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Community Perspectives from Pond Inlet, Nunavut, on Shipping Risk and Emergency Preparedness at the Eastern Entrance to the Northwest Passage

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ABSTRACT. Over the past two decades, ship traffic in Arctic Canada has increased, leading to concerns about increased risks to the region, including heightened probabilities of a major shipping accident or disaster. This situation challenges the emergency preparedness capacities of Arctic coastal communities and governments. The Northwest Passage (NWP) is of particular interest due to increased accessibility related to climate change and sea ice reduction, along with its rising popularity as a potential maritime trade route and cruise ship hot spot. The coastal community of Pond Inlet, Nunavut, sits on the eastern mouth of the NWP and is a community with first-hand experiences with increases in ship traffic volume. To explore community perspectives on emergency preparedness for different types of shipping accidents and events, we applied a scenario-based survey with residents of Pond Inlet. Results of the study revealed that Pond Inlet residents have a low level of confidence in what the level of emergency response timing would be if a shipping accident occurred, and they anticipate high levels of devastation for the community and environment in such a moment. They also offered insights into what an Arctic shipping disaster could look like and opportunities for risk mitigation.

Keywords: Arctic; shipping accidents; marine disasters; emergency preparedness; community-based research; coastal community perspectives; climate change adaptations

RÉSUMÉ. Au cours des deux dernières décennies, la circulation maritime s'est intensifiée dans l'Arctique canadien, ce qui entraîne des inquiétudes quant aux risques plus élevés encourus par la région, y compris la plus grande probabilité d'accidents ou de catastrophes de navigation. Cette situation exerce de la pression sur les capacités de préparation en cas d'urgence des collectivités côtières de l'Arctique et des gouvernements. Le passage du Nord-Ouest suscite un vif intérêt en raison de son accès facilité par le réchauffement climatique et la diminution de la couverture glaciaire, en plus de son émergence comme voie potentielle de commerce maritime et comme centre névralgique des navires de croisière. La collectivité côtière de Pond Inlet, au Nunavut, qui se trouve à l'embouchure est du passage du Nord-Ouest, est témoin de première main de l'augmentation du débit de circulation maritime. Nous avons mené une enquête auprès des résidents de Pond Inlet en proposant divers scénarios d'accidents et d'événements maritimes pour évaluer leur point de vue sur la préparation aux situations d'urgence. Selon l'étude, les habitants de Pond Inlet ont peu confiance en la rapidité d'intervention en cas d'urgence liée à un accident maritime. En conséquence, ils s'attendent à une dévastation importante, non seulement pour leur collectivité, mais aussi pour l'écosystème. Ils ont également partagé leur perception d'une éventuelle catastrophe maritime ainsi que les moyens d'atténuer les risques connexes.

Mots-clés : Arctique; accidents maritimes; catastrophes maritimes; préparation aux situations d'urgence; recherche communautaire; perspectives des collectivités côtières; adaptations au changement climatique

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INTRODUCTION

Climate change and related reductions in sea ice extent in Arctic Canada (Stephenson and Smith, 2015; Cai et al., 2021) have led to a significant increase in a range of shipping activities and maritime-based transportation opportunities (Stephenson et al., 2018; Dawson et al., 2018; Li and Lynch, 2023; Ford et al., 2014; Mudryk et al., 2021). Despite economic opportunities associated with the increased Arctic shipping related to tourism, resource development, fisheries, and domestic and international maritime trade, there are also substantial costs that may outweigh the benefits if risks are not managed effectively (Dawson et al., 2020; Khan et al., 2020; Afenyo et al., 2022). Proper preparedness in anticipation of potential accidents or incidents is becoming increasingly important. That's because current projections show ongoing growth in economic activities related to maritime shipping (movement of goods) and transportation

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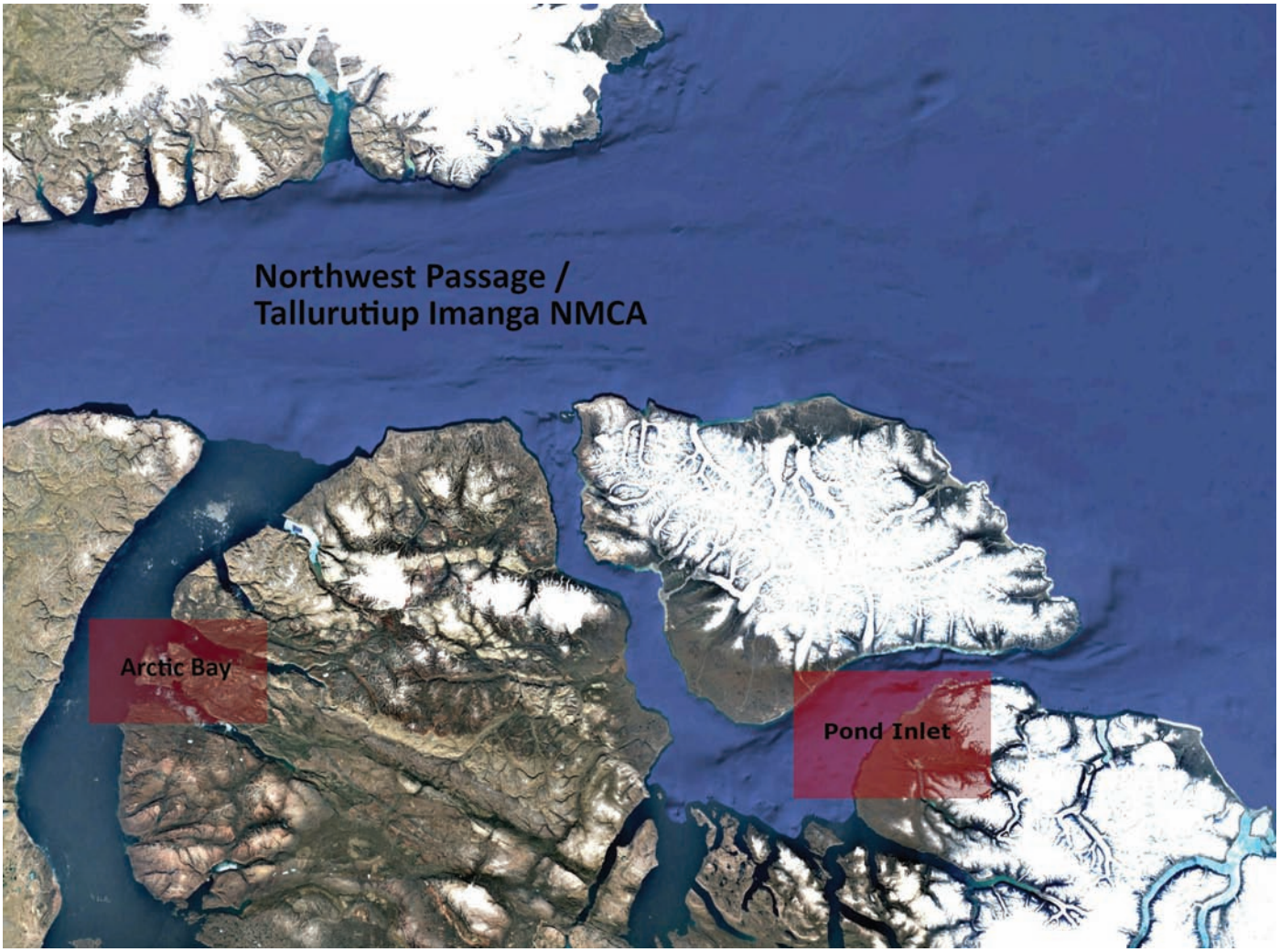

FIG. 1. Location of Pond Inlet along the Tallurutiup Imanga NMCA (captured from Google Earth Pro).

(movement of people) within the Canadian Arctic alongside the projections of climate change (Afenyo et al., 2022). This situation also signals the need for Indigenous Knowledge, or Inuit Qaujimajatuqangit, to be integrated within studies alongside the western sciences, and also for community perspectives to be recognized in Arctic policy and activities (Kelley and Ljubicic, 2012; Chang et al., 2014; Balay-As et al., 2018; Pedersen et al., 2020; Ali et al., 2021).

