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Introduction

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Chapter 1
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Abstract This chapter introduces a multidisciplinary collection of chapters addressing various aspects of governance of Arctic shipping written by leading international scholars. It investigates how ocean changes and anthropogenic impacts affect our understanding of risk, policy, management and regulation for safe navigation, environment protection, conflict management between ocean uses, and protection of Indigenous peoples' interests in Canadian Arctic waters. The book is divided in three parts, together providing a multi-faceted and interdisciplinary view on governance of Arctic shipping. The first part addresses conceptual and empirical aspects of risk governance, management, and assessment in the Canadian Arctic. The second part focuses on the human dimensions of a changing Arctic, providing insights in Inuit perspectives and knowledge, occupational safety issues onboard cruise and other commercial vessels, and aspects of fishing vessel safety. The third part focuses on regulatory considerations of shipping and ocean use, with contributions addressing the IMO's framework for Arctic shipping, the Polar Code implementation in Canada, and contemporary topics concerning ship emissions, heavy fuel oil, and maritime spatial planning. It is hoped that the contributions encourage further multi- and interdisciplinary work by established and emerging scholars, and that these can assist decision-makers in planning, managing, and regulating Arctic Shipping.

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1.1 Purpose

Over the last decade, there has been an exponential increase in the literature on the governance of Arctic shipping, especially in the wake of the Arctic Council's seminal *Arctic Marine Shipping Assessment Report* (Arctic Council 2009) and following the commencement of the International Maritime Organization (IMO) deliberations on a mandatory code for polar shipping. There are several multidisciplinary monographs and collected works focused on Arctic shipping (Østreng et al. 2013; Beckman et al. 2017; Hildebrand et al. 2018; Rothwell 2018; Lasserre and Faury 2019). There are also monographs and handbooks on polar law and policy containing individual chapters on Arctic shipping, as well as numerous articles in the refereed journal literature and technical publications.

In an era when climate change is of high societal concern and a political priority, academia has mobilized to highlight and explain what is at stake for the Arctic as one of the most fragile marine regions and the implications of a changing Arctic for the planet as a whole. Work focuses on the effects of climate change on oceans and marine ecosystems but also on economic implications and social impacts on Arctic populations, most especially Indigenous peoples. Furthermore, academia scrutinizes the efficacy of global, regional and national governance structures and processes in meeting the various challenges. This book joins the body of literature on the governance of Arctic shipping and aims to add value through the perspectives of risk, the human dimension and regulatory strategy, with a particular focus on Canadian Arctic waters.

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1.2 Context

The Arctic is undergoing profound change with far-reaching consequences for accessibility, the marine environment, regional economies, infrastructure, Indigenous peoples and coastal communities, more than any other region and at a

much faster pace (IPCC 2019; Arctic Council 2009; Østreng et al. 2013). Until approximately two decades ago, most of the Canadian Arctic was inaccessible to shipping, and, when reachable, vessels usually required icebreaker assistance. The purposes of shipping in those times were limited and primarily related to the transportation of minerals, northern community supply logistics, scientific research and services provided by government ships, such as aids to navigation, surveillance and search and rescue (SAR). The progressive loss of sea ice caused by climate change has changed the intensity and purposes of shipping. Today, record-breaking sea ice loss leads to enhanced mobility for a range of commercial and non-commercial ships, including cruise ships and recreational vessels engaged in opportunistic voyages. These developments are having profound impacts on navigation routes, the infrastructure needed, ship operations and the well-being of Arctic communities, triggering concerns for sustainability (Hildebrand et al. 2018; Lasserre and Faury 2019).

