upon the declared urgency of an incident: a reported vessel overdue would require extensive investigation prior to the tasking of SRUs, while a Mayday broadcast from a verified source should elicit a more immediate response. An Arctic specific LOS must define the operating season during which activity levels as well as the availability of response assets will be significantly greater.

Recommendation

- It is recommended that an Arctic LOS with a comprehensive suite of performance indicators be established, in order to act as a benchmark through which to evaluate program effectiveness and to help direct future capital projects.
- Though a time based standard has not received a favourable review in the past, it should be part of an Arctic LOS. One potential standard is that when an incident is confirmed to have moved into a Distress Phase, primary Fixed Wing SRUs would be expected on scene within twelve hours for 90% of all northern incidents.
- In terms of marine SRUs, during the summer navigation season (subject to annual variation) within identified regions, secondary marine SRUs should be expected on scene within 96 hours. The Mackenzie River delta, Lancaster Sound and Hudson Strait are all high traffic areas could be subject to heightened LOS during the summer months.
- Designating of specific waterways as Primary Response, Enhanced Response and Remote Response Areas according to traffic type, traffic volume and environmental hazards should be considered, similar to the system currently

utilized by the Eastern Canadian Response Organization. Adapting a tiered response strategy for northern SAR incidents (Appendix VI) would aid in the development of appropriate emergency plans for vessel operators.

Strategic Elements

Accident Prevention

There is no doubt that incident prevention should be the top priority of any Arctic Safety strategy. International organizations such as the IMO, industry groups such as the IAATO and classification societies such as DMV have initiated risk-management initiatives and Best Practice Guidelines for Arctic Operations, including DNV's *Rules for Winterization*, or the IMO's forthcoming *Mandatory Polar Code*.[31] These advancements will improve the safety of northern commercial operations, but will not completely eliminate the risk of accidents or the need for northern SAR capabilities.

Efforts to minimize both distress and non-distress incidents within the Arctic must be initiated at the government, community and industry level. This is especially true for not only commercial vessels, but also for recreational and fishing vessels, traditionally two groups which comprise a significant portion of annual SAR cases in Canadian waters. Groundings, mechanical breakdowns and running out of fuel are common incidents which are typically non-distress, but as demonstrated in Appendix IV, resolving these incidents in remote areas is significantly more dangerous and costly. Properly educated and equipped users, knowledgeable of the demands of northern navigation are better able to avoid an emergency situation. While proper onboard safety equipment is

[31] Presently, DNV is the only classification society to have established Polar standards for vessels operating in northern waters.

necessary, it is critical to recall that the seaworthiness of any northbound ship is contingent upon the human element, the qualifications and experience of the ship's crew.

It is cause for concern that the Association of Arctic Expedition Cruise Operators (AECO), the junior counterpart to the IAATO, focuses upon avoiding the misuse of SAR resources, stating in the 2011 *Guidelines for Expedition Cruise Operations in the Arctic* that, "SAR services are present in most Arctic areas" without providing further detail or suggested preparation (23). Education campaigns amongst local communities and northern visitors are necessary as a means of addressing commonly held misperceptions regarding the reality of Arctic travel.

Recommendations

- Support the timely implementation of the forthcoming mandatory Polar Code as developed by the IMO.
- Develop an Arctic Marine Safety Program in partnership with territorial authorities, designed to educate boaters and local communities concerning the specific challenges of northern activity in the face of variable environmental conditions, in particular emphasizing the need for specialized equipment, training and the filing of sailing plans with a responsible authority. The Nunavut Circular regarding the hazards of Spring Travel is an example of one such program
- Work with industry groups to develop Best Practice Documents for commercial operations in remote areas, addressing accident prevention, emergency preparedness and self-rescue.
- Consider the implementation of a system requiring the deposit of cash-bonds with Canadian authorities, or additional mandatory insurance for northern-bound traffic, especially for vessels carrying commercial passengers
- Given the hazards of the northern maritime environment, commercial operations with year-round operations must establish a SAR plan as part of the initial project proposal, specifying response strategies for emergency contingencies involving marine and aeronautical incidents, as well as

industrial accidents. Required information would include available medical facilities, emergency resources, and support infrastructure.

Search

The minimization of search efforts within a SAR case is critical to the successful conclusion of an incident, and the timely location of survivors is especially critical within the Arctic, given that the severe environmental conditions result in reduced survival time. Ideally, registered satellite locating beacons (Emergency Position-Indicating Radio Beacon (EPIRBs); Emergency Locator Transmitter (ELTs); Personal Locator Transmitter (PLBs) and satellite phones would be carried by all vessels and other travellers within the Arctic, as this would allow for the rapid alerting of SAR authorities. However, while new technology has, to some extent, filled the void left by the erosion of the traditional knowledge base within indigenous communities, technological advancements alone are an insufficient solution to northern SAR needs.

Furthermore, it is unreasonable to expect that emergency beacons will completely 'take the *search* out of search and rescue.' To further supplement alerting technologies, the existing NORDREG reporting requirements should be expanded to include vessels of all type entering the Canadian Arctic. Improvements in the collection and dissemination of this information will allow for increased marine domain awareness and enhanced supervision of maritime traffic. The need for timely and accurate reporting of vessel activity is especially necessary within the northern regions; in the event that a vessel fails to report according to a pre-determined schedule, the coordination of search efforts may be focused within a much narrower area as compared to an vessel reported hours or even days overdue which may be located within a much larger geographic area.

Recommendations

- Every effort should be made to ensure that all northern bound traffic carries registered satellite notification equipment capable of operating in Arctic conditions. The Government of Nunavut has recently undertaken a program to provide free PLBs upon request.
- Initiatives such as the RADARSAT Polar Elipson project should continue to be supported, and the resulting data be made readily available to RCCs. Further technological solutions to improve upon existing capabilities must be sought, such as the use of unmanned aerial vehicles in northern searches.
- The communication deficiencies within the region require cooperation between government agencies and private industry in order to address technological barriers limiting northern communication capabilities. Distributing satellite phones to local authorities within northern communities stands as the best means of improving emergency communities.
- Bi and multi-lateral efforts with international partners should be actively pursued to develop a northern notification and tracking system to bolster and improved the existing Canadian arrangement (NORDREG). The current reporting requirements should be re-examined, and amended to include smaller commercial and recreational vessels.
- The current drift modeling software (CANSARP) lacks the capability to calculate drift patterns in ice conditions. The decision not to support the "Development of a Drift Prediction System to Support SAR Operations in Ice-Covered Waters" project should be revisited, and any future upgrades should take into consideration searches within ice-covered waters.
- Strengthen ties with local EMO organizations, in particular promoting the need for the development of uniform procedures and equipment to allow for increased interoperability between local and southern based SRUs during a MAJAID/MAJMAR event.