Among the interested parties and rightsholders most impacted by the increase in shipping traffic are the northern communities and their residents within the Canadian Arctic. Climate change and the rise in ship traffic serve to highlight the coinciding risks and pressures Inuit peoples are already experiencing with respect to local and human security, self-determination, and Indigenous and national sovereignty, leaving Arctic communities feeling increasingly that they are on the front lines of a rapidly changing Arctic (van Luijk et al., 2021). With the rising probabilities of a shipping accident occurring in this region (Council of Canadian Academies, 2016), there is an urgent need for co-operation and collaborative action among all relevant interested parties, especially local interested parties, and rightsholders, to ensure effective and efficient emergency response capabilities for maritime disasters (Mileski et al., 2018).

This study is geographically focused on Canada's NWP and the community of Pond Inlet, Nunavut, located at the NWP's eastern entrance. The selection of this location is largely because of its cultural importance to the Inuit, and the significance of this area's ecological sensitivity and biodiversity, which is being disturbed by the sharp rise in shipping traffic (Kelley and Ljubicic, 2012; Dawson et al., 2020; Kochanowicz et al., 2020; van Luijk et al., 2020; Halliday et al., 2022). Beyond seeking community insight into likely shipping futures and the prospect of shipping disasters, exploratory scenarios allow for historic shipping accidents to be placed in the Arctic community's context. This also allows more in-depth understanding of community perspectives on how these events and emergency responses are perceived at a locale scale, while also raising community awareness of such risks (van den Ende et al., 2022). The work entailed community-based research with the objective to explore community perspectives on a range of topics in Arctic shipping futures. Topics included regional shipping

risks; consequences; and emergency preparedness and prevention around the community, along with shipping accident scenarios in the context of the NWP. The study's findings can contribute to the evolving policy developments, regulatory frameworks, and emergency response planning in the Canadian Arctic.

METHODS

Study Location

Pond Inlet, or Mittimatalik, is a coastal community situated at the northern edge of Baffin Island along the Tallurutiup Imanga National Marine Conservation Area (NMCA) including Lancaster Sound. This location is also at the eastern entrance to the NWP (Fig. 1). Tallurutiup Imanga NMCA is a protected area that spans the eastern portion of the NWP, including the sounds where both Arctic Bay and Pond Inlet are located. According to the most recent Statistics Canada census (2021), Pond Inlet's population is 1555, with 94% of residents identifying as Inuit.

Study Approach and Co-Development

This study was designed in alignment with Canada's National Inuit Strategy on Research (Inuit Tapiriit Kanatami, 2018), which highlights the importance of Inuit involvement and leadership in all stages of a research project occurring within the Inuit homeland. As a result, our research approach was to build on existing relationships with community groups in Pond Inlet, particularly with the community organization, Ikaarvik. Ikaarvik is a youth-focused research group headquartered in Pond Inlet that aims to bridge the gap between Indigenous knowledge and Euro-American science in research for meaningful and collaborative Indigenous engagement in the Arctic (Ikaarvik, n.d.). It is now well understood that community–academic partnerships developed through respectful and mutual collaboration and using an ethical co-development approach to research can lead to higher-quality data collection and greater awareness of the challenges and uncertainties for the selected community, and possible solutions (Cuerrier et al., 2015; Dawson et al., 2020; Gyapay et al., 2022; Martin et al., 2022; McKemey et al., 2022). Such partnerships can benefit the entire research team and the quality of study findings through better inclusion of community members' deep knowledge of the community context and through strong social networks used to recruit participants (Duea et al., 2022).

Survey Instrument

Through regular meetings with Ikaarvik, we co-developed and implemented a survey instrument in the community of Pond Inlet. The research team involved Ikaarvik staff in reviewing and discussing drafts of the survey. These meetings, held virtually using Microsoft Teams, were intended to result in initial drafts being torn apart and redeveloped according to the knowledge and requests of local Inuit partners (see Glauser, 2020). Ikaarvik staff helped identify the specific areas of focus for the survey, with implementation largely conducted online via Qualtrics. To allow for further accessibility and inclusion, survey participants also had the option to complete the survey in person, assisted by the research team and collaborators. Surveys can typically lead to less trust building due to a lack of personal contact (van den Ende et al., 2022), but this limitation was mitigated through the collaborators' networks and their understandings of the best approaches for how the survey should be implemented within the community.

We used a qualitative and quantitative approach for this survey. The first section of the questionnaire sought basic demographic data, including verification of respondents' age, length of time living in the community, whether they identified with an Indigenous group (and which group), as well as roles and experience levels in the community. The second section focused on ship-based transportation and changes in sea ice conditions for this type of transportation. This section contained a range of statements surrounding the current state of, and projections for, shipping and sea ice conditions, along with the risks that may arise from these conditions. We used a Likert scale to identify levels of agreement or disagreement with each statement on Arctic shipping and sea ice conditions. The Likert Scale provides a simple scale format and the ability to demonstrate levels of intensity among statements (Babbie, 2016).

The final section focused on community perspectives on potential shipping accidents and corresponding emergency preparedness. We asked respondents open-ended questions in which they could consider or imagine a potential shipping accident that could happen around their community and the NWP**.** Respondents could also describe feelings this scenario evoked, consequences that could arise, and what would need to happen to reduce the probabilities of such an accident. Open-ended questions can allow for responses that act as a "window into people's understandings," which pre-set choice selections may fail to capture (Scott et al., 2009:6). The research team then categorized qualitative responses that respondents had freely identified for each category in the survey (vessel, event, consequence, worst-case scenario, and risk mitigation). We then inserted the themes into a process framework. We chose the process framework because it let us group the identified themes and keywords into a simplified visualization, where each category flows downward from vessel, to event, consequence, then worst-case scenario and risk mitigation.

We also employed a foresight method within the survey to explore possible futures with community participants through exploratory scenarios (van den Ende et al., 2022). Initially, approximately 10 historic shipping accidents that occurred along Canadian coasts were selected from the Canadian Disaster Database and the Clear Seas Marine

Incidents and Accidents Dashboard (Clear Seas, n.d.). We filtered through the Canadian Disaster Database by selecting "Leak / Spill Release" and "Marine Release" in the "Transportation accident" category, and "Marine" in the "Explosion" category. We selected the most detailed shipping accidents from the past 50 years and filtered the Clear Seas Dashboard to "Pollution occurrences" and "Serious accidents." These scenarios were assessed and discussed with the collaborators from Ikaarvik. Ultimately, collaborators chose four accidents as the scenarios to present to respondents, basing this decision on the accidents' relevance to the region and potential regional conditions. The details provided within these four scenarios were also deliberated over until the questionnaire was finalized. The survey instructed respondents to consider these four historic scenarios in the context of their community, then answer three questions, with response categories scaled from one to ten on: the probability of such an event happening around their community; the likely speed of an emergency response; and the likely level of devastation. They could then respond to an optional open-ended question.

Recruitment and Sampling

To understand how Arctic shipping future and emergency preparedness is perceived and to what extent these topics are considered at the community level, we needed a diverse array of perspectives from a wide range of community members (see Walsh et al., 2019). This is why we implemented the final survey via purposeful and random sampling, thereby reaching a broad range of respondents. With the collaborators leading recruiting for the questionnaire, the core strategies used to reach respondents included word of mouth and submitting posts on a Facebook page reserved for community members. Word-of-mouth strategies are often more effective and preferred in studies on smaller or rural communities (Farquhar et al., 2014; Friedman et al., 2015). Similarly, using social media, such as Facebook, for recruitment, and notably, designated pages for a study or community, allows for a low-cost and easily accessible source for potential respondents to engage with the promoted study (Kayrouz et al., 2016; Vos et al., 2023).