In theory, and regional destination shipping aside, there are three potential major routes for intercontinental transits through the Arctic (Arctic Council 2009; Østreng et al. 2013). The first, and most realistic, is the Northeast Passage, which includes the Northern Sea Route through Russian Federation waters. The latter has been seeing growing, albeit incremental, commercial traffic since the first transits of the German-owned heavy lift vessels *Beluga Fraternity* and *Beluga Foresight* from Asia to Europe in 2009 (Østreng et al. 2013). The second is the transpolar route through the central Arctic Ocean, which has not yet been tested by commercial shipping and is thought not to be feasible for several more decades. The third is the Northwest Passage, mostly through Canadian Arctic waters. This route has seen very few pilot commercial transits. To date, the bulk of shipping in the Canadian Arctic consists of destination shipping, with more occasional activity by small cruise ships and recreational vessels (Wright 2016). While it is too soon to determine whether new and sustainable international shipping routes will take hold in the Northwest Passage, considerable efforts have been invested by public authorities and research institutions to anticipate and understand the potential impacts.

A stark reality is that even under the most optimistic forecasts for navigational accessibility, navigation in Arctic waters will remain challenging for the foreseeable future. There is a need for developing marine transportation policies, where risk reduction strategies adequately represent the changing geophysical processes that pose risks, such as marine visibility, meteorology, sea ice and ocean-atmosphere interaction (Koračin et al. 2014). Even with rising temperatures, sea ice will be present for most of the year, as ice lost in the summer season will form again during the winter months. Even during the summer navigation season, there could be variable and unpredictable sea ice movement, bad weather and limited visibility for prolonged periods, making for extreme conditions and posing particular risks for efficient and safe navigation (Arctic Council 2009; Snider 2018). In addition, Arctic shipping, most especially in Canadian waters, has to contend with remoteness and minimal infrastructure, including absence of, or insufficient, charting, and limited services such as pilotage, salvage, spill response and SAR (Arctic Council 2009).

Conversely, especially without appropriate standards and controls, the increasing shipping activity could adversely impact the fragile Arctic environment through

toxic emissions, black carbon, oil spills, habitat damage, introduction of exotic species and underwater noise, with potential disruptions to humans, species and ecosystems (Richardson et al. 1995; Weigart 2007; IMO 2009; Arai et al. 2009; Slabbekoorn et al. 2010).

There is very limited capacity to respond in a timely and effective manner to a spill of heavy fuel oil in an area with extensive sea ice presence. Virtually the entire response capacity would need to be transported over great distances because of the poor infrastructure and geographical remoteness. Many oil spill response techniques have limited usefulness in Arctic environments (EPPR 2017). A major pollution or SAR incident, such as a cruise ship in distress, would easily overwhelm Inuit and other coastal communities and existing response capacity. In Canada, even with capacity built under the recently launched Oceans Action Plan (OPP) (DFO 2016), the response times are very long (Ford and Clark 2019). There are further dangers of physical, mental and community health impacts (Eykelbosh 2014; Chang et al. 2014). Spills and other incidents have the potential to erode social license for shipping in the region. Hence, emergency prevention, preparedness and response based on sound risk assessment and conforming to the highest practicable standards, grounded in solid scientific understanding of ocean and weather pattern changes and other sources of knowledge such as traditional knowledge by Indigenous peoples, are essential (Nevalainen et al. 2017). There is need to enhance efficiencies in the use of scarce resources through a better understanding of risk leading to greater integration of planning for SAR and spill response, especially in remote areas.

Underwater noise is a risk, as reports of whale strandings following explosive noises and high-intensity sonar trials demonstrate elsewhere (Ketten et al. 1993; IMO 2014; Urick 1984). Sublethal consequences can also affect marine mammals due to chronic noise that interferes with normal animal activities, causing changes in stress hormones in whales (Rolland et al. 2012). Elevated anthropogenic noise has been shown to negatively impact commercial fish catch rates (Engås et al. 1996). Conditions are exceptionally and dynamically variable in the Arctic, so the effect of noise from a single ship may vary significantly from one day to the next. Current standards for ship-generated noise are only voluntary at this time (IMO 2014).

Coastal communities could be exposed to harmful atmospheric emissions that can pose public health risks, such as premature mortality and respiratory illnesses (IMO 2009). In this context, it is interesting to note that the northernmost limit of the IMO North American Emission Control Area for controls of emissions of sulphur oxides (SOx), nitrogen oxides (NOx) and particulate matter (PM) from ships is located at 60 degrees North. The IMO International Code for Ships Operating in Polar Waters (Polar Code) does not address atmospheric pollution (Chircop 2016; Polar Code 2014/2015).