Rescue

The case has been argued that northern based SRUs are required within the Arctic: however, until such time that activity levels approach that of southern Canadian maritime ports, the emphasis must be placed upon self rescue capabilities rather than pre-positioned primary rescue assets. It is not simply increased risk exposure which dictates the stationing of SRUs, but rather a determination which weighs the potential benefits of positioning resources in a certain area versus another. Furthermore, due to the noted environmental conditions and distances between northern communities, it is not accurate

to conclude that enhanced primary SAR capabilities would significantly improve the survival rate during Arctic incidents. This being said, the growth of northern communities and the development of industrial projects will provide additional secondary SRUs to act in place of federal SAR assets.

A recent IMO circular stated that passenger vessels operating in remote areas possess the necessary equipment to survive for five days following an emergency evacuation, and this remains a reasonable standard. The EER model discussed above (Figure XV) indicates the components for which performance standards must be established, especially as evacuation during a marine emergency in the Arctic presents specific challenges for which traditional safety equipment is not designed to withstand.

Recommendations

- In conjunction with international organizations such as the IMO, mandatory guidelines requiring that all northern bound commercial traffic be capable of evacuating in Arctic conditions and surviving for a minimum of five days should be established.
- Commercial passenger vessels travelling through the Canadian Arctic must have pre-established procedures and standing arrangements with remote medical organizations and salvage companies to address scenarios such as medical emergencies, groundings and catastrophic incidents.
- Support the continued development of northern based secondary SRUs by encouraging membership and providing additional training for CCGA and CASARA members. Providing local vessels and aircraft with SAR equipment would reduce the associated cost and challenges of delivering primary SRUs to the Arctic.
- The development of marine capabilities of CF Ranger units should be implemented. Given that the members are drawn from the local community, they possess vital local knowledge as well as acting as a bridge between SAR authorities and the community.
- An Arctic Tailored Force Unit with specialized training and equipment, capable of being transported via Fixed Wing aircraft to remote locations and

sustaining extended SAR operations should be developed. The United States Coast Guard (USCG) has utilized these Force Packages since 2008.

SAR Capacity Strategy

Escaping an emergency incident within the Arctic is only part of the concern, as the issue remains how to affect a rescue. With present activity levels, basing primary SRUs in the Arctic is not an economically feasible or effective strategy for the delivery of northern emergency services, requiring that other avenues must be considered. In the rescue of Tom Smithergale in 2010, the civilian helicopter, while capable of remaining on scene for an extended period of time, did not possess hoist capabilities or the necessary equipment for locating a 406 MhZ beacon; however, it was the only available aircraft. Given that private aircraft and vessels are increasingly located throughout the Arctic, industrial organizations must be required to carry a minimum amount of SAR equipment, for the safety of their personnel, as well as for the benefit of the local community. In Newfoundland, Cougar Aircraft has developed an independent rescue operation, and on the West coast, the Northern Gateway Project will be installing several radar installations and stationing of rescue tugs along the proposed sea-route.

Recommendations

- The proposed AOPS and Fixed Wing replacement projects will strengthen the Canadian SAR system in general; however, these units should not form the basis of an Arctic SAR strategy, but rather act in a supporting role during MAJMAR/MAJAID incidents and during extended operations.
- Community based SRUs must from the basis of the Canadian Arctic SAR Strategy. The CCGA and CASARA must continue to expand their membership within northern communities.
- A base equipment standard such as the carriage of satellite phones and emergency beacons must be created for these units to ensure the protection of searchers as well increasing inter-asset operability.

- The role of the Canadian Rangers, who presently have members stationed in 163 communities should be expanded. Though lacking marine capabilities, this organization may be utilized to strengthen northern SAR given its established connection with local groups and formal command structure.
- Commercial operators, particularly those operating year-round facilities with extensive infrastructure development must possess basic SAR capabilities such as the ability to home in on 406 MhZ beacons. Memorandum of Understandings should be with such projects, allowing for commercial vessels/aircraft to be utilized for SAR operations when required.

Implementation Issues

Arctic RCC

In light of the recent consolidations of the MRSCs from St John's, NL and Quebec City, PQ, the development of an additional RCC to supervise the Arctic region is an unlikely prospect. However, this centre does not and should not be a strictly Canadian funded initiative. The 2008 "Model Negotiation on Northern Waters" conducted by a panel of Canadian and American experts suggested that a maritime organization be modeled after the International Joint Commission, which was created in 1909 by Canada and the United States to oversee the activity within the Great Lakes. It was the recommended that such a commission could without resolving the NWP debate, thereby allowing the two nations to "collaborate in the development of parallel rules and standards and co-operative enforcement mechanisms with respect to notifications and interdiction zones in the northern waters of Alaska and Canada" (ArcticNet., 2008). Article 9 of the ASAR Agreement provides a mechanism to explore potential avenues for shared SAR responsibilities beyond annual training exercises. In light of the closely aligned interests between Canada and the US, the establishment of a centralized Maritime Operation Centre with joint security/coordination responsibility may be considered.

Recommendations

- The ASAR Agreement specifies a SRR that does not presently correspond with the existing Canadian boundaries, and a re-alignment the domestic SRRs should be undertaken to reflect the new boundary. There are three potential means this may occur:
    - The transfer of the northernmost portion of JRCC Halifax's SRR to JRCC Trenton.
    - The creation of Eastern and Western SRR which may be staffed in conjunction with neighbouring states (Greenland and the US).
    - The creation of a Northern SRR with a corresponding RCC.

Equipments Bases/Prepositioned Equipment

A key concern for primary SRUs operating in remote locations is the logistical and equipment challenges which must be overcome. On several occasions, responses have been delayed due to inadequate facilities for refuelling and repair, while providing adequate quarters also presents a problem. As such, forward operating bases with the necessary logistical supplies required to support extended SAR operations should be established. These stations could be manned with minimal personnel, and do not necessarily have to be stand alone facilities operated by the CF.

Northern mining projects are supported by year-round flights, and using these existing airfields as staging areas in the event of a SAR incident should be considered. Similarly, several proposed initiatives call for the creation of northern deep water ports, and these facilities should possess the capacity to assist a vessel in distress with pollution response equipment and emergency tugs. Delivering equipment to northern locations is challenging scenario at the best of times, and therefore, prepositioning equipment is key, in particular to support a MAJAID/MAJMAR incident. There are presently six Arctic Emergency Clothing Caches situated in strategic locations, and this program should be expanded to include airfields within high traffic areas. Additionally, the nineteen Arctic

Community Packs installed in northern communities containing surface booms, shoreline cleanup kits, small vessels and trailers demonstrates the increasing recognition that having stockpiled resources on hand is vital in the event of a northern operation.

Recommendations

- Consider the establishment of northern forwarding operating bases in cooperation with private operations, with the necessary supplies to support extended northern SAR operations.