To initiate the first week of this survey, the primary author and a research assistant, alongside the community collaborators in Pond Inlet, undertook field work. This allowed the primary author to gain in-person experience and context directly within the case study coastal community. The target sample size for this survey was 35 – 50 respondents. Respondents had to be over the age of 18. Each respondent who attempted the questionnaire received a gift card to the local Co-op store. The survey spanned the month of November 2023 and closed when no further responses were received. Exclusions to the final sample included incomplete questionnaires and those completed by respondents who were not residents of Pond Inlet. The final sample size after exclusions was 44 respondents from Pond Inlet. Pond Inlet's working age (15 – 64) and elderly (65+) population accounts for 980 residents (Statistics Canada, 2021). Thus, this sample size represents around 4.5% of Pond Inlet's population (working age and elderly) at the time of the study.

RESULTS

Demographic Profile of Survey Participants

Within the total sample of 44 respondents, 93% (n = 41) identified as Indigenous and 7% (n = 3) as non-Indigenous. Of the 41 respondents who identified as Indigenous, 98% identified as Inuit (n = 40) and 2% as First Nations (n = 1). Males were the majority respondents at 61% (n = 27), and 39% of respondents were female (n = 17). The minimum age within the sample was 20 years and maximum age was 71 years, while the average age of respondents was around 42 years. The majority of respondents had lived in the community for 20 to 39 years (n=15, 34%), and 40 or more years (n = 17, 39%). Languages spoken by respondents included Inuktitut (n = 40, 91%), English (n = 38, 86%), French (n = 1, 2%), and sign language (n = 1, 2%). Most respondents (73%) were employed (n = 32), 23% were unemployed (n = 10), and 5% were involved in voluntary work (n = 2).

Community Perspectives on the Implications of Shipping Changes and Risk

Figure 2 shows the findings for community perspectives on shipping changes and futures around Pond Inlet. The vast majority of respondents agreed that the increase in ship traffic can negatively affect the sea ice environment (96%, n = 42). A significant majority also agreed that rising risks of shipping accidents, such as fuel spills, correspond with the increases in shipping traffic near Pond Inlet (86%, n = 38). Most respondents agreed that a further increase in temperatures might lengthen the shipping season while also disrupting marine transportation routes (84%, n = 37), and that this increase in traffic can potentially cause harm to local boaters (82%, n = 36). Many agreed that the increase in ship traffic due to climate change could present higher social and economic risks for the community and environment compared to benefits from the increased ship traffic (82%, n = 36), which aligns with previous findings (Kelley and Ljubicic, 2012; Dawson et al., 2020). Climate change was perceived by most respondents as contributing to an increase in shipping activities around Pond Inlet (82%, n = 36), while many agreed that this increase in shipping traffic affects their ability to access hunting locations (75%, n = 33), and that the increase in ship traffic causes early sea ice breakup, which impacts safe travel (73%, n = 32). Respondents largely believed that this increase in shipping activities will significantly reduce local

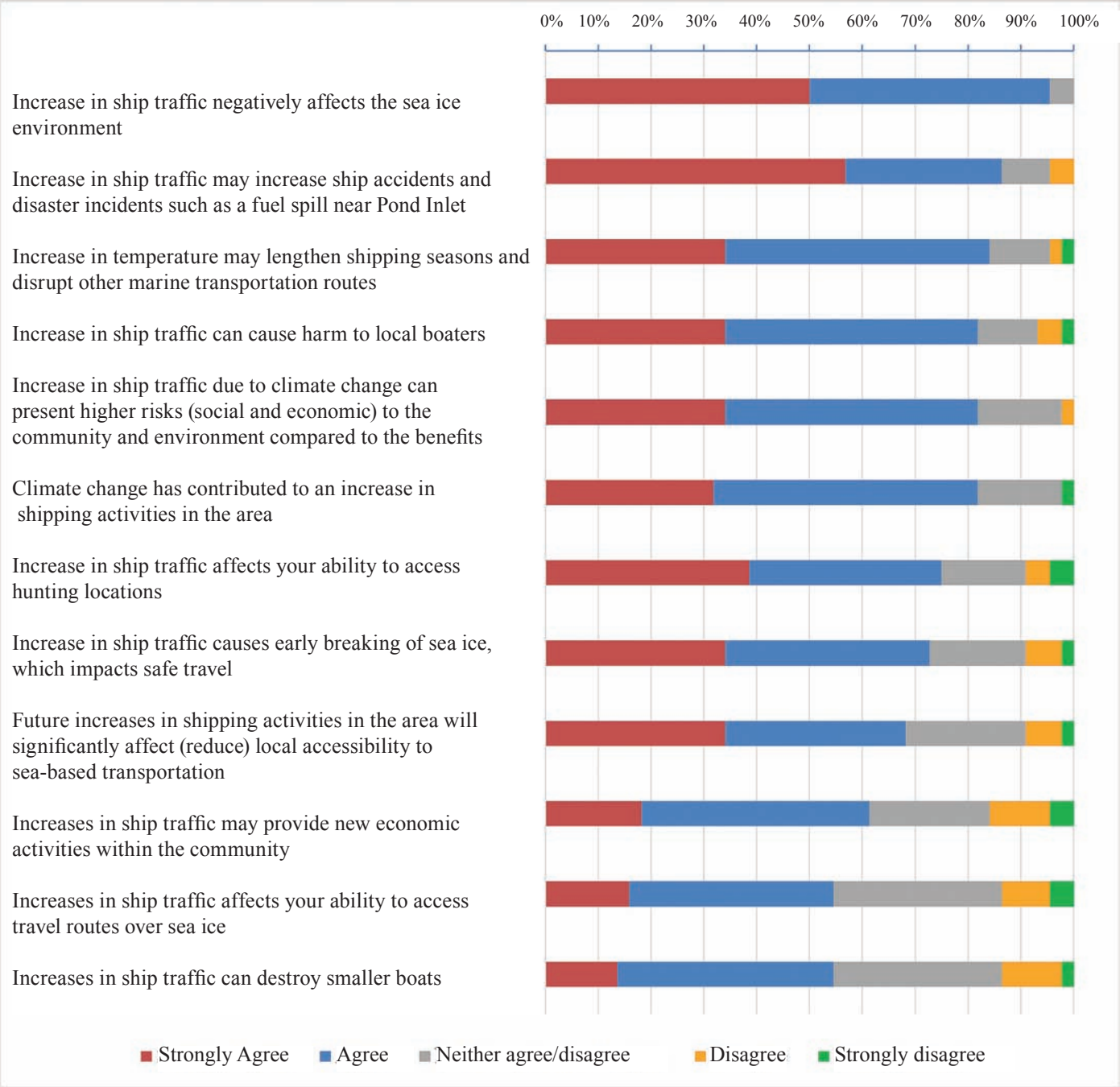

FIG. 2. Levels of agreement or disagreement (%) among participants with statements on climate change, Arctic shipping changes, and transportation.

accessibility for sea-based transportation (68%, n = 30), while also considering that the increase in ship traffic may provide new economic activities within the community (61% n = 27). However, over half of respondents agreed that this increased shipping traffic affects their personal travel routes via sea ice (55%, n = 24), and around half of respondents agreed that this increase in traffic can destroy smaller boats (55%, n = 24). In addition, to identify levels of concern, respondents were asked how often they have considered or thought about the possibilities of a shipping accident in or around their community. According to the findings, 21% of respondents (n = 9) selected regularly (5–10 times per year), 36% (n = 16) selected occasionally (2–5 times per year), 36% (n = 16) selected rarely (1 time per year or less), while 7% of respondents (n = 3) selected never.