Several of the risks posed by shipping have the potential to generate conflict. Conflicting interactions between shipping and Inuit activities, coastal communities and other ocean user interests can be prevented or mitigated. Conflict prevention and mitigation benefit from marine spatial planning (MSP) and ship routeing measures (Ehler and Douvere 2009; IMO 1985, 2015). MSP ‘is a public process of analysing and allocating the spatial and temporal distribution of human activities in

marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process' (UNESCO n.d.). Despite ocean management efforts in Canada, to date MSP has not been embraced in the Arctic as in European waters. MSP in the Canadian Arctic context would need to be driven in great part by Inuit perspectives. This is especially significant because the traditional marine bias of MSP needs adaptation to a different Indigenous conception of space involving land, ice and sea as a continuity (Boucquey et al. 2016; Aporta 2010a, 2010b). MSP supported by ship routeing and reporting measures could help address Inuit concerns regarding impacts of shipping on land, ice, sea and air quality and facilitate the prevention and mitigation of other conflicts.

The risks posed by shipping to Indigenous peoples and other coastal communities are accompanied by other human impacts produced by this industry. In particular, the growth of traffic entails a corresponding increase in the numbers and diversity of workers in the maritime industries, most especially in commercial shipping, cruise shipping and fishing industries. Subsequent to the adoption of the Polar Code, the IMO scaled up the training and certification requirements for seafarers employed in polar regions (STCW 1978/2016). While this is good news for commercial traffic, the full extent of application of these higher standards to personnel other than traditional seafarers on cruise ships is unclear. On the one hand, rules of the International Labour Organization (ILO) include all workers on board ships as seafarers for occupational health and safety standards; on the other hand, the IMO rules on training concern only seafarers responsible for the safe navigation of the ship (MLC 2006; STCW 1978/2016). Moreover, personnel on fishing vessels are not covered by the Polar Code, the IMO rules on training and certification seafarers and the ILO rules. The only international safety rules dedicated to fishing vessels are not yet in force (Cape Town Agreement 2012). There are serious gaps in occupational health and safety standards for maritime workers, other than seafarers, in polar regions.

How are principles, structures and processes for the governance of Arctic shipping positioned to address the challenges of increased shipping in the region? There is much unfinished business in the governance of Arctic shipping. At the global level, the recently adopted Polar Code, accompanied by amendments to major safety of life at sea and pollution prevention instruments, has achieved much in mitigating the risks of Arctic shipping (Polar Code 2014/2015). It introduced new international safety and environmental standards for polar shipping effective on 1 January 2017 (Chircop 2016; Beckman et al. 2017). However, important gaps remain. The safety provisions of the Polar Code do not apply to non-SOLAS ships, such as fishing vessels. During deliberations on the Polar Code, the need to establish appropriate standards for ship emissions in polar and other waters to protect public health was identified but left for future work. Similarly, the regulation of use and carriage for use of heavy fuel oil (HFO) was left to a future time and is currently under consideration at the IMO. It is remarkable that Arctic ship emissions are regulated to a lower standard than that applicable to the sub-Arctic waters of North America. In Canada this means there is a dual standard: ship atmospheric emissions south of 60 degrees are far more stringent than in Arctic waters.