Community Based Initiatives

A challenge remains for the development of a closer relationship between SAR authorities and local communities. The social networks characteristic of traditional Inuit society includes a "high level of interdependence within the extended family unit, a strong sense of collective community responsibility and mutual aid" (Ford *et al*., 2007, 155). These networks facilitate the sharing of food, equipment, and knowledge and ensure rapid response to crisis, which is demonstrated the offers of assistance in the form of search units and spotters during recent incidents. By the same token however, the delay in notifying SAR authorities regarding a potential incident has resulted in fatalities in recent years. Further efforts to develop closer ties with local communities are therefore necessary, particularly regarding the importance of early activation of the SAR system and concerns regarding false reporting.

In order to accomplish this, an education campaign to develop further liaison with northern communities should be initiated, as community involvement will play a critical role in a Canadian Arctic SAR strategy. The challenge is to establish a functional relationship with communities that is cognizant of cultural differences between northern and southern populations while acting in an efficient manner to deliver emergency

resources and not endangering further lives. Community based resources must play a leading role within the delivery of Arctic SAR services. These resources have several advantages over southern based SRUs, as they are typically within close proximity of an incident, possess extensive experience with northern conditions and have a wealth of knowledge regarding the particular hazards of the regional environmental.

A particular challenge for RCCs is determining an appropriate search area due to the absence of hydrographic charts and unfamiliarity with local place names. The Multilingual Arctic Topographical Map Series, an off-shoot of the Geo-mapping for Energy and Minerals (GEM) project serves as a template of a collaborative effort which combines the efforts of various levels of government, local residents and industry (Appendix VII). The Multilingual Arctic Topographical Map Series has produced a limited series of topographical maps which were created through collaboration between National Resources Canada and local northern communities. Initially developed as a tool for geologists conducting field research, these maps are intended to be "culturally/regionally meaningful and relevant," and list a variety of attributes as compiled by community elders. These include: local place names, the location of emergency cabins, commonly used snowmobile trails, prevailing wind direction, bathymetric lines and polynias (Moore, 2010). Having such information would allow for southern based RCCs to coordinate with northern SRUs with a common point of reference.

<u>Recommendations</u>

- A central database of available commercial and privately owned vessels and aircraft should be complied. However, in light of the number of small, far-flung communities within the Arctic, emphasis should be placed upon the collection of

this data at the local level and the coalition of this information in an open sourced database akin to the Google Earth platform

- While the overall search coordination may be conducted from a remote location, communication difficulties necessitate an on scene coordinator, in particular to organize local resources and to serve as a community liaison. The CCG Onscene Coordinator Course should be provided for locally based authorities, such as members of the Canadian Rangers, RCMP, or the local EMO, in order to provide effective coordination of local assets and the to bolster the relationship between SAR authorities and local communities.
- Multi-agency collaborations are required to effectively support northern initiatives such as the Multilingual Arctic Topographical Map Series. Such efforts have numerous advantages, including providing a uniform multi lingual charts allowing for improved geo-referencing and formally recording traditional knowledge regarding geographic and environmental conditions.

Conclusion

The Canadian Arctic has experienced a resurgence of activity within recent years, as the region enjoys increased maritime accessibility as a result of declining sea ice levels and commercial interests look to expand northward. Future activity is not expected to be composed of international shipping, but rather vessels travelling to destinations within Canadian Arctic, for reasons ranging from carrying mineral resources extracted from northern mines to European markets, to recreational boaters attempting to transverse the NWP. Continued commercial activity within this challenging operating environment will place additional burdens on the Canadian SAR system, particularly as traffic becomes increasingly spread over a large, sparsely populated geographic area. Given the recently signed ASAR Agreement, Canadian authorities are required to provide an "adequate and effective search and rescue capability" within Canada's Arctic SRR.

As it stands, the Canadian SAR system is comprised of several federal departments who have limited resources to dedicate to SAR. The limitations of the existing system have been highlighted in numerous reports, yet SAR retains an orphaned status within these organizations. With the potential for a significant northern developments occurring in the near future, Canadian SAR authorities are faced with the prospect of delivering emergency response remote locations on an increasingly regular basis. Given the additional burden to be placed upon this system, appropriate service standards with a suite of performance indicators must be developed in order to determine program efficiencies.

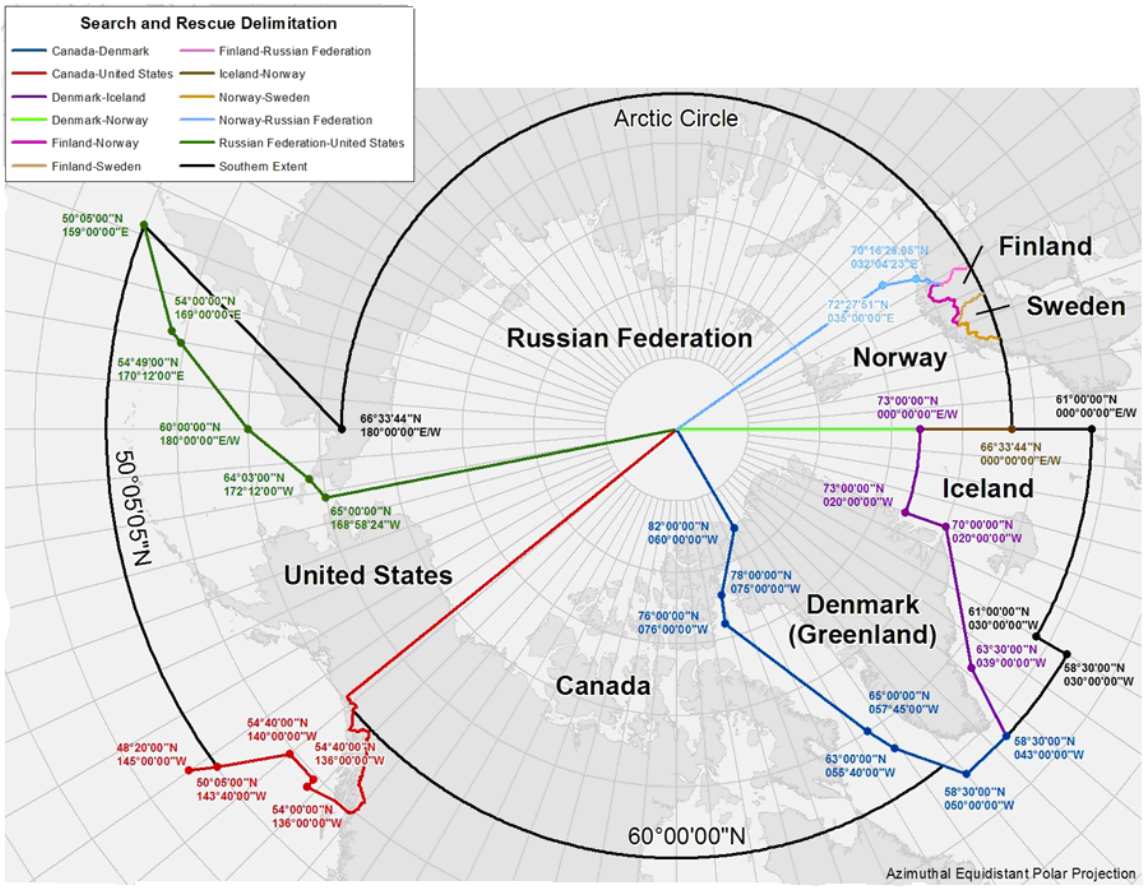
Delivering SAR services within the Arctic will require the cooperation of the federal and territorial governments, which must work with commercial interests operating

in the region in order to develop an Arctic Safety program designed to prevent incidents from ever occurring. Community based resources belonging to members of the CCGA and CASARA must play a leading role in northern operations, supported by primary SRUs based in southern locations. These local units have a distinct advantage over southern SRUs, namely being located in relative proximity to the incident location, familiarity with the local geography and experience operating in northern conditions. However, investment in properly equipping and training these members is vital to ensure that these SRUs and personnel are suitably prepared to perform SAR operations.