Respondents were then asked to consider shipping accidents, worst-case scenarios, and emergency preparedness around their community. Responses to the open-ended questions and subsequent themes are discussed in the classifications below. We identified themes in survey respondents's answers to the open-ended questions and organized them into a process framework that visualizes Arctic shipping risk, potential for disaster, and

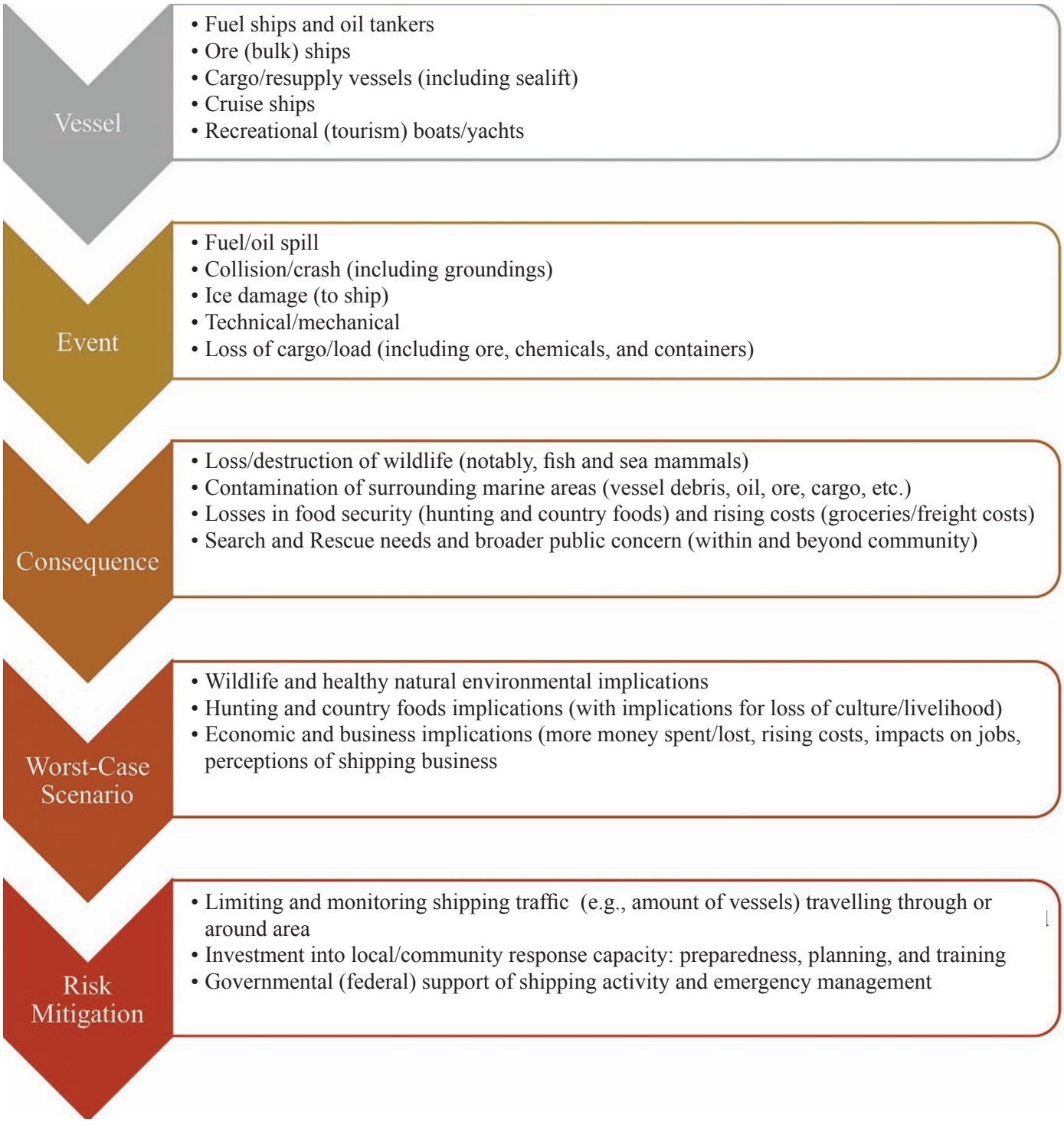

FIG. 3. Process framework showing themes identified by residents. The framework flows from vessel type, through event and consequences, then residents' perceived worst-case scenarios for an accident or disaster, and strategies they saw for reducing probabilities of a shipping disaster through risk mitigation.

opportunities for risk mitigation (Fig. 3). Themes included vessel types, types of accident events, consequences of an event, what is at stake for community members in the event of a worst-case scenario shipping accident, and the areas of need for risk mitigation. Lastly, respondents were asked for their perspectives on community and governmental preparedness for responding to an emergency from an Arctic shipping accident around Pond Inlet.

Vessel

When asked to consider a worst-case scenario shipping accident near Pond Inlet, respondents were first required to identify the type of vessel they anticipate would be involved in this shipping accident. Five types of vessels emerged. Respondents most commonly identified cargo and resupply vessels, followed by fuel ships and oil tankers. When

comparing respondents' choices with existing figures for the proportions of vessel types travelling around the Tallurutiup Imanga NMCA between 2010 and 2018, we note that the general cargo vessels respondents most often identified made up about 14% of traffic, while tanker ships made up about 9% (Kochanowicz et al., 2020). Ore and bulk ships, also known as bulk carriers, were the third most-identified type of vessel among survey respondents. This is likely due to the nearby Mary River Mine, which operates along the north end of Baffin Island (Baffinland, n.d.). Kochanowicz et al. (2020) found that bulk carriers were around 14% of shipping proportion in the region for the 2010–18 timeframe. Some respondents also chose cruise ships as likely to be involved in an accident or incident. In the period and region Kochanowicz et al. (2020) examined, passenger (or cruise) ships made up 21% of ship traffic. Recreational boats and yachts were the least mentioned by respondents, yet still relevant due to the growing tourism interests in the region (Kochanowicz et al., 2020).

Event

Regarding type of shipping accident events respondents envisioned, we identified five themes. Unsurprisingly, fuel and oil spills were the most of these. A couple of respondents mentioned that the floating fuel hose connected from a refuel vessel to the community pipeline posed a concern and risk to the community via holes in the fuel line or contact with a smaller vessel. Collisions (or crashes) and groundings, as well as ice damage to the ship were both themes commonly mentioned by respondents. In one case, a respondent noted that there are risks of "groundings in uncharted areas" and "collisions or entrapments with ice," while other respondents noted icebergs as a risk. A couple of respondents also noted the risks of groundings in shallow areas or an "unseen underwater hill or trench." The least-mentioned type of possible accidents were the loss of cargo, such as ore, chemicals, or containers, as well as the possibilities of technical or mechanical problems. Specific cargo that was noted included lead, zinc, iron, oil, gasoline, and diesel.

Consequences

We identified four themes based on respondents' responses about the consequences of potential shipping accidents. These themes are largely interconnected, similar to the worst-case scenario discussion below. Loss and destruction of wildlife, especially sea mammals and fish, was of particular concern to many respondents. Likewise, respondents noted the risk of contamination of the surrounding marine areas from pollutants such as vessel debris, oil, ore, or other cargo. One respondent advised that "contaminated waters might not be safe for sea mammals [country foods] to eat and the ice might not form well." Another respondent warned, "[an] oil spill would ruin the ocean where I hunt for seals and narwhals." Another identified theme related to losses in food security through losses in hunting and country foods and the rising household costs for community members that would result from a shipping accident and pollution event. According to previous findings in the literature, costs rise after country food supplies are negatively impacted, as hunters and others who rely on these foods are forced to supplement with store-bought foods, leading to health concerns from increased consumption of foods with higher fat, salt, and sugars (Jonasson et al., 2019; Gyapay et al., 2022). There was broad concern among our survey respondents over the safety of country foods after a shipping accident, emphasizing the importance of country foods. The last theme encompasses search and rescue needs in the event of a shipping accident, as well as broader public concern after a shipping accident occurs. This relates to how the public, within the community and beyond, could react to a shipping accident event, and how the event would be viewed publicly. Some respondents suggested that there would be collaboration between communities and assistance from community members within Pond Inlet, but that there could also be broader concern from other Arctic communities and communities beyond the Arctic. To highlight this, a respondent suggested, "I feel we as an Indigenous people would be held the most responsible and feel the most damage when in fact it would affect everyone." Another respondent, referring to potential significant loss of life and environmental disaster that could follow an accident, noted that "our communities have limited response capabilities for either type of [impact]."