In the last few years, Canada has shifted its northern policy from an almost exclusive focus on sovereignty, reinforced by annual prime ministerial pilgrimages, to a more general and contemporary concern with rules-based governance to support development, safety and environment protection and a strong role for communities (Canada 2018). It includes an express goal to '[E]nsure safe and environmentally-responsible shipping' (ibid. Goal 5.9). The OPP adopted by the Trudeau government in 2016 prioritized maritime safety and oil spill response in partnership with Indigenous peoples and coastal communities, including in the Arctic (Canada 2016). The numerous contemplated actions for the Arctic include the assessment of potential cumulative effects of shipping, modern hydrographic surveys, increasing the number of marine safety inspectors, extending the operational season of the Canadian Coast Guard and creation of CCG Auxiliary chapters, strengthening inshore rescue capacity, expanding the National Aerial Surveillance Program for marine pollution, and a real-time marine traffic information system accessible by local communities and local traffic management. The Polar Code has been implemented through new regulations. High profile is being given to Indigenous peoples, such as in land claims agreements and marine conservation areas that potentially interact with shipping. Canadian action in the Arctic Council and in the IMO with respect to the governance of shipping has been vigorous and sustained (Chircop et al. 2018). For example, Canada currently co-chairs the Shipping Expert Group of the Protection of the Arctic Marine Environment (PAME) working group with the United States, and in 2009 Canada was the first to table a full draft of the future Polar Code (ibid.). Canada has thus adopted a range of domestic measures, including investments in the North, and has taken steps to develop low-impact navigation corridors in Arctic waters with engagement of Indigenous communities (Chénier et al. 2017).

1.3 Objective and Contributors

Against the above backdrop, this book is multidisciplinary and investigates how ocean change and anthropogenic impacts affect our understanding of risk, policy, management and regulation for safe navigation, environment protection, conflict management between ocean uses and protection of Indigenous peoples' interests in Canadian Arctic waters. Some of the most pressing and under-addressed concerns in the governance of shipping are addressed, including conceptualization of risk types and risk governance strategies for risk-based ship design for ice loads, SAR and oil spill preparedness response planning, planning for the deployment of limited search and rescue assets and capabilities in remote regions, impact of ship noise on the marine environment, risks of heavy fuel oils, atmospheric emissions from ships producing impacts on public health and the environment, and safety of maritime workers.

These concerns were addressed at a workshop in Halifax, Nova Scotia, in August 2018, following which contributors, working in a team and/or individually, proceeded to research and write the chapters in this book. The contributors hail from

several disciplines and fields (anthropology, industrial engineering and risk management, law of the sea and maritime law, marine management, oceanography, social work, sociology) and countries (Canada, China, France, Germany, Italy, the Philippines, South Korea and Sweden), as well as personnel at the IMO participating in their personal capacities.

1.4 Structure

The book has 16 chapters divided in three parts, each chapter drawing individual and separate conclusions. Part A is on 'Rethinking Maritime Risks' and contains five chapters. The first contribution, Chap. 2, is entitled 'An Exploratory Application of the International Risk Governance Council's Risk Governance Framework to Shipping Risks in the Canadian Arctic' and is authored by Floris Goerlandt and Ronald Pelot. The chapter introduces the IRGC risk governance framework and explores its application for management strategies for risks associated with operation of ships and responding to requests for assistance in Arctic waters. It highlights the importance of articulating risk governance strategies aligned with the characteristics of the risks under consideration. Chapter 3 is entitled 'Historical Maritime Search and Rescue (SAR) Incident Data Analysis' and is authored by Mark A. Stoddard and Ronald Pelot. Using incident data from the Canadian Search and Rescue Program Information Management System database, the authors identify and visualize temporal and spatial patterns in maritime SAR activities. The work serves to highlight the potential benefits of enhanced cross-border coordination of SAR planning and response. This is followed by Francesco Munari's Chap. 4 on 'Search and Rescue at Sea: Do New Challenges Require New Rules?' Munari argues that the original conception of SAR and related responsibilities in international law needs to be updated to better reflect the diversity of situations demanding assistance at sea, such as emergency response resulting from activity by recreational vessels, cruise ships and venture vessels in dangerous waters, as well the increasingly pressing phenomenon of migrants in distress at sea. He demonstrates that traditional SAR necessitates additional forms of international cooperation. Authored by Jinho Yoo, Floris Goerlandt and Aldo Chircop, Chap. 5 further considers SAR through the lens of emerging technologies through a contribution entitled 'Unmanned Remotely Operated Search and Rescue Ships (RO-SARS) in the Canadian Arctic: Exploring the Opportunities, Risk Dimensions and Governance Implications'. The authors discuss the traditional Canadian approach and assets dedicated to Arctic SAR, noting the challenges in responding to requests for assistance in the large, harsh and remote environment as the region becomes increasingly accessible to diverse shipping. The chapter considers the role of autonomous technologies, including remotely operated unmanned ships, in addressing the gaps of SAR response in Canadian Arctic waters and discusses the related risk governance implications. Chapter 6 is the last in this part and redirects discussion to an emerging concern, in addition to the safety and environmental and SAR response risks