In 1820, an British captain following a failed whaling expedition noted that "the navigation of the Polar seas, which is peculiar, requires in a particular manner, an extensive knowledge of the nature, properties and usual motions of the ice, and it can only be performed to the best advantage by those who have long experience with working a ship in icy conditions" (Scorsby, 1820, 28). His observations remain valid today, and as human activity continues to expand further northward, the Arctic nevertheless remains a demanding operating environment necessitating specialized equipment and training. Canadian authorities must be cognizant of these challenges, and move to proactively address SAR concerns prior to the occurrence of a catastrophic incident.

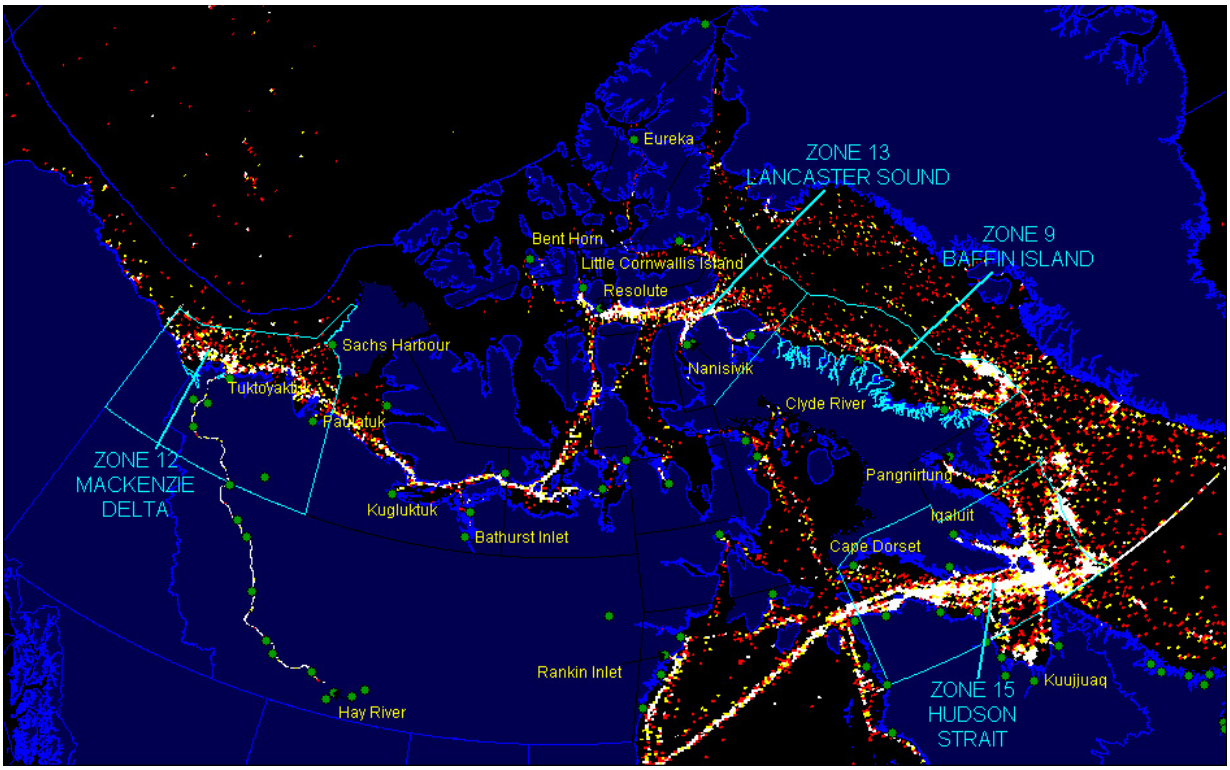
Appendices

Appendix I- National SRRs under the ASAR Agreement



Arctic Portal. (2011). Arctic Search and Rescue Agreement- Map. Retrieved from http://www.arcticportal.org

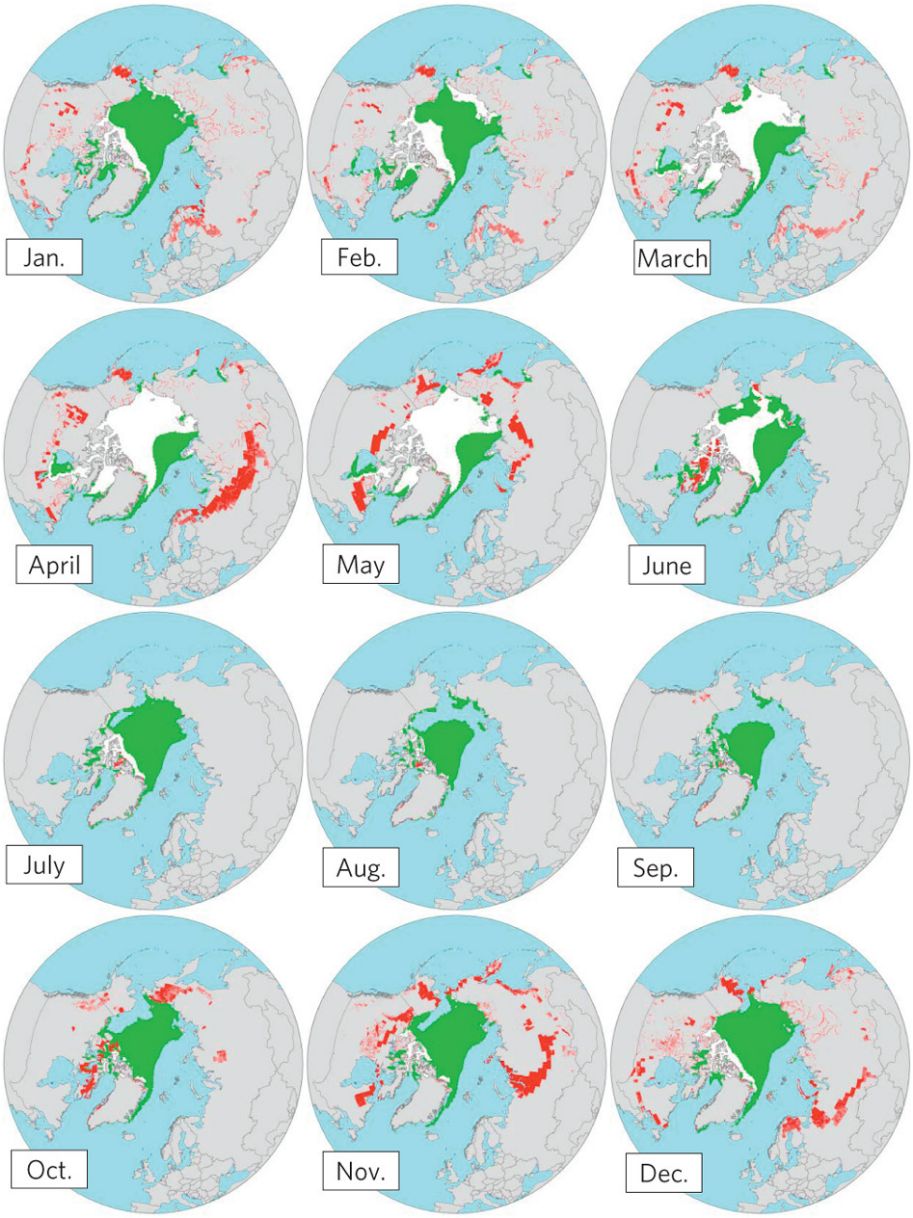
Appendix II- Traffic Density- Ship-days (1991-2008)