WORST-CASE SCENARIO

Responses to what would be lost personally, or at a community level, in a worst-case scenario shipping accident or shipping disaster were classified into three themes of broader implications. Concerns for wildlife and the healthy natural environment were most prominently mentioned in the responses. Specific wildlife mentioned by respondents included fish, murres, and mammals, such as seals, narwhals, and polar bears, most of which are also local country foods. Alongside these mentions of wildlife, respondents commonly mentioned implications to hunting and local foods. Several respondents suggested that they may lose everything and could go hungry from a loss of country foods, with some noting how this would increase spending on store-bought foods, which would be more expensive for households. As a respondent stated when considering the potential loss of country food, "more money spent on food and less good nutritious food to eat." The potential for losing Inuit culture if a "bad enough" shipping accident occurred was also noted. The third theme of worst-case scenarios related to economic and business implications of an accident through rising costs, more money being spent, impacts to jobs, and the perceptions of shipping businesses. Basic needs, such as heating, transportation,

TABLE 1. Detailed overview of historic shipping scenarios used in the survey instrument. Respondents were asked to consider all scenarios in the context of Pond Inlet and the NWP.

MV *Marathassa* oil spill	A bulk carrier called the MV *Marathassa* discharged over 2700 litres of bunker fuel into Vancouver's English Bay. Toxic oil spread to the shorelines and had a significant negative impact on the water quality, wildlife (with at least 20 birds being affected), and surrounding environment. The oil spill was not noticed until a recreational boater spotted the oil in the water and reported it. It was later determined that the oil was coming from the MV *Marathassa* (Clear Seas, 2016; Canadian Disaster Database, n.d.; City of Vancouver, n.d.; Public Safety Canada, n.d.).
MV *SKRIM* receives ice damage	Off the shore of Newfoundland, during the beginning of spring (March), a bulk carrier from Panama called the MV *SKRIM* began leaking heavy oil after receiving ice damage. The oil could be found in the ice near the ship and on the rocks on the Newfoundland shoreline. With the amount of heavy oil leaking into the sea ice and marine space, it was clear that marine life would be impacted, and oil would increase sea ice melt around the impacted area by absorbing more heat from sunlight. But the degree of impact was unclear. Some fish might have become unsafe to eat if they passed through the contaminated area (Canadian Disaster Database, n.d.; Public Safety Canada, n.d.).
Nathan E. Stewart accident and response	In a remote part of the Seaforth Channel in British Columbia, a barge and tug called *Nathan E. Stewart* struck the bottom of a shallow part of the channel after the operator fell asleep, causing over 100,000 litres of diesel fuel and over 2000 litres of lubricants to spill into the channel near the Heiltsuk First Nation, affecting 350 kilometres of shoreline. Two arial flights confirmed that the diesel fuel and lubricants were spreading throughout the channel. A dive team repaired the fuel tanks in an attempt to stop the leaking, while a team of workers attempted to pump out the remaining fuel, but bad weather hindered cleanup and salvage efforts. The tug was lifted out of the water and taken to shore over a month later. Despite the cleanup efforts, Heiltsuk First Nation fisheries were still closed due to environmental contamination concerns (Public Safety Canada, n.d. Canadian Disaster Database).
Vancouver Harbour collision	This collision took place between two ships around the Vancouver Harbour during fog conditions, causing marine diesel oil to spill, contaminating the surrounding water, with over a kilometre of shoreline affected. This incident killed 65 birds, while over 200 birds were rescued during cleanup efforts (Public Safety Canada, n.d. Canadian Disaster Database).

and health, were mentioned as being at risk in a worst-case scenario, with a respondent warning that "human rights and freedoms [in Pond Inlet] will be compromised and limited." When respondents were asked a follow-up question on how this would make them feel, they also described a host of emotional responses, which we organized into four areas: anger and frustration; sadness, vulnerability, and depression; concern and worry; and distress and devastation.

Risk Mitigation

Lastly, we identified respondents' perspectives on risk mitigation strategies through our question on what needs to happen to reduce probabilities or risks of severe damages from a shipping accident or disaster (see Fig. 3). The most common theme was limiting, reducing, and monitoring shipping traffic travelling through or around the Lancaster Sound. This finding aligns with previous recommendations for vessels travelling through the Tallurutiup Imanga NMCA (Halliday et al., 2022). Investment into local response capacity, including preparedness, planning, and training, was another theme identified in this area. Some respondents proposed that significant investment into local capacity is needed in the areas of education, planning, support, and infrastructure to ensure better emergency preparedness. While they mentioned it less frequently than other mitigation strategies, respondents still found government support of shipping activity and emergency management requirements to be valuable, notably from the federal level. A respondent emphasized that the Inuit and traditional knowledge from residents and Elders must be listened to, further noting that the community will "need more consensus between parties at Inuit and federal level." One respondent suggested that the Canadian Coast Guard should be more present when ships from the mines are operating, and that there should be immediate communication and information-sharing between community members and the Royal Canadian Mounted Police (RCMP) in the event of a shipping accident.

Governmental Preparedness

When respondents were asked if they believed that the Government of Nunavut and Government of Canada would provide enough assistance to reduce risks caused by a shipping accident, 27% (n = 12) selected no, 64% (n = 28) selected unsure, and 9% (n = 4) selected yes. As one respondent stated, "over the years, federal government is not showing they have a plan." This respondent expressed frustration over a lack of communication from the federal government. Others expressed optimism that the community, especially hunters, would take action and collaborate with governmental departments if an Arctic shipping emergency happened. A respondent suggested that the community might be ready, but would require more training and resources, also noting, "we are living so far up north it would take twice if not three or four times as long to get help from the rest of Canada if that were to happen."

Community Perspectives on Scenario-based Shipping Accidents

Beyond understanding perceptions of the current trends in Arctic shipping, placing historic shipping

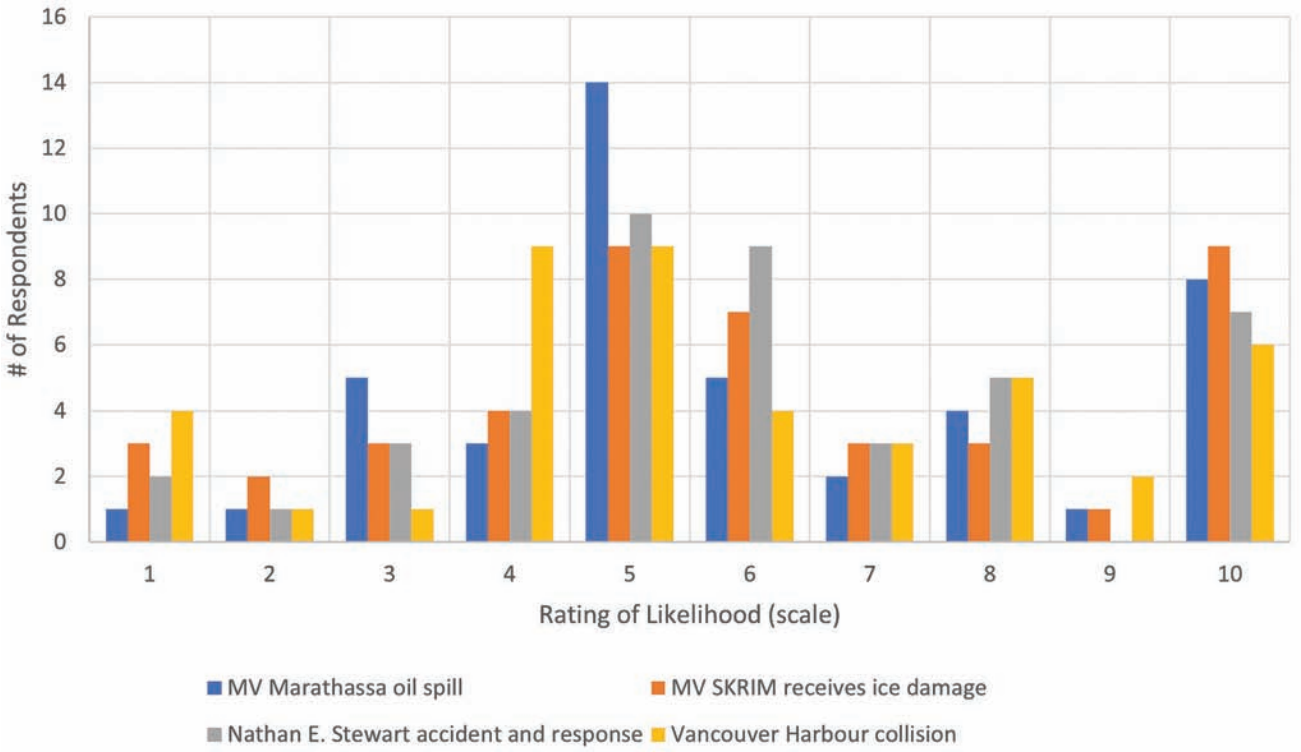

FIG. 4. Rating of likelihood (from 1 – very unlikely to 10 – extremely likely) of four historic shipping accidents in the context of the region where respondents reside. Each colour represents the four scenarios briefly described in Table 1.

accident scenarios in the Arctic context may allow for an understanding of how community members in Pond Inlet perceive the levels of risk and preparedness around the NWP. Table 1 shows the four historic shipping accident scenarios we presented as part of the survey.