discussed by the previous chapters. In ‘Ambient Noise and Underwater Sound Propagation in the Canadian Arctic’, David Barclay, Emmanuelle Cooke and Clark Richards discuss ocean ambient noise and under-ice acoustic propagation and reverberation in the Canadian Arctic. An updated seasonal baseline for ambient noise in Barrow Strait is calculated and compared against historical measurements. The chapter observes that there is a role for underwater acoustic modelling in marine spatial planning to enable quantification of the impact of seasonal noise from industrial activity.

Shifting from maritime risk, the theme of Part B moves the discussion to ‘The Human Dimension’ through five chapters with a focus on Indigenous peoples and maritime workers in Canadian Arctic waters. The first two chapters consider Inuit conceptualizations and knowledge of Arctic spaces, which differ fundamentally from conceptualization for ocean policy, management and legal purposes and are key to decision-support systems in the region. In Chap. 7, Leah Beveridge discusses ‘Inuit Nunangat and the Northwest Passage: An Exploration of Inuit and Arctic Shipping Conceptualizations of and Relationships with Arctic Marine Spaces in Canada’. Beveridge notes that until recently Inuit have not participated in the governance of Arctic shipping but that there are now efforts to engage them through partnerships and collaboration. Drawing on ethnographic and anthropological literature, the author highlights the importance of understanding the Inuit worldview, exploring further the cross-cultural collaborations in the governance of shipping in Canadian Arctic waters. This is followed by Chap. 8 on ‘Knowledge and Data: An Exploration of the Use of Inuit Knowledge in Decision Support Systems for Marine Management’ co-authored by Claudio Aporta, Breanna Bishop, Olivia Choi and Weishan Wang. The co-authors discuss the significance of Inuit knowledge in the data hubs essential for coastal and ocean management in the Arctic and identify ontological tensions and difficulties in converting that knowledge to data. They propose an approach to integrating Inuit knowledge in decision-support systems and management tools.

The next three chapters address the situation of maritime workers on cruise, commercial and fishing vessels. Chapter 9 by Joseph Anthony Loot discusses ‘Seafarers and Arctic Cruise Shipping: Protecting Those Who Work While Others Explore and Sightsee’. Loot discusses the concerns of the wide range of workers on board cruise ships, including traditional seafarers responsible for the navigation of the ship, and the rest of the crew complement providing leisure, tourism, travel and hospitality services on board. He observes the dearth of data on these workers on Arctic cruise ships and argues for the need to profile their work and assess labour, employment and social conditions to ensure compliance with labour and human rights standards. Desai Shan follows with a focused discussion on traditional seafarers in Chap. 10 on ‘Mapping the Maritime Occupational Health and Safety Challenges Faced by Canadian Seafarers’. Shan draws upon qualitative semi-structured interviews with 25 Canadian seafarers and a preliminary legal review of Canadian maritime occupational health and safety law to discuss common challenges confronted by Canadian seafarers. She observes challenges related to climate change, intensified work-related mobility and insufficient legal protection. Moving

from seafarers, Part B concludes with Chap. 11, which looks at 'Insights from the History of Fishing Safety: Preparing for Increased Fisheries and Shipping in the Canadian Arctic', co-authored by Barbara Neis, Joel Finnis, Ronald Pelot and James Shewmake. Fishing has always been one of the most hazardous industries, and in the harsh operating conditions of the Arctic, the dangers are exacerbated. The authors make a strong case to study the history of occupational health safety aspects of fishing in subpolar and low-Arctic seas to anticipate and respond to the issues that can be expected to arise as fishing activity moves deeper into Arctic waters.

