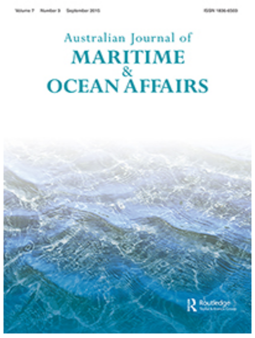

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The emergence of Arctic shipping: issues, threats, costs, and risk-mitigating strategies of the Polar Code

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Commercial shipping in the Arctic region presents significant financial incentives through reduced transit times and opportunities for natural resource activities. However, it also presents significant risks for the safe navigation of vessels and increased environmental pollution. This paper describes the factors that are promoting the expansion and inhibition of commercial shipping in the Arctic region. It explains the hazards of Arctic shipping and classifies threats to the environment under oil pollution, aquatic species invasion, marine mammal displacement, and carbon emissions. The costs described relate to underwriter and insurance premiums. The paper also describes the risk-mitigating elements of the International Code for Ships Operating in Polar Waters (Polar Code). The paper concludes to highlight the need for a deeper understanding of associated risks by stakeholders before sea routes in the Arctic region are fully commercialised for maritime use.

Introduction

The Arctic region is undergoing rapid and dynamic change. Human activity and global warming are attributed to Arctic temperatures rising by more than twice the world's average since 1980, which is causing rapid melting and receding of sea ice, and stimulating an accelerated expansion in commercial shipping and natural resource activities such as mining, oil and gas exploration, and commercial fishing throughout the region (*The Economist*, 24 March 2012; United Nations Environment Programme (UNEP) 2013, 4). In response to the growing concerns of risks posed to the Arctic environment from increasing commercial shipping, the International Maritime Organization (IMO) has responded with the adoption of the International Code for Ships Operating in Polar Waters (Polar Code) in November 2014. The Code prescribed minimum standards for vessel construction, safety, and environmental protection (International Maritime Organization (IMO) 2015a). This paper will examine the factors promoting and inhibiting the growth of commercial shipping in the Arctic region. Emerging environmental issues through increasing commercial shipping, such as oil pollution, invasive aquatic species from ships ballast water, marine mammal displacement, and carbon emissions, will be explored, and possible strategies for addressing these issues will be discussed. Hazards and safety issues relating to commercial vessels operating in extreme Arctic environments are described. Costs and insurance considerations are explored, and the risk-mitigating elements of the Polar Code are discussed.

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Factors promoting and inhibiting Arctic shipping growth

The Arctic region is an ocean surrounded by the partial landmasses of the Russian Federation, Canada, the USA, Iceland, Greenland, Norway, Sweden, and Finland, and is broadly defined as being above the Arctic Circle (the imaginary line that circles the globe at 66°N of the equator) (UNEP 2013, 5). Trans-Arctic shipping is generally facilitated via three traditional routes: the Northern Sea Route (NSR) which is the most accessible route due to less ice coverage and follows the Russian Federation's northern coastline; the North West Passage (NWP) which follows Canada's northern coastline; and the Trans-Polar Route (TPR) which bisects the Arctic Ocean through the North Pole (Buixade Farre et al. 2014, 299–300). Figure 1 provides an example of a map showing the NSR, the NWP, and the TPR (Foreign Affairs, 11 December 2014).

Rapidly receding sea ice is yielding intense commercial interest for a viable trans-Arctic shipping route as an alternative to less economically attractive traditional routes between Asia and Europe, resulting in significant commercial shipping increases throughout the region (Buixade Farre et al. 2014, 299). For example, a vessel transiting between Shanghai and Rotterdam via the Cape of Good Hope undertakes a voyage of 14,000 nautical miles. The same voyage when undertaken via the Suez Canal using the Suez route reduces the distance by 23%. However, the same voyage undertaken via the NSR reduces the distance by an additional 24% (Buixade Farre et al. 2014, 301), providing a considerable advantage over other routes in terms of transit time and fuel consumption.

Shipowners utilising the NSR are able to reduce transit times between Asia and Europe by an average of seven days, achieve more rapid turn-around times, avoid high-risk piracy areas such as the Gulf of Aden and Somalia, and realise bunker savings of approximately $650,000 per journey (Fair Observer, 14 February 2014). In conjunction with receding sea ice, the effect of these

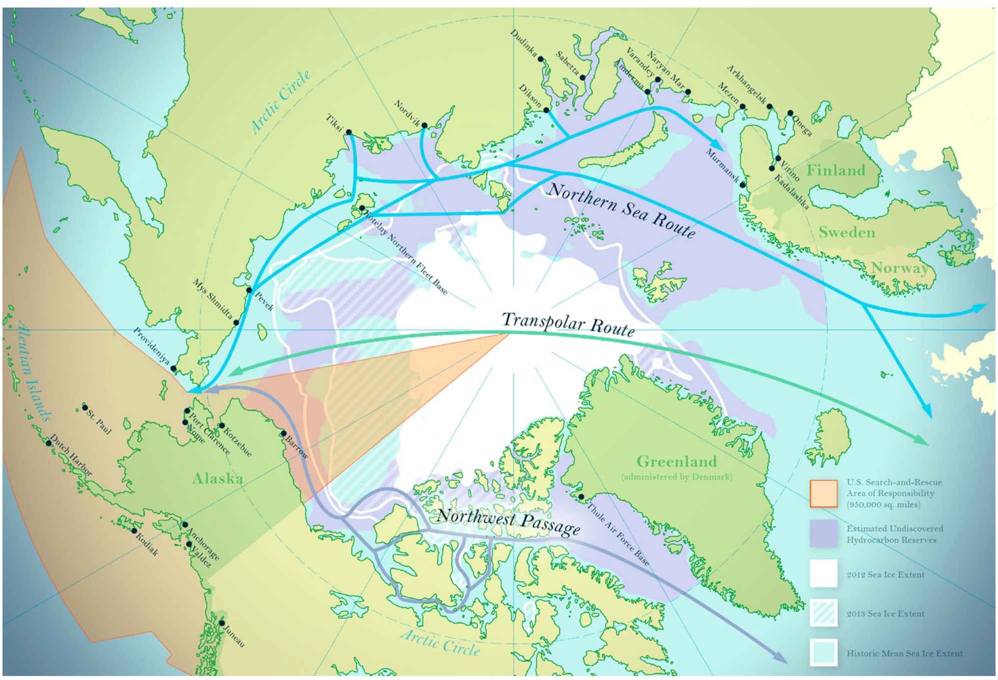

Figure 1. The Arctic shipping routes.
Source: https://www.foreignaffairs.com/articles/united-states/2014-12-11/breaking-ice

economic incentives may have contributed to the accelerating rate of shipping numbers in the Arctic region. For example, in 2010, only four commercial cargo vessels transited the complete NSR; in 2011 the number grew to 34; in 2012 the number grew to 46; and in 2013 the number grew to 71. However, Western economic sanctions on Russia due to Russian involvement in the Ukraine conflict are attributed to a significant reduction in NSR shipping numbers (down to 53 primarily Russian flagged vessels) in 2014 (Council on Foreign Relations [CFR], 16 December 2013; Reuters, 22 January 2015).

Yet despite the growing optimism for Arctic shipping, the following disincentives remain:

- The NSR is only ice free for between 2 and 4 months a year at present, with forecasts of 90–100 days ice free by 2080;
- Navigation risks due to heavy ice in winter and ice floes and icebergs during summer ice-free periods;
- Very little infrastructure for vessels to call on for assistance when required;
- Sections of the NSR have poor navigation charts;
- Weather and ice unpredictability is discouraging to 'just-in-time' cargo charters typically used with the containerised liner market;
- Increased risks to the environment through oil spills;
- Introduction of invasive aquatic species in ships' ballast water;
- Marine mammal displacement due to increased shipping noise;
- Vessel emissions such as black carbon, NO_x and SO_x; and
- High costing of risks by underwriters (EUObserver, 6 July 2011).

Arctic shipping hazards

Weather and environmental conditions in the Arctic are extremely hazardous for vessels navigating through the region, with the presence of ice perhaps presenting the greatest risk of all. The accelerating rate of shipping has raised international concerns over vessel safety and protection of the marine environment, resulting in the IMO adopting the Polar Code which provides standards for vessel construction and environmental regulations for vessels operating in polar waters, and is expected to come into force in January 2017 (INCE & CO, 17 November 2014). Navigation in the Arctic brings unique hazards such as atmospheric refractions resulting in mirages; low ice-covered land formations; lack of navigational aids or markers; no designated traffic segregation scheme; months of complete darkness; erratic compass readings due to anomalies in the earth's magnetic field; and less reliable navigation and satellite communications due to ionosphere interference (WWF 2014a, 5). In addition to this, broadband satellite communications are extremely slow or non-existent, leading to unreliable weather and ice reporting information to assist in safe navigation (Canadian Sailings, 15 November 2014).

Ice accretion through sea spray coming into contact with the vessel's deck, deck fittings, and superstructure when the air temperature is sub-zero can dangerously reduce stability due to the accumulated mass of ice above the vessel freeboard deck, and present other dangers such as radar failure, aerial insulator failure, mast navigational instrument failure, malfunctioning deck machinery, blocked tank and cargo hold vents, reduced visibility through bridge windows, and physical dangers to the crew attempting to remove the accumulated ice (Green4Sea, 30 September 2014). Floating ice is extremely hazardous and takes many forms. Land-based and glacial in origin, icebergs and ice islands are extremely hard and may cause catastrophic damage through collision. Smaller pieces of icebergs, known as bergy bits and growlers, are even more hazardous especially in the presence of pack ice and in large swell or storm conditions, as they are difficult to detect visually and by radar, and are hard enough to breach a vessel's hull (Oil Companies International Marine Forum (OCIMF) 2014, 15).

The thickness and hardness of sea ice greatly affect navigational performance, with multi-year ice being harder than first year ice. Hull friction becomes a factor through the amount of snow cover on the ice, while ice deformation and accumulation due to wind and ocean currents can be a significant navigational obstacle even for ice breakers (OCIMF 2014, 15). Ice pressure, a significant aspect of ice deformation, is particularly hazardous due to the vessel's reduced ability to manoeuvre and clear ice ridges and break ice. The vessel's propeller, rudder, and hull may become beset in the ice under significant forces which may be sufficient to cause a hull breach (OCIMF 2014, 15).

Apart from ice and severe sub-zero temperatures, other serious navigation hazards exist through the lack of seabed hydrography surveys. Less than 10% of the Arctic Ocean is charted to international standards. The hazards of this are clearly illustrated with the cruise ship 'Clipper Adventure' grounding on an uncharted rock shelf off Kugluktuk, and the fuel tanker 'Nanny' grounding off Gjoa Haven in 2010 (WWF 2014, 5). There are significant draft and beam restrictions, particularly along the NSR where commercial vessels must pass through narrow and shallow straits such as the Yugorskiy Shar Strait situated at the southern entrance from the Barents Sea to the Kara Sea, which is 21 nautical miles long and 12–30 metres deep, and along the Dimitry Laptev Strait which is less than 10 metres deep (The Arctic Institute, 11 October 2012).

Considerable risks are also presented should a vessel suffer ice or heavy weather damage, grounding, or machinery failure, through the extreme remoteness of the region; lack of significant ports; lack of infrastructure including medical assistance; lack of icebreakers and support helicopters; vast distances between salvage or repair facilities; and inadequacy of salvage and repair facilities to cope with such a disaster (Smith School of Enterprise and the Environment 2011, 11; Brink, 16 April 2015). Additional hazards may be introduced if vessel crews are not appropriately prepared and trained for the hazards that navigation in extreme sub-zero temperatures brings. Personnel must be outfitted with proper thermal protective clothing and provided with ice removal equipment that allows