To determine respondents' perceptions of the likelihood of the four scenarios, we asked them to consider each one as occurring around their community and the NWP in the future (see Fig. 4). For each scenario, most respondents selected a moderate likelihood, between 4 and 6, and responses peaked around the likelihood of 5, while a smaller peak can be seen at the highest likelihood of the scale (10). The first scenario saw the highest peak, at a likelihood of 5, selected by 14 respondents. This suggests that most respondents in the sample considered the likelihood of a shipping accident event a possibility around their community, while six to nine respondents considered each of these scenarios to be extremely likely.

As shown in Figure 5, each scenario peaks at the lowest emergency-response-speed rating (1) in the majority of responses. A second, smaller peak for each scenario occurs around the low–medium-response-speed selections (4 and 5). The highest-response-speed selections (9 and 10) for each scenario were selected by a maximum of one to three respondents, whereas the lowest response speed selections were selected by 11–17 respondents. Overall, respondents largely believed that an emergency response to the shipping accident scenarios would be slow to very slow.

Figure 6 shows that the vast majority of respondents in the sample perceived that a potential shipping accident would be devastating and extensive to the marine space and themselves for each of the four scenarios (rating of 10). While these findings were to be expected, they reaffirm the community-incurred levels of risk from pollution events in the marine space that can arise from heightened shipping or development activities.

DISCUSSION

Encompassing the Lancaster Sound and the mouth of the NWP, the Tallurutiup Imanga NMCA has an estimated ecosystem service value of $37 billion CAD per year among Canada's natural capital assets, as determined by a benefit transfer approach (Mulrooney and Jones, 2023). Mulrooney and Jones (2023:41) suggest that such valuations can "demonstrate the importance of ecosystem services and the potential impact to societal welfare if compromised," which is also why we note this value despite discourse surrounding the economization of the environment. The marine space is also habitat to biologically and culturally significant wildlife species that are more sensitive to disturbances from shipping compared to southern species**.** Yet there is still a lack of data on shipping impacts in the Arctic to provide evidence-based plans for mitigation of the risks (Halliday et al., 2022). From 1990 to 2018, vessel traffic in the Tallurutiup Imanga NMCA increased well over twofold due to climate change and changes in sea ice, and the pace of the expected continued growth rate in shipping season length depends on a low, medium, or high emissions trajectory (Dawson et al.,

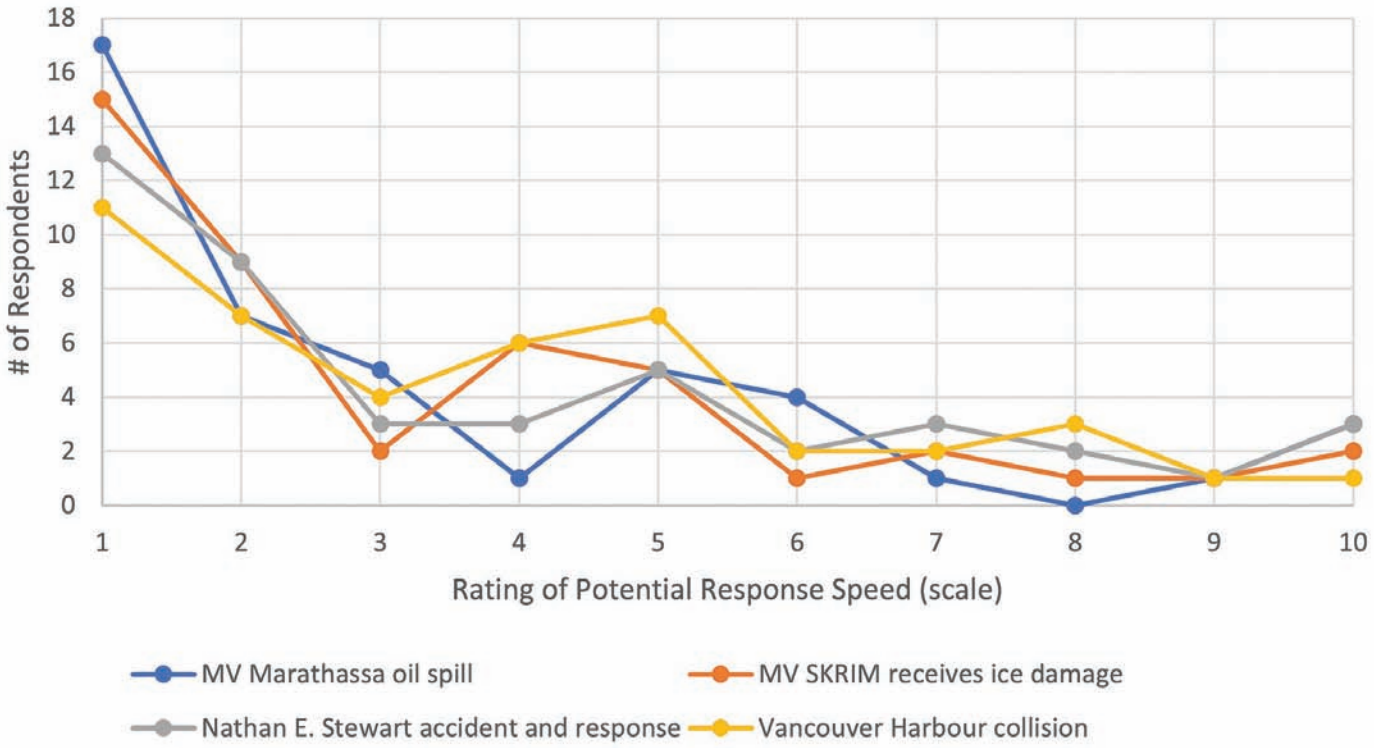

FIG. 5. Rating of potential speed (from 1 – very slow to 10 – very fast) of an emergency response in the context of the historic shipping scenario occurring in the region where the respondents reside. Each colour represents one of the four scenarios briefly described in Table 1.