While various regulatory concerns are addressed in Parts A and B, Part C provides a more focused discussion on international standards for marine safety and vessel-source pollution in Arctic waters. Titled 'Regulating Shipping and Ocean Use', Part C consists of five chapters focusing on the governance of shipping through the IMO, ship emissions, the Polar Code and heavy fuel oil and includes a discussion on marine spatial planning. Setting the stage for subsequent chapters, Chap. 12 is on 'The IMO Regulatory Framework for Arctic Shipping: Risk Perspectives and Goal-based Pathways' and is co-authored by Anish Hebbar, Jens-Uwe Schröder-Hinrichs, Maximo Q. Mejia Jr., Heike Deggim and Sascha Pristrom. As the competent international organization with respect to international shipping, the IMO adopts global standards for safety, security and environmental performance of shipping. The chapter discusses the organization's goal-based approach to regulation and the instruments relevant to Arctic shipping, including the Polar Code, and approaches to implementation by flag and coastal states as well as regional cooperation. The next two chapters concern unfinished business in the regulation of the environmental aspects of polar shipping. Authored by Aldo Chircop, Chap. 13 is on 'The Regulation of Ship Emissions in Canadian Northwest Atlantic and Arctic Waters: Is there a Need for Consistency and Equity?' The author argues that while the Polar Code has raised standards for the prevention of vessel-source pollution, it stopped short of addressing the environmental impacts and public health concerns of ship emissions, including PM, SOx and NOx. The author argues for the designation of an emission control area in Canadian Arctic waters consistent with the standards applicable in the North American Emission Control Area. Chapter 14 concerns 'The Regulation of Heavy Fuel Oil in Arctic Shipping: Interests, Measures and Impacts' and is co-authored by Jiayu Bai and Aldo Chircop. The Polar Code failed to address HFOs in Arctic waters, and the IMO continues consideration on whether to adopt a standard for ships operating in Arctic waters similar to those in Antarctic waters, where HFOs are banned. The authors discuss the nature of the regulatory challenge and explore a possible strategy consistent with public and private maritime law. In Chap. 15, the discussion moves to the implementation of the Polar Code. In 'A Change in the Ice Regime: Polar Code Implementation in Canada', Drummond Fraser discusses how Canada proceeded with the implementation of the Polar Code through domestic regulation. While Canada continued to protect essential interests in its waters, it largely implemented the new international standards and effectively harmonized much of its domestic regulation. The last contribution is Chap. 16 authored by Annie Cudennec on 'Integrated Ocean and Coastal Zone Management in France: Some Perspectives'. This final chapter opens up

discussion to the national implementation of integrated ocean management pursuant to the regional policies and directives adopted by the European Union, focusing on the French approach and the challenges it faces in domesticating regional standards.

The editors and contributors hope that this book complements the existing literature by providing new insights into the complex challenges in the governance of Arctic shipping, especially in Canada. We hope that the findings in the various contributions will encourage further multi- and interdisciplinary scholarship. We further hope that the findings on planning, management and regulatory concerns will assist Canadian decision-makers in policy and law-making for Arctic shipping.

References

Aporta, C. (2010a). The sea, the land, the coast and the winds: Understanding Inuit sea ice use in context. In I. Krupnik, C. Aporta, S. Gearheard, G. J. Laidler, & L. Kielsen-Holm (Eds.), *Siku: Knowing our ice, documenting Inuit Sea ice knowledge and use* (pp. 163–180). Berlin: Springer.

Aporta, C. (2010b). Life on the ice. In L. Main Johnson & E. Hunn (Eds.), *Landscape ethnoecology: Concepts of biotic and physical space* (pp. 175–200). New York: Berghahn Books.

Arai, T., Harino, H., Ohji, M., & Langston, W. (Eds.). (2009). *Ecotoxicology of antifouling biocides*. Berlin: Springer.

Arctic Council. (2009). *Arctic marine shipping assessment 2009 report*. Tromsø: Arctic Council.

Beckman, R. C., Henriksen, T., Dalaker Kraabel, K., Molenaar, E. J., & Roach, J. A. (Eds.). (2017). *Governance of Arctic shipping: Balancing rights and interests of Arctic states and user states*. Leiden: Brill.