Red:<=2 ship-days, Yellow: 3 ship-days, White = 4+ ship days.

Judson, B. (2010). Trends in Canadian Arctic Shipping Traffic – Myths and Rumours. In *Proceedings of the 20th International Offshore (Ocean) and Polar Engineering Conference & Exhibition*. Retrieved from www.members.shaw.ca

Appendix III- Change in maritime and land-based transportation accessibility by mid-century, baseline (2000–2014) minus mid-century (2045–2059)



Green indicates newly formed maritime access to light icebreakers, while red indicates lost winter roads for 2,000kg vehicles. White shows the areas still inaccessible to light icebreakers by mid-century.

Stephenson, S.R. Smith, L.C., Agnew, J.A. (2011). Divergent long-term trajectories of human access to the Arctic. *Nature Climate Change, 1.* 156–160. doi:10.1038/nclimate1120

Appendix IV- Recent Arctic SAR Cases

Overdue Canoe- Ungava Bay, Quebec (SAROPS)

On August 18th 2003, JRCC Halifax was notified that a 22 ft Freighter canoe had been overdue for nearly two days. With 4 People on Board (POB), the party was last seen departing a campsite on August 15th. A locally initiated search resulted in the discovery of a tarp belonging to the vessel, which, given the unknown position of the canoe was used as datum for the search. The CCGS *Des Groseilliers*, the CCGS *Henry Larsen* and their helicopters, a CASARA Twin Otter, a Hercules (R0317) a Cormorant (R-906) and a chartered aircraft were all tasked by JRCC. After two days, in poor weather conditions, a gas can from the canoe was located, leading to the location of the overturned canoe and a body forty-eight hours later. By that time, relations between local officials and CCG personnel had deteriorated significantly, compounded by earlier disagreements regarding the conduct of the search and the availability of SRUs for community use. It was later revealed that three bodies had been spotted by an earlier flight that had been chartered by the local council, but had not been relayed to JRCC.

In the final report, several key issues were highlighted. First and foremost was the delay in notifying JRCC Halifax, which was contacted 50 hours after the canoe was first overdue. Given this delay and the fact that there was no safety equipment onboard, search efforts were severely hampered from the outset, a fact which was not clearly relayed to the local community. The use of local knowledge was essential, given that the lack of hydrographical information limited the search effectiveness of the *Des Groseilliers* and the *Henry Larsen*. However, there was no clear line of communication with next-of-kin and community elders established, resulting in a problematic and tense relationship. The issue of northern based CASARA and CCGA units was raised, as such units would allow

for communities to be professionally prepared to assist with SAR incidents, shortening response times and allowing for the closer integration of the local inhabitants with southern based SRUs and RCCs.

Overdue Aircraft from Kimmirut, Nunavut (SAROPS)

An ultra light Pelican Club S/A, single engine, homebuilt aircraft owned by a self-taught pilot with 15 years experience departed from Kimmirut on June 30th 2000 and failed to arrive in Iqaluit, Nunavut. Given numerous interviews with community members, it was determined that pilot was capable of 'living off the land' for an extended period of time, had he survived a crash/forced landing. After seven days of searching, involving nearly 400 flight hours by twelve SRUs from the CF, CCG, RCMP and chartered organizations, the wreckage of the aircraft with two deceased passengers was located. It was determined that damage to the propeller sustained on June 30th, poor weather and a lack of IFR instrumentation all contributed to the crash.

The final report made numerous remarks, including suggesting the mandatory carriage of ELTs by aircraft in remote areas and the challenge of coordinating resources located in different locations during 24 hour operations (due to the near continual daylight during the summer months). Of particular importance was the relationship between SAR authorities and the local community, in large part due to the use of locally based individuals as liaisons. The meeting on July 6th with the town council of Kimmirut allowed for the Search Master to explain the conduct of the search and lay out future evolutions, including the possibility of a search reduction. It was noted that developing strong ties with the local community as well as utilizing local knowledge and equipment

was of utmost importance to both the successful completion of a search and to promote the role of SAR services.

Missing Walrus Hunters off Cape Dorset, Nunavut (SAROPS)

EMO Iqaluit was advised on the morning of February 28th 2005 that a hunting party of four in a 24 ft 'Freighter' canoe, who had been hunting walrus off Cape Dorset, was overdue. Once JRCC Halifax was notified, a C130 Hercules aircraft (R-320) from CFB Greenwood was tasked, but had to return to base for fuel prior to proceeding north. Arriving on scene six hours later, R-320 located the party on an ice flow after only half an hour. A Survival Kit Air Droppable (SKAD) was delivered, allowing for R-320 to establish verbal contact with the survivors, though this contact was intermittent and later lost on Day 2 of the search.

A CH149 Cormorant helicopter (R-903) had been tasked to fly to Iqaluit from Gander, but due to the 1200 NM transit, the crew was forced to rest once they arrived due to operational restrictions. A second Cormorant crew was transported to Iqaluit the following day to continue the search effort. Though other SRUs were tasked to the search area and a private charter was approved though not utilized, there was initial confusion as to available assets in the region. Poor weather and in-flight vibrations due to icing forced R-903 to return to Iqaluit from two earlier sorties on January 1st. During the third attempted flight, after over two hours of no communication with R-903 and no top cover due to the C130 having to return to Iqaluit for fuel, the Cormorant returned safely with the hunting party.

