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Ice-related Disruptions to Ferry Services in Eastern Canada: Prevention and Consequence Mitigation Strategies

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Abstract

The aim of this paper is to examine experiences from Eastern Canada to summarize and present information which may help operators, planners, researchers, and policy-makers in the marine transportation sector identify potential short-term and long-term strategies for improving services and making more effective decisions regarding ways to minimize the impact of ice-related disruptions to ferry service in ice prone regions of the world. In this study, emphasis has been placed on examining the impacts of ice-related disruptions in ferry service on public stakeholders, since this end-user perspective provides important insights into consequences and associated mitigation strategies. The methodology employed includes a high-level examination of regional ferry services, followed by an identification and selection of specific routes, completion of a survey of publically reported disruption events for these routes and compiling information about reported stakeholder consequences associated with ice-related disruptions. Three representative ferry routes have been considered to assess issues relating to resilience in urban versus rural regions, the availability of alternatives and changes with time, as well as potential strategies that may be taken to help address the most pressing issues are discussed. The main impacts most frequently reported as consequences of ice-related disruptions for these routes are: (1) Reduced access to medical care; (2) Decreased food security; (3) Disruptions for workers and commercial transport; and (4) Inconvenience, frustration and cost to travelers. Most commonly identified preventative strategies for addressing these issues include: (1) New ferries with increased ice capabilities; (2) Increased icebreaker support and ice forecasting capabilities; (3) Infrastructure upgrades, including consideration of alternative ports; and (4) Use of alternative modes of transport (e.g. alternate routes, airplanes, or fixed links). Identified mitigation strategies for reducing the impact of these disruptions include: (1) Increased communication services; (2) Government programs to improve community preparedness and resilience; and (3) Government programs (e.g. subsidies) to assist those affected by disruptions.

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1. Introduction

For marine operations in northern regions, the presence of sea ice can significantly increase the resistance and decrease the maneuverability of ice-transiting vessels, ultimately leading to slower transit speeds, higher fuel consumption, and potential besetting of the vessel in the ice. In some cases, such ice conditions can potentially damage vessels and compromise safety, particularly if vessels are operating in heavier ice conditions than they are designed for. These threats are particularly high when heavy ice conditions prevail (e.g. high concentrations of thick ice that impedes navigation) or when pressured ice poses a threat to such operations. The term pressured ice (sometimes also referred to as compressive ice) refers to conditions where convergence of the ice field due to environmental forcing (e.g. wind, current and pack ice), which often occurs in areas where the pack is forced against a coastal or landfast ice boundary. These conditions create internal pressure within the pack, which can in turn "nip" vessels in the ice, impeding their performance.

As discussed by Leisti et al. (2011), ice-related disruptions are an important consideration for shipping in many regions such as the Baltic Sea, which has led to two major European Union (EU) projects in the past decade: SAFEICE (2007) and SAFEWIN (http://www.safewin.org/). Other research in this area has included model-scale basin studies of vessel performance of ships in pressured ice (Suominen and Kujala, 2012), as well as numerical simulation of the effects of the increased effective thickness of ice over larger areas (e.g. Savage, 2008). The estimation of extreme ice loads on vessels operating in ice is also highly important (e.g., Glen and Blount, 1984; Riska, 1991; Jordaan, 2001; Taylor et al., 2010; Erceg et al., 2014). In the Canadian context, several aspects of this issue have been considered, including surveying Captains' perspectives on how ship safety and performance can be improved in pressured ice regions (Kubat and Sudom, 2008), developing models for assessing ice pressure effects at small scales (e.g. Sayed and Kubat, 2011), compiling a database of vessel besetting (Kubat et al., 2011) and developing tools to aid in forecasting pressured ice (Kubat et al., 2012). Probabilistic models of ice jamming have also been developed to aid in assessing the likelihood of ice-related disruptions to offshore supply vessel traffic servicing oil platforms on the Grand Banks (Turnbull et al., 2014).

In Eastern Canada, the province of Newfoundland and Labrador has a significant percentage of its population located on islands and in coastal communities. Ferry services play an important role in the provincial supply chain and transportation networks and they continue to be the major supply conduit for many types of goods (e.g. food, fuel, manufactured goods). They also serve as a vital link that connects the island portion of the province with mainland Canada, linking land-based transportation networks. Consequently, significant numbers of transport trucks, automobiles and people continue to use these ferry routes on a year-round basis. At the same time, harsh ice and metocean conditions present coastal and island communities with challenges in terms of ice-related disruptions to operations associated with shipping, mining, offshore oil and fishing industries, as well as essential ferry services.

While ice-related disruptions are a highly important consideration for marine transportation operations in northern regions, much of the research in this area has focused on technical solutions and approaches driven by physical and technological aspects of the issue, rather than assessing impacts of disruptions on the end-user. As discussed by Taylor et al., (2015), both threats and impacts must be considered to provide an accurate picture of the risk, since risk consists of probability and consequence, as is embodied in the bowtie diagram illustrated in Figure 1.

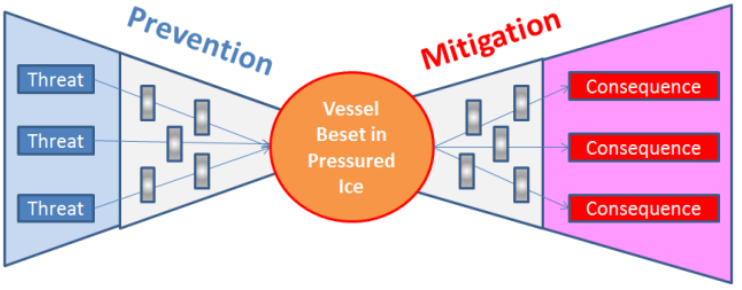

Fig. 1. Bowtie diagram representation of elements of risk associated with vessel besetting events.

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