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Preparing for the impacts of climate change along Canada's Arctic coast: The importance of search and rescue

Abstract: The Arctic is undergoing transformative climate change, with profound implications for transportation safety in marine areas. Circumpolar marine risks are growing due to ship traffic increases linked to more ice-free open water, as well as increases in hazards for individuals that frequently travel on ice and trails in the region. While recent Government of Canada policies have attempted to respond to the growing risk of marine and coastal emergencies, there is strong evidence that the federal government and communities along Canada's Arctic coast are minimally prepared for the emerging risks. In this Short Communication, we argue that Canada is falling short of its international and national obligations to provide timely search and rescue across the Arctic, to the detriment of Arctic communities. Drawing from recently published reports and literature, we argue that providing additional training, resources, and support for volunteer SAR groups across the region is critical, along with increasing federal air and marine resources committed to the region. Such investments need underpin Canada's approach to climate change adaptation in the North.

Key words: Arctic; climate change; search and rescue; emergency preparedness

In 2011, Canada signed the Arctic Search and Rescue Agreement, agreeing to "promote the establishment, operation and maintenance of an adequate and effective search and rescue capability" within the Canadian Arctic [1]. Further, Canada agreed to "ensure that assistance be provided to any person in distress… regardless of the nationality or status of such a person or the circumstances in which that person is found." The agreement has been a benchmark for successful international cooperation by the Arctic Council [2], but has not markedly improved search and rescue (SAR) response capacity in Canada's response region or the burden of weekly small-scale search and rescues felt by those living in the Canadian Arctic [3].

Annually there are more than 1000 people in Canada above 55°N that require SAR assistance, nearly 20% of whom are facing medical emergencies, and at a rate of 7.81 per 1000, SAR incidence is 16.4 times the Canadian average [4]. While SAR data in northern Canada is patchy, data that are available indicate that SAR rates are increasing over time [3-5], and a recent report by the Canadian Senate identifies significant concerns over the capacity of existing SAR systems to cope with increased risks associated with climate change and increasing use of Arctic marine environments [3].

Canada's Arctic coastline extends more than 176 000 km, and is home to 58 remote and small communities [6]. More than 70 000 people live in the region, the majority of whom are Inuit, First Nations or Métis. The presence of sea ice is a defining feature for much of the year along the of the Arctic coast, which is characterized by long, extremely cold winters interrupted by short, cool summers [6]. The majority of SAR incidents along the Arctic coast are associated with the use of transportation networks in marine environments, with few permanent roads linking the Arctic coast to southern Canada [3, 7]. This includes commercial traffic associated with bulk shipping, cruise ships, oil and gas development, and fisheries, and is most common in the ice-free open water

season, although may involve the use of ice breakers for accessing mine sites and other forms of transport (e.g. aviation). Unmaintained semi-permanent transportation routes on the sea ice are also widely used for travelling between settlements, to cultural sites, and for practicing traditional hunting, fishing, and gathering activities which retain significant cultural and economic importance [8-11]. Such activities involve individuals travelling often hundreds of kilometers in remote regions by snowmobile, all-terrain vehicle, or boat, with the majority of search and rescues being for individuals using these semi-permanent trails [12].

Transportation networks along Canada's Arctic coastline are highly climate sensitive [11]. Sea ice, for example, provides both a platform for semi-permanent trails and an obstacle to shipping, with the extent, duration, and stability of ice varying annually. Herein, climate change is affecting transportation networks across the circumpolar north, which for several decades has been undergoing transformative change in climatic conditions [11, 13]. This includes a circumpolar warming trend of 1.9°C documented over the last 30 years—a rate more than double the global average and exceeding 3C in parts of the Canadian Arctic—and dramatic changes in sea ice conditions, including later sea ice freeze up, earlier break up, and more ice free open water [6, 8, 9, 14]. Declining ice extent and duration is already lengthening the shipping season along Canada's Arctic coastline and opening up new transport routes (e.g. Northwest Passage), creating new opportunities for cruise tourism, fisheries, and community boat usage, while compromising the operating period for semi-permanent trails on the sea ice [15-22]. Models indicate that climate change will continue to be amplified in the Arctic [23], with Canada's Arctic coast a global hotspot of warming [6]. Even if nations manage to limit warming globally to 1.5°C compared to pre-industrial levels, warming of 4°C-6°C and more extreme weather events are still anticipated in the Arctic along with continuing change in sea ice conditions [14, 24-27]. Responding to these risks through adaptation will thus be essential, as highlighted recently in the IPCCs Special Report on the impacts of global warming of 1.5°C [28].

These climate trends have significant implications for SAR. Maritime traffic along Canada's Arctic coastline is anticipated to increase rapidly due to longer ice-free seasons, bringing with it ship crews unfamiliar with the region and cruise ships of 200 to 1000 passengers, resulting in a higher risk of mishaps and disasters [2, 17, 29]. Thinner and more dangerous ice conditions have already been observed to be increasing SAR associated with the use of semi-permanent trails in the territory of Nunavut [25], with studies highlighting that climate impacts are being exacerbated by reduced transmission of land skills to younger generations and the expense of safety equipment [30-34]. These emerging threats not only increase SAR needs, but are also increasing the risk of mass casualty incidents (MCIs). An MCI is defined as an event that overwhelms the emergency response system with the number or severity of injuries. Given emergency medical capacity, infrastructure, and community resource limitations, five qualifying trauma alert patients would overwhelm local and regional emergency resources in nearly all communities along Canada's Arctic coastline [5]. Further, in the case of a shipload of passengers needing food, shelter, and evacuation communities would be massively impacted for a period of weeks to months.