The report identified several concerns, in particular: Poor communications between SRUs; logistical challenges involving de-icing, maintaining and fueling aircraft;

Issues with outdated/malfunctioning equipment in the SKAD, and; Insufficient training in northern operations for flight crews. Further concerns highlighted by this case include the significant delay in notifying JRCC by local resources, the challenges of delivering operable SRUs with functional crews to remote areas and the complications of Arctic weather.

Pleasure Craft out of fuel in the Davis Strait

A 23ft 'Mako' fibreglass boat with two passengers onboard attempted to transit across the Davis Strait to Greenland on August 24th 2007. Unexpected ice conditions resulted in a series of course deviations, leaving the vessel with insufficient fuel to reach Sisimiut, Greenland or to return to Iqaluit, Nun. Due to a lack of local SAR resources willing or able to complete a tow, 180 litres of gasoline were delivered to the vessel by a Canadian C130 Hercules, at a total estimated cost of over $200,000. No cost recovery was made for this incident, though it was an option that received some consideration.

This incident demonstrates the importance of appropriate satellite communication, as this non-distress incident would have undoubtedly evolved into a much more serious event without the benefit of timely and accurate communication. Furthermore, it also highlights the unpredictable nature of northern maritime conditions, and the grossly inflated cost of Arctic operations.

Fishing Vessel Medevac

On June 7th 2010, the captain of the 42 m F/V *Oujukoaq* (16 POB) contacted JRCC Halifax, as he had experienced pain in his chest and left shoulder for over twelve hours. As his condition was stable, the flight surgeon advised that he seek medical attention as soon as possible, but that a medevac was not immediately required. Given the

vessel's location, the case was transferred to RCC Gronedal, which arranged for a helicopter hoist once the *Oujukoaq* was 50 NM away from Nuuk, Greenland. Despite the fact that the ASAR Agreement had yet to be signed, a high level of international cooperation between neighbouring RCCs is clearly evident. A similar incident occurred on May 27th, 2011 when a severely injured crew member off the F/V *Nain Baker* was rescued by the nearby Danish naval vessel the *Vaedderen* at the behest of JRCC Halifax.

Medevac from a Fishing Vessel

On June 16th, 2011 a crew member on the F/V *Taurus* suffered a suspected heart attack and lapsed into a coma. Though he later regained consciousness, an immediate medevac was required. A Cormorant from 103 Squadron (R-912) was tasked to rendezvous with the *Taurus*, as ice conditions prevented the vessel from returning to Iqaluit, 170 NM to the northwest. The patient was eventually rescued and evacuated to emergency facilities in Iqaluit by the Cormorant, though R-912 was delayed in arriving onscene when it was forced to return to Kuujjuaq, PQ to recalibrate its engine electronics.

During this incident, there are two issues of note. The first is the lack of Northern Fuel Caches. Due to the limited range of the CH-149, it was forced to refuel several times enroute to the *Taurus*. A privately owned fuel cache was available on Resolution Island, but R-912 did not have immediate access to this location. Secondly, the C130 Hercules, required for top-cover during a flight beyond 20 NM from the coast was an hour and a half delayed in arriving on scene. R-912 was given permission to proceed without support, as the Hercules was in transit and within close proximity.

Cruise Ship Grounding

On August 28th 2010, off the west coast of Nunavut, the *Clipper Adventurer* ran aground with 197 passengers and crew aboard. Within ten minutes of the distress being received, the CCGS *Amundsen* was tasked, and upon arriving on scene after a 41 hour transit, the captain of the CCG *Amundsen* described the conditions as being 'picture perfect.' Potential vessels of opportunity were not tasked, given that the stranded vessel was not taking on water and passengers were determined to be in no immediate distress. All passengers were removed by the *Amundsen* and transported to a nearby community, while the vessel was later refloated without incident.

This incident drew a great deal of media and public attention. Despite a company press release which stated that the *Adventurer* had struck an' unchartered rock,' this claim was later refuted. The ship had in fact grounded on a kilometre long underwater shoal that had been noted by Canadian Hydrographic Service and publicized within a Notice to Shipping report in 2007, raising concerns about the qualifications of the ship's crew. This incident also demonstrates the need for clearly established LOS and public awareness regarding the expectations for the Canadian SAR system in remote areas. Finally, though no additional assets were required, several potential aircraft of opportunity from nearby mining operations which were considered were later revealed to be unavailable as the sites had been closed for the winter season.[32]

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[32] In July 2011, the owners of the *Clipper Adventurer*, the Bahamian based Adventurer Owner Ltd launched a $15 million US lawsuit against the Canadian Government. The suit alleges that DFO "failed to put in place and maintain, or to take reasonable steps to put in place and maintain … any reasonable system for disseminating [navigational] information," resulting in the grounding of the vessel.

Overdue Hunter near Qikiqtarjuaq, Nunavut

On April 17th, 2010, a hunter was reported overdue when he did not return the previous evening, as there was concern that his snowmobile had broken through the ice. Though the case was resolved quickly as the individual had simply been delayed by slushy conditions and was aided by another hunter, several potential weaknesses of northern SAR are apparent upon examining the case log.

The first is the lack of local knowledge. Though the local SAR teams were familiar with the area, the EMO Iqaluit contact was not, and was unsure of the name of the community, even though it had been officially changed to Qikiqtarjuaq from Broughton Island in 1998. Furthermore, it was unknown if the hunter spoke any English, and whether or not the flight crew would have needed a fluent spotter. Search efforts were initiated at the local level, and while equipped with a satellite phone, the search teams did not have a GPS unit. As well, the nearest available CASARA aircraft did not have night vision capabilities. The self-tasking of searchers on snowmobiles into an unstable situation on ice is of concern. At present, the existing software used by the JRCC does not allow for accurate drift modelling of ice covered waters in a region with no reliable source of current and wind data.

Skiing to the North Pole

On April 15th 2010, after 48 days of travelling, an Australian adventurer attempting to reach the North Pole to raise money for charity fell through the ice 250 NM from Alert, Nun. Freeing himself from the water, he was able to activate a PLB and was later retrieved by a civilian Sikorsky S-61, assisted by two CF Twin Otters (CC138) which had been engaged in *Operation NUNALIVUT 10*. Though only six hours elapsed

between the PLB activation and his rescue, it was only a last minute location correction of 2.2 NM which allowed the Twin Otter to locate the survivor.

Despite pre-arranged stops which had both one of CC138 and the S-61 take on additional fuel at Ward Hunt Island, the SAR aircraft flying top-cover had only five minutes of search time on scene. The S-61, though capable of remaining on scene for an hour, was not SAR equipped and did not have the capability of homing onto a 406 beacon and as it did not have satellite communication, it was reliant on the CC138 for communications. The likelihood of discovery by the S-61 through a visual search was low.

Rowing the NWP

During the summer 2010, a French rower attempted to be the first to row through the NWP. On one occasion, the rower contacted the crew of the CCGS Terry Fox for assistance lifting his 6.9 m vessel above the high water mark on Beechey Island, pictured right. At this time, having expressed some concern regarding his upcoming passage, the CCG crew gave the rower a briefing on the Canadian SAR system and the contact information for JRCC Trenton. In early September, a CCGA vessel assisted Mr. Bonnier into Cambridge Bay, as high winds and ice conditions prevented him from proceeding any further. In addition, he was running low on power as he had been unable to charge his electronics due to extended cloud coverage. Despite being supported by a crew in a nearby vessel, this incident demonstrates the issue of well-equipped expeditions who are nevertheless unprepared for northern operations.

Seal Hunting in Adams Sound

On July 28th, two brothers departed Arctic Bay in a 24-foot Lake Winnipeg yawl type vessel to go seal hunting in nearby Adams Sound. The hunters carried no safety equipment onboard and only a limited amount of fuel. Reported missing on the evening of the 29th, the CCGS *Terry Fox* departed Nanisivik to the search area, later joined by a chartered Twin Otter from Unaalik Aviation, stationed in Arctic Bay. Two local vessels from the local community, type unknown, also participated in the search. A TC flight was in the area on an ice patrol, but as they were approaching the end of their crew day, they were not tasked to assist. Numerous wrecks were noted by the RHIB of the *Terry Fox* as well as by a First Air flight, but it was not until early on the 30th that the Twin Otter located an overturned vessel. When the *Terry Fox* arrived onscene four hours later, the crew discovered the canoe with the bodies of the hunters trapped inside the cabin.

There were both positive and negative issues of note during this search. The response of the *Terry Fox* allowed for an onscene SRU within a matter of hours. Though no primary SRU was available, the chartered aircraft was able to carry six CASARA spotters, though several contact numbers for this organization were no longer valid. At one point, there was a request by the community that this aircraft be directed to another search area- though involving the local community is vital, SAR coordination must be understood to be the responsibility of the appropriate RCC. The RCMP officer within Arctic Bay was able to relay information to the community. However, language barriers limited the ability to gather information regarding the equipment carried onboard and the intention of the hunters. Furthermore, local SRUs were an asset to the search, however with only VHF radios as their sole means of communication, there are concerns regarding

the range of these resources. Onscene visibility was good, but due to a two metre swell with numerous 'bergs and bergy bits,' the *Terry Fox* was only able to proceed with the search due to the presence of a crew from the Canadian Hydrographic Service, as the area was uncharted.

Disabled Cargo Vessel

On September 29th 2009, the M/V *Avataq* requested assistance from the nearest CCG ice breaker as its engines were disabled, and there was a forecasted storm approaching. Within a confined waterway outside the town of Sallisut, the captain of the *Avataq* had concerns about his vessel dragging its anchors. The CCGS *Des Grosseilliers* was tasked to respond, initially as a ROC operation but this was changed to a SAR incident once the *Avataq* began to drag its anchors in 40 knot winds. The *Grosseilliers* arrived onscene following a 177 NM overnight transit, and remained alongside for nearly 48 hours. No commercial tugs were available in the area to assists, requiring that a tug be sent from Quebec City.

Though this incident was resolved with no damage, several concerns are revealed. First and foremost is the lack of rescue tug capacity within the region. CCGS vessels are not equipped to tow large M/V, and there was a significant delay- over 96 hours- before a tug could reach the disabled vessel. Secondly, the master of the *Avataq* requested ice-breaker assistance, despite the fact that there was no ice within the harbour. In a similar event, the SAR system must be activated early, and an appropriate response strategy, in this case, the tasking of a commercial tug must be pursued without delay.

Fire Onboard Fishing Vessel

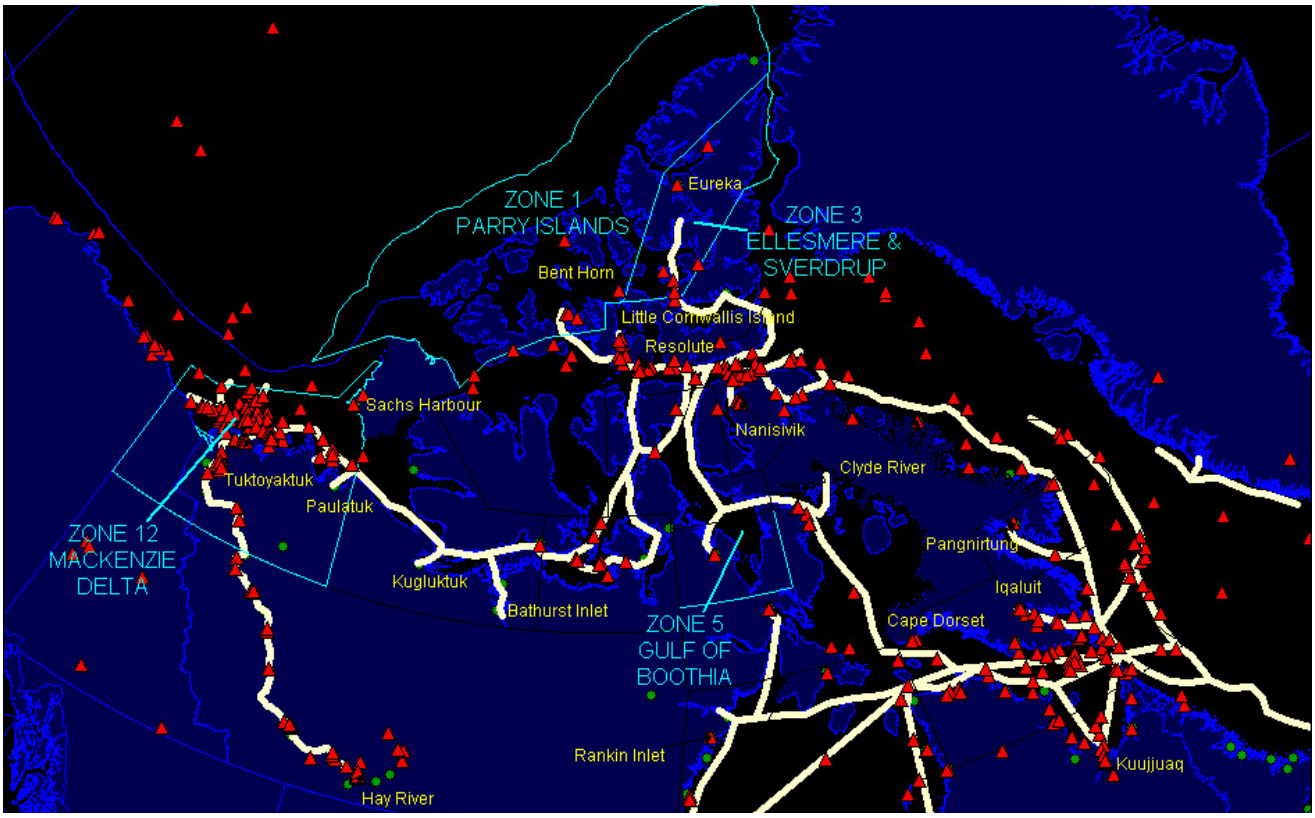
On October 20th 2008, JRCC Halifax was notified that the F/V *Newfoundland Lynx* with 27 POB had declared Mayday due to a fire below decks. The area had been sealed off but due to concerns regarding flooding the lower holds and a lack of breathing apparatus, no fire fighting was initiated. The F/V *Mercury Phoenix* was 25 nm away and was on scene within two hours, which was later joined by the F/V *Acadianne Gale II* 10 hours later. A Cormorant from 103 Squadron and Hercules from 413 were both tasked, but were stood down after it was determined that the fire had been contained. However, the Cormorant was required to assist with evacuating five crew members with potential injuries due to smoke inhalation, and was required to deliver air tanks and breathing apparatus to allow for the damaged area to be inspected. This equipment is not normally carried by CF aircraft, and was borrowed from the Kuujuak Fire Department.

As the fire damage to the *Newfoundland Lynx* was extensive, all non-essential personnel were eventually transferred to the *Acadienne Gale II* once weather conditions improved. The *Acadienne* took the disabled vessel under tow until the tug *Ocean Foxtrot* arrived on the October 24th, which later escorted the disabled vessel to Bay Bulls on the 27th.

The extended flight required that the Cormorant refuel mid operation. However, as the North Warning facility at Resolution Island did not have the necessary equipment, a coupling had to be delivered via a private charter, at a cost of over $30,000. Furthermore, vibrations were noted within the aircraft soon after departing Iqaluit on October 25th, requiring the Cormorant to return to await repairs. There were communications issues throughout the incident, both in contacting SRUs and between

federal agencies, most concerning being that discussion to assign NL SRUs to monitor the situation did not include JRCC Halifax.

Appendix V- Casualty Location and Traffic Network (1975-2008)



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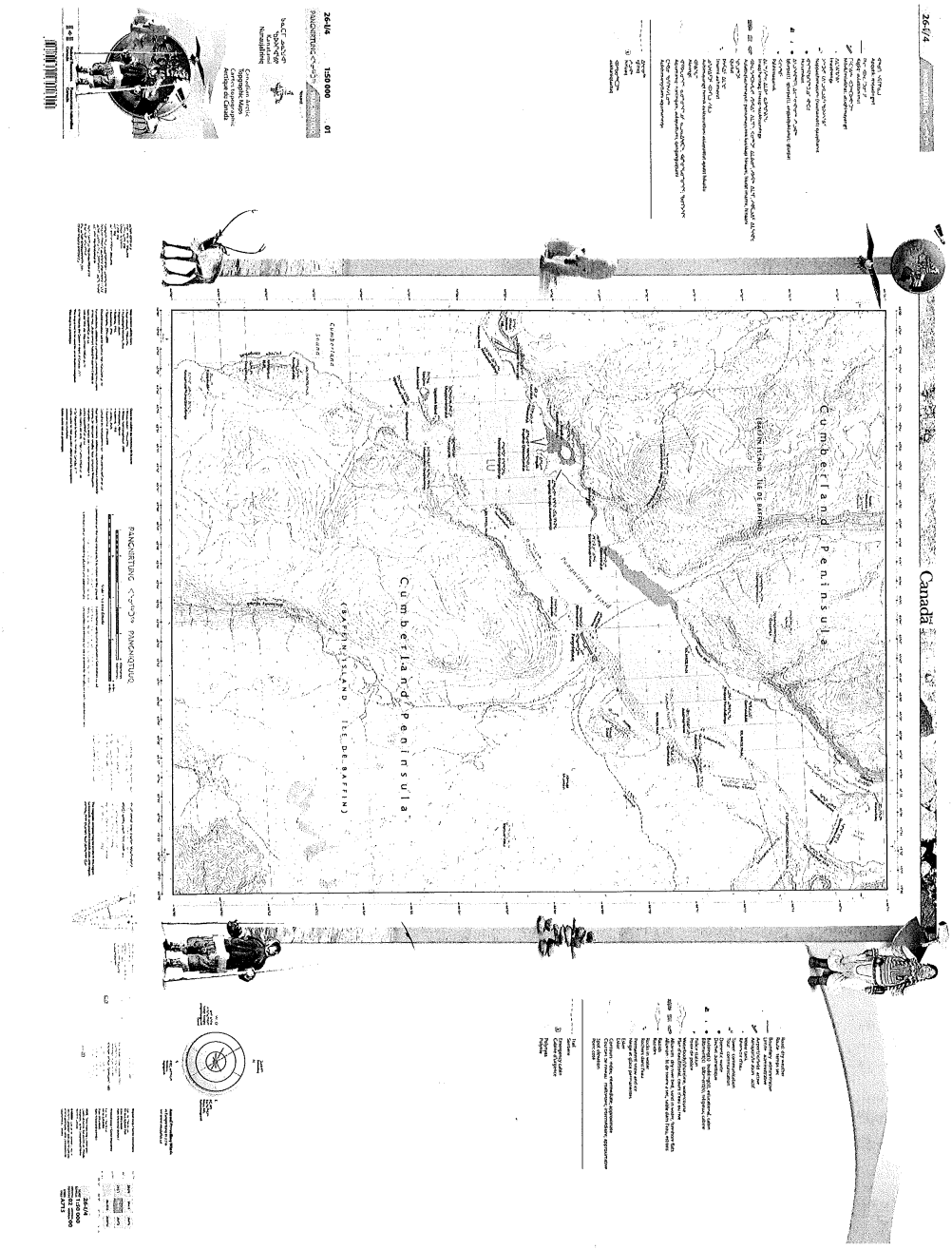
Appendix VI- Requirements for a Tiered Response

Area Type	Tier 1 150 Tonnes	Tier 2 1,000 Tonnes	Tier 3 2,500 Tonnes	Tier 4 10,000 Tonnes
Inside Port Boundary	Deployed on-scene in the affected operating environments (dedicated resident equipment) *(within 6 hours after notification of a spill)*	Deployed on-scene in the affected operating environments *(within 12 hours after notification of a spill)*	⇩	⇩
Inside PAR/ERA	⇨	⇨	Delivered on-scene to the affected operating environments *(within 18 hours after notification of a spill)*	Delivered on-scene to the affected operating environments *(within 72 hours after notification of a spill)*
Outside PAR/ERA	⇨	⇨	Delivered on-scene to the affected operating environments *(within 18 hours after notification of a spill plus travel time at an average travel speed* from nearest PAR/ERA)*	Delivered on-scene to the affected operating environments *(within 72 hours after notification of a spill plus travel time at an average travel speed* from nearest PAR/ERA)*

Eastern Canada Response Organization. (1999). Overview of Canada's Marine Oil Spill Response Organizations. Retrieved from http://www.ecrc.ca

Appendix VII- Sample Multilingual Arctic Topographical Map



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