Boucquey, N., Fairbanks, L., Martin, K. S., & Campbell, L. (2016). The ontological politics of marine spatial planning: Assembling the ocean and shaping the capacities of 'community' and 'environment'. *Geoforum, 75*, 1–11. https://doi.org/10.1016/j.geoforum.2016.06.014.

Canada. (2016). *The Prime Minister of Canada announces the National Oceans Action Plan, Justin Trudeau Prime Minister of Canada*. https://pm.gc.ca/eng/news/2016/11/07/prime-minister-canada-announces-national-oceans-protection-plan. Accessed 24 Oct 2019.

Canada. (2018). *Canada's Arctic and Northern Policy Framework (Government of Canada)*. https://www.rcaanc-cirnac.gc.ca/eng/1560523306861/1560523330587. Accessed 24 Oct 2019.

Cape Town Agreement. (2012). Agreement on the Implementation of the Provisions of Torremolinos Protocol of 1993 relating to the Torremolinos International Convention for the Safety of Fishing Vessels, 1977 (adopted 11 October 2012, not in force).

Chang, S. E., Stone, J., Demes, K., & Piscitelli, M. (2014). Consequences of oil spills: A review and framework for informing planning. *Ecology and Society, 19*(2), 26.

Chénier, R., Abado, L., Sabourin, O., & Tardif, L. (2017). Northern marine transportation corridors: Creation and analysis of northern marine traffic routes in Canadian waters. *Transactions in GIS, 21*, 1085–1097.

Chircop, A. (2016). Sustainable Arctic shipping: Are current international rules for polar shipping sufficient? *Journal of Ocean Technology, 11*, 39–51.

Chircop, A., Pamel, P., & Czarski, M. (2018). Canada's implementation of the Polar Code. *Journal of International Maritime Law, 24*(6), 428–450.

DFO (Fisheries and Oceans Canada). (2016). *Oceans Action Plan*. http://www.dfo-mpo.gc.ca/oceans/publications/oap-pao/index-eng.html. Accessed 24 Oct 2019.

Ehler, W., & Douvere, F. (2009). *Marine spatial planning: A step-by-step approach to ecosystem based management*. Paris: UNESCO.

Engås, A., Løkkeborg, S., Ona, E., & Vold, A. (1996). Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences, 53*, 2238–2249. https://doi.org/10.1139/cjfas-53-10-2238.

EPPR (Emergency Prevention, Preparedness and Response Working Group). (2017). *Circumpolar oil spill response viability analysis: Technical report* (Arctic Council Report 9, Rev. 1. Doc. no. 110B3A5N-9). Tromsø: Arctic Council Secretariat.

Eykelbosh, A. (2014). *Short- and long-term health impacts of marine and terrestrial oil spills: A literature review prepared for the Regional Health Protection Program, Office of the Chief Medical Health Officer, Vancouver Coastal Health*. http://www.vch.ca/Documents/VCH-health-impacts-oil-spill.pdf. Accessed 24 Oct 2019.

Ford, J., & Clark, D. (2019). Preparing for the impacts of climate change along Canada's Arctic coast: The importance of search and rescue. *Marine Policy, 108*, 103662.

Hildebrand, L., Brigham, L., & Tafsir, T. M. (Eds.). (2018). *Sustainable shipping in a changing Arctic*. Berlin: Springer.

IMO (International Maritime Organization). (1985). General provisions on ships' routeing, IMO Doc. A572(14) (20 November).

IMO. (2009). Proposal to designate an Emission Control Area for nitrogen oxides, sulphur oxides and particulate matter submitted by the United States and Canada, IMO Doc. MEPC 59/6/5 (2 April).

IMO. (2014). *Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life,* IMO Doc. MEPC.1/Circ.833 (7 April).

IMO. (2015). *Amendments to the Revised Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas (Res A.982(24)),* IMO Doc. MEPC.267(68) (15 May).

IPCC (Intergovernmental Panel on Climate Change). 2019. *AR6 synthesis report: Climate Change 2022*. https://www.ipcc.ch/report/sixth-assessment-report-cycle/. Accessed 24 Oct 2019.

Ketten, D. R., Lien, J., & Todd, S. (1993). Blast injury in humpback whale ears: Evidence and implications. *The Journal of the Acoustical Society of America, 94*, 1849–1850.

Koračin, D., Dorman, C. E., Lewis, J. M., Hudson, J. G., Wilcox, E. M., & Torregrosa, A. (2014). Marine fog: A review. *Atmospheric Research, 143*, 142–175. https://doi.org/10.1016/j.atmosres.2013.12.012.

Lasserre, F., & Faury, O. (2019). *Arctic shipping: Climate change, commercial traffic and port development*. Abingdon: Routledge.

MLC. 2006. Maritime Labour Convention, 23 February 2006, Can TS 2013 No 16 (in force 20 August 2013).

Nevalainen, M., Helle, I., & Vanhatalo, J. (2017). Preparing for the unprecedented: Towards quantitative oil risk assessment in the Arctic marine areas. *Marine Pollution Bulletin, 114*(1), 90–101. https://doi.org/10.1016/j.marpolbul.2016.08.064.

Østreng, W., Eger, K. M., Fløistad, B., Jørgensen-Dahl, A., Lothe, L., Mejlaender-Larsen, M., & Wergeland, T. (Eds.). (2013). *Shipping in Arctic waters: A comparison of the Northeast, Northwest and trans polar passages*. Berlin: Springer.

Polar Code. (2014/2015). International Code for Ships Operating in Polar Waters (Polar Code), IMO Resolution MSC.385(94) (21 November 2014, effective 1 January 2017); Amendments to the International Convention for the Safety of Life at Sea 1974, IMO Resolution MSC.386(94) (21 November 2014, effective 1 January 2017); Amendments to MARPOL Annexes I, II, IV and V, IMO Resolution MEPC.265(68) (15 May 2015, effective 1 January 2017). http://www.imo.org/en/MediaCentre/HotTopics/polar/Documents/POLAR%20CODE%20TEXT%20AS%20ADOPTED.pdf. Accessed 17 Oct 2019.

Richardson, W. J., Greene, C., Malme, C., & Thomson, D. (1995). *Marine mammals and noise*. San Diego: Academic Press.

Rolland, R. M., Parks, S. E., Hunt, K. E., Castellote, M., Corkeron, P. J., Nowcek, D. P., Wasser, S. K., & Kraus, S. D. (2012). Evidence that ship noise increases stress in right whales. *Proceedings of the Royal Society of London B: Biological Sciences, 279*, 2363–2368. https://doi.org/10.1098/rspb.2011.2429.

Rothwell, D. R. (2018). *Arctic Ocean shipping: Navigation, security and sovereignty in the North American Arctic* (Brill Research Paper Series). Leiden: Brill.

Slabbekoorn, H., Bouton, N., van Opzeeland, I., Coers, A., ten Cate, C., & Popper, A. N. (2010). A noisy spring: The impact of globally rising underwater sound levels on fish. *Trends in Ecology and Evolution, 25*(7), 419–427. https://doi.org/10.1016/j.tree.2010.04.005.

Snider, D. (2018). *Polar ship operations: A practical guide* (2nd ed.). London: Nautical Institute.

STCW. (1978/2016). International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 7 July 1978, 1361 *UNTS* 2 (in force 28 April 1984); Amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended, IMO Resolution MSC.416(97)(25 November 2016, effective 1 July 2018); Amendments to Part A of the Seafarers' Training, Certification and Watchkeeping (STCW) Code, IMO Resolution MSC.417(97)(25 November 2016, effective 1 July 2018).

UNESCO. n.d. *Marine spatial planning*. http://msp.ioc-unesco.org/about/marine-spatial-planning/. Accessed 24 Oct 2019.

Urick, R. J. (1984). *Ambient noise in the sea*. Washington, DC: Catholic University of America Press.

Weigart, L. S. (2007). A brief review of known effects of noise on marine mammals. *International Journal of Comparative Psychology, 20*(2–3), 159–168.

Wright, C. (2016). *Arctic cargo: A history of marine transportation in Canada's north*. Marquis Book Printing.