SAR response across Arctic Canada is provided by numerous actors and agencies. The Royal Canadian Air Force (RCAF) is responsible for aeronautical incidents; the Canadian Coast Guard (CCG) is responsible for marine incidents, and are usually only used when icebreakers are North during the summer; and provincial and territorial governments are responsible for searches for

missing persons including those who are lost or overdue, commonly known as ground search and rescue (GSAR) [3]. While GSAR responses may involve RCAF and CCG resources (Figure 1), we estimate—based on an assessment of SAR data [7, 35]—that more than 90% of incidents across the region rely on ground searchers, nearly always community volunteers (Figure 2).

Figure 1: While most search and rescues rely on ground searchers, in instances where the RCAF responds, it involves sending aircraft from air force bases in southern Canada such as the CC-130 Hercules pictured here (photo credit: to be added on accetpance)

Figure 2: Community volunteers are the cornerstone of SAR and first response across the Canadian Arctic (photo credit: to be added on accetpance)

Most communities are minimally prepared and resourced for the current SAR demands, which is largely dependent on volunteers [3]. While the system benefits from the strong land knowledge and skills of volunteers, volunteers often have to use their own boat or snowmobile for SAR missions with only gas and oil reimbursements [7, 32, 36-38]. The recent addition of more CCG Auxiliary units has increased resources and tools but training available to most communities remains limited. Training that volunteers have observed as lacking includes first aid training, emergency management training, training on how to work with RCMP, and practice conducting multi-agency responses [7].

Providing additional training, resources, and support for volunteer SAR groups across the region is critical as they are nearly always the first responders and are an invaluable resource in ensuring quick and efficient response. Additional support and presence from RCAF and the CCG is also essential to ensure backup is readily available to ground searchers and for rapid response to MCIs. Challenges to coverage across the North from RCAF (Figure 3) are anticipated to be exacerbated when the C-295 replaces the CC-130 unless aircraft are stationed farther north, with the new planes scheduled to be delivered in late 2019 [39].

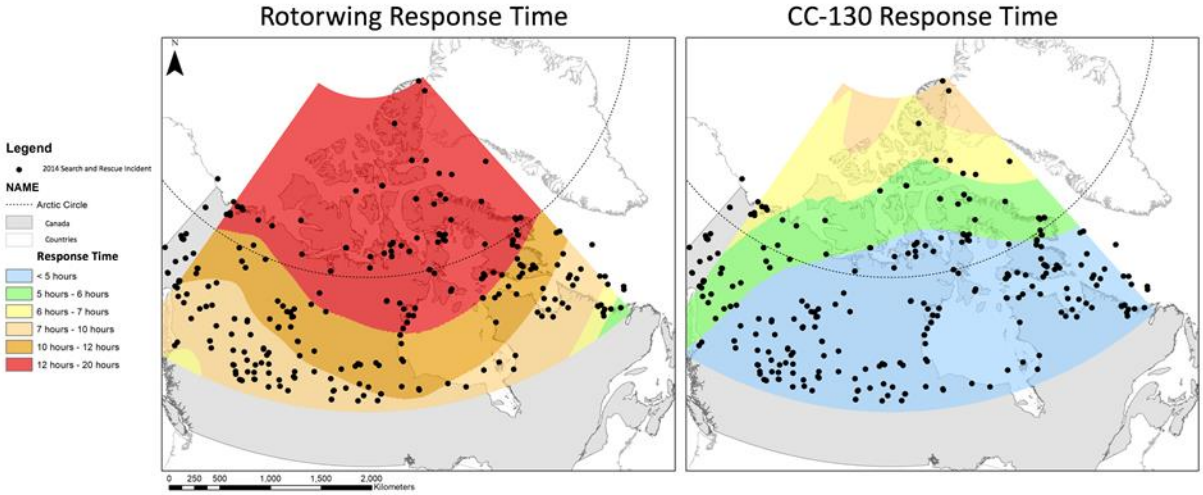

Figure 3: In-air response time for emergency response / search and rescue support from the absolute closest air base with that asset, overlaid on location of 2014 search and rescue incidents north of 55°N. Of all 2014 search and rescue incidents above 55°N, 61% were within 75km of the coast.

Many communities are responding to increasing SAR incidents with prevention programs that emphasize providing avenues for youth to learn traditional land and navigation skills from Elders [38, 40]. Communities and territories are also promoting safety by lending out satellite beacons and also subsidizing equipment and gasoline costs through hunter support programs. Additional efforts are needed, however, including further reducing financial barriers for purchasing safety gear, building marine-band and CB repeater towers near communities, continuing to subsidize satellite beacon use, and funding programs that allow youth to learn traditional land skills. Yet resource challenges remain a pervasive barrier, as noted in testimony given to the Canadian Senate Standing Committee as part of its investigation of Maritime Search and Rescue activities [41]:

> "It's the lack of allocation of resources. At the end of the day, it's dollar signs as opposed to anything else. The government needs to shift its centre of gravity toward the North because the is opening up….. Unfortunately, as you say, it will probably require a major disaster, a major loss of life, headlines across the world, "Canada failed," for the government to put assets in the North." Col. LeBlanc, 15th February 2018

The goals by which Canada has agreed to in the Arctic Search and Rescue Agreement of timely and equal response to all emergencies should translate to intra-national response with significant differences in SAR and medical care between northern and southern Canada, with some Arctic

communities over 9 hours from basic prehospital medical care. It is likely that the case load as well as severity will increase in the coming decade with climate change and increasing use of Arctic marine environments. Building resilience and improving search and rescue is essential for meeting these challenges, and needs to underpin Canada's approach to climate change adaptation in the North.

Declaration of interests

We declare no competing interests

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