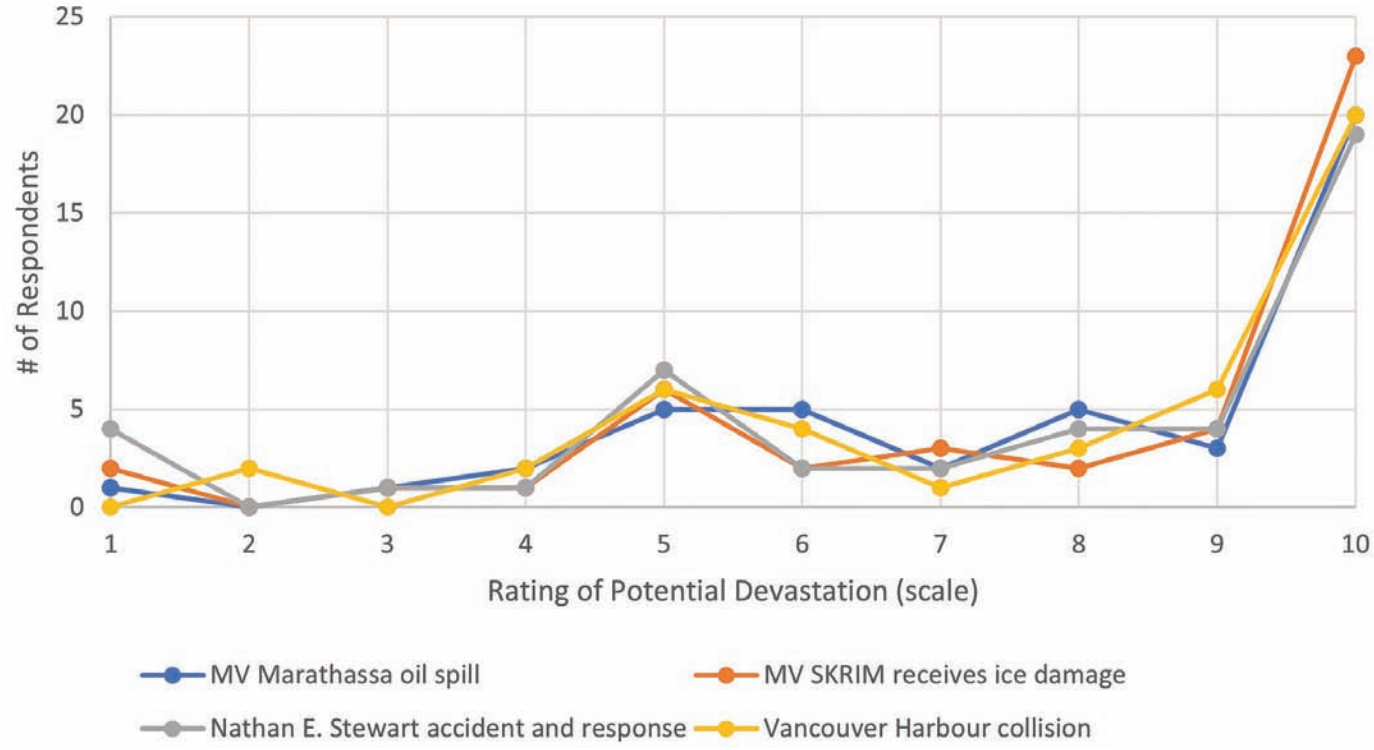

FIG. 6. Rating of the potential scale of devastation (from 1 – limited/contained impact to 10 – devastating/extensive impact) in the context of the historic shipping scenario occurring in the region where the respondents reside. Each colour represents one of the four scenarios briefly described in Table 1.

2018; Kochanowicz et al., 2020; Li and Lynch, 2023). The majority of respondents from Pond Inlet concurred with the current data on these connections between climate change and increased shipping. As emphasized, the increased probability of a shipping accident and emergency in the region follows the increase in ship traffic and lengthening

shipping seasons. In concert with the potential for greater areal coverage and shoreline exposure from a warming climate and seasonal trends, these shipping trends in the Arctic broaden environmental risks due to the heightened potential of oil spills or cargo lost overboard (Nordam et al., 2017).

A study by Kelley and Ljubicic (2012) showed substantial disconnects between governmental policy and community perspectives on Arctic shipping in Cape Dorset (also recognized as Kinngait), Nunavut, a community impacted by changes in sea ice conditions and evolving shipping practices, along with the rising associated risks. Arctic sea ice is significant for Inuit daily life and integral to the marine environment, and the ocean is used year-round by Inuit whether the waters are open or frozen, while sea ice is also comparable to highways in southern Canada as a platform of connectivity (Kelley and Ljubicic, 2012; Bishop et al., 2022). Kelley and Ljubicic (2012) found that community members feel there should be more local involvement at the Canadian policy and decision-making levels for issues relating to Arctic shipping, especially to ensure that benefits and risks are effectively weighed with local needs and concerns in mind. Community members in Cape Dorset have undertaken monitoring, based on observation, for shipping in the region, but long-term community-based monitoring could be improved with a more collaborative approach between government agencies and community organizations to address the environmental and social concerns related to shipping (Kelley and Ljubicic, 2012).

The need for community engagement and collaboration for co-managing emergency response preparedness and risk mitigation strategies has been well established internationally (Pennington-Gray et al., 2014; Cahyanto et al., 2021; Khan and Eslamian, 2022; Nowell et al., 2022), and for the Arctic region (Mileski et al., 2018; Kirchner, 2019; Olsen et al., 2019). However, much of the literature has been focused on natural disasters**,** rather than technological disasters, such as shipping accidents, which has held less of a spotlight. As suggested by Lauta et al. (2018:15), if a ship travelling through the NWP, such as the *Crystal Serenity*, collided with an iceberg, the emergency response would occur in a "cold and hostile environment" with little to no resources and uncertainty over the responsibilities of parties. Findings from the Pond Inlet sample suggest that this could also be the case if a shipping accident transpired. At the same time, over half of respondents from Pond Inlet considered an increase in shipping as a potential opportunity for new economic activities for the community, mirroring previous findings from Cape Dorset, where increases in goods and economic activity were considered positive outcomes of increased shipping in the Arctic (Kelley and Ljubicic, 2012).

The findings from responses to the scenarios were, to a degree, anticipated based on the remoteness of Pond Inlet, the lack of port as well as other types of supporting infrastructure, and the cultural significance of the broader marine space and sea ice for the Inuit. The remoteness and infrastructure challenges in the Arctic create a vulnerability for communities and national security, as an emergency response would prove logistically complex and challenging (Briggs, 2020). Threats to Inuit food sovereignty and cultural practices, which are constitutionally protected, increase with the rising risks of a shipping accident, accentuating vulnerabilities for the Arctic population (Ford et al., 2015; Kochanowicz et al., 2021). Some have called Arctic communities the "zero-order responders" when it comes to managing local hazards, due to their embeddedness in the regional environment and historically accumulated local and Indigenous knowledge (Hadlos et al., 2022:1). In the case of Pond Inlet and Arctic communities, hazards from human activities, such as shipping, abruptly challenge the accumulated knowledge and strategies developed by communities and their members. Indigenous knowledge systems in the Arctic recognize the region as being in a "constant state of flux" (Ford et al., 2015:1046). In this worldview, uncertainty and unpredictability are necessary elements for local peoples. This is suggestive of the adaptive capacity of Inuit populations to natural hazards from climate change challenges, despite the heightened vulnerability (Ford et al., 2015). Thus, the warming from climate change paired with the hazards that shipping poses, as a respondent suggested, compound and raise the unpredictability that Arctic communities already face.

Several researchers have noted that working with uncertainty, flexibility, and the need for improvisation, maintaining resilience in the face of unpredictable events, are requirements in Arctic shipping safety and in the context of an emergency response to potential shipping accidents in the Arctic (Andreassen et al., 2018; Lauta et al., 2018; Mileski et al., 2018; Salokannel et al., 2018). Some study respondents indicated that local hunters and community residents would be responders in the event of a shipping accident, challenging rigid governmental structures in traditional emergency management. Uncertainty and improvisation are elements that operators must also account for to operate in the region safely, together with ensuring a safe and healthy workplace that allows operators to communicate effectively (Salokannel et al., 2018). Yet, shipping accidents still happen and will require a response, an especially important consideration for remote communities. As a respondent from Pond Inlet expressed, "we're prepared enough to take action but not prepared enough to be the experts at this." Another respondent also offered, "I think the community would try to respond as soon as people hear about the accident." Responses indicate that improvisation would likely occur if a shipping accident happened around the community. However, these optimistic views were overshadowed by the views of a greater number of respondents who were either unsure or who believed their community was underprepared or unprepared for a variety of reasons, which may highlight a lack of proper communications and engagement within communities. In the Kelley and Ljubicic

(2012) study, participants from Cape Dorset expressed concerns over ships releasing pollutants and contaminants into Arctic waters**.** They also reported concerns about the community's realistic capacity to respond to emergencies and clean-up after any accidental spills. Ritsema et al. (2015:168), also found that interviewees from Pond Inlet were expressing concern over a "very under resourced and severely understaffed" hamlet office, highlighting a gap in the need for an immediate emergency response from the community if a shipping accident were to happen. In our study, Pond Inlet residents expressed similar sentiments when considering an emergency response to a shipping accident.

The Arctic Council has demonstrated progress in Arctic risk mitigation. The Council used a multilateral co-operation process to establish the binding Arctic Search and Rescue Agreement in 2011, and the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic in 2013 (Duda and Kelman, 2019). Mileski et al. (2018) promote maintaining close multilateral collaboration, higher environmental standards and safety standards, improved preparedness, and effective management plans as precursors to sustainable economic activity in the Arctic Ocean. As a warming climate allows for the rising accessibility of Arctic waters to ships, risks of accidents or disasters will clearly rise alongside the increasing traffic. These risks are multiplied in the Arctic when accounting for the rapidly changing and extreme weather, lack of physical or social infrastructures, vast distances between communities, and complex institutional landscapes (Lauta et al., 2018).

The high-profile *Exxon Valdez* shipping disaster in 1989 provides an example of an Arctic shipping accident in Alaska where emergency response was limited, while irreversible long-term impacts were substantial (Peterson et al., 2003; Halliday et al., 2022). The super oil tanker ran aground on Bligh Reef near Prince William Sound, Alaska, causing over 35,000 tonnes of oil to spill into the seas, while it took over two days before oil spill response equipment could finally be deployed (Barron et al., 2020). But shipping is not the only area of concern. Pincus (2015) argues that conditions today are ripe for a wicked problem in the Arctic cruise tourism. He points to the Arctic Council's 2009 Arctic Marine Shipping Assessment, which noted that investment and development in the region's infrastructure is being outpaced by Arctic marine tourism. Canada and the US have lagged behind in this area of emergency preparedness in the Arctic and lack capacity for effective enforcement of their jurisdictions and responses to accidents, while Russia has invested significantly into the governance of the Northern Sea route for building capacity (Huntington et al., 2023). In northern Canada, disaster and large-scale emergency response capacities are largely based at the regional and federal levels, with reliance on northern communities for day-to-day response, when instead, community first responders could be valuable force multipliers if roles and responsibilities are effectively determined and outlined by governmental partners (Clark et al., 2018; Kikkert et al., 2023).

The Canadian Coast Guard has community-based volunteer auxiliary responders throughout the Canadian Arctic, and this program has been undergoing expansion, along with ongoing community engagement and relationship building efforts (Kikkert and Lackenbauer, 2021). Auxiliary units, such as the Canadian Coast Guard Auxiliary units, the Canadian Rangers, and Inuit Guardians (among a range of other search and rescue–based units) have been found to strengthen emergency response operations through improving response times; function as detectives for search and rescue operations; assist in marine safety; and integrate local and Indigenous knowledge and skills into emergency operations (Kikkert et al., 2023). Technology-based options, such as community responder–piloted unmanned aerial vehicles, have also been explored as a tool for hazard mapping and planned missions in preparation for potential emergency responses, but pairing these technologies with support systems, skill development investments, and adherence to cultural values are crucial considerations for their integration (Clark et al., 2018).

Opportunities for risk mitigation, emergency preparedness, response, and management in the Canadian Arctic have been highlighted in the literature and recent initiatives, including efforts by the Canadian Coast Guard through the Oceans Protection Plan, local initiatives, such as by the Ikaarvik youth science organization, and the academic community, such as through the Arctic Corridors and Northern Voices project, among others (Oceans North Canada, 2016; Kikkert and Lackenbauer, 2019; Dawson et al., 2020; DFO/CCG, 2020; Goerlandt and Pelot, 2020; Munari, 2020; van Luijk et al., 2021). The community-based Canadian Rangers, who operate alongside the Canadian military, are another example of Arctic community resilience and collaboration in readiness for disasters or search and rescue operations (Lackenbauer and Kikkert, 2020). Because communities within the Canadian Arctic remain at the front lines for any emergency response, the core need for community consultation and collaboration has been underlined by many researchers as an essential precursor (Kelley and Ljubicic, 2012; Duda and Kelman, 2019; Dawson et al., 2020; van Luijk et al., 2021). The present study reiterated and stressed these insights. Prevention opportunities proposed by respondents from Pond Inlet that align with recommendations from a previous study include limiting vessels, or a quota system, through corridors where vessels travel, as well as speed limits for vessels passing through the region (Halliday et al., 2022). Overlapping risk mitigation themes identified from respondents in Pond Inlet also included governmental support and investment into local capacities. While governmental programs and personnel, such as the Canadian Rangers, exist in the Canadian Arctic, bolstering these existing capacities and increasing investment in local capacities to meet the current day risks will be

critical for Canada's overall risk mitigation and emergency preparedness systems in the Arctic (Kelley and Ljubicic, 2012; Pincus, 2015; Lauta et al., 2018).

CONCLUSION

This study assessed community perspectives on the implications of increased Arctic shipping around Pond Inlet and the NWP, along with the risks of shipping accidents and subsequent emergency responses. Collaborating with Ikaarvik, the survey functioned as a case study for our interdisciplinary approach to analyzing community perceptions of shipping risks and possible emergency responses in the Canadian Arctic. Findings indicate near consensus among community members within the sample on the increase in shipping activities and lengthening of seasons due to climate change, increases in temperature, as well as in the risks that coincide with increasing ship traffic (see Fig. 2). We classified responses into themes, then developed a process framework to capture several aspects of Arctic shipping risks (See Fig. 3). Responses and speculation on the probabilities of shipping accidents based on exploratory scenarios were mixed (Fig. 4), though consensus was concentrated along the lower end of the spectrum for emergency response speed for all scenarios (Fig. 5) and along the higher end of the spectrum for the level of potential devastation for all scenarios (Fig. 6).

Given that many respondents had not previously experienced an Arctic shipping accident near the community, imagining such an event might have been difficult. The survey itself was an experimental approach, and there were a wide range of interdisciplinary questions. Thus, individual topics or subjects within shipping and emergency preparedness may have lacked depth. The quality of responses may have been hindered based on rushed completion of the survey or in cases of minimal effort taken when providing responses. In addition, the lower sample size might not have been representative of the broader population within Pond Inlet, and the one-month timeframe for implementating the survey might not have allowed for a fully diverse sample.

Future studies can expand on the existing literature on Arctic shipping emergencies through continuing engagement and consultations on emergency response options with a range of interested parties and rightsholders: governmental and non-governmental, local communities, and relevant industries. Future studies can also allow for a longer implementation phase and integrate open-ended interviews or focus groups to supplement survey responses, allowing for a more holistic dataset. If using exploratory scenarios on shipping accidents similar to those used in this study, we advise researchers to build these scenarios (fictional or historic) with the community-of-focus and relevant interested parties or rightsholders. Assessing the current shipping safety and pollution prevention plans alongside emergency response plans for each type of interested party will also be important to determine levels of risk posed to Arctic marine spaces along shipping corridors, especially around the NWP.

There must be adequate engagement and consultations with communities and Indigenous peoples within the Canadian Arctic on existing and future emergency response plans and policies relevant to the region (Kelley and Ljubicic, 2012; Carter et al., 2019; Dawson et al., 2020; Bishop et al., 2022; Hadlos et al., 2022). Within this process of engagement and consultations, we advise researchers to introduce community campaigns to raise awareness on shipping-specific preparedness and emergency response plans for the region. Doing so will raise confidence for community members. The next recommendation is to control and limit ship traffic in the region using tools such as quotas and speed limits. This could be accomplished through existing legislation such as Northern Canada Vessel Traffic Services Zone Regulations and the Canada Shipping Act, 2001. Controlling ship traffic was proposed by community respondents and is also a recommendation found in the literature (see Halliday et al., 2022; Bishop et al., 2022). The final recommendation is for heightened government intervention into Arctic shipping and emergency response plans, which entails investment into community-based response capacities and preparedness within the Canadian Arctic (Pincus, 2015; Kirchner, 2019; Bechtel and Mannino, 2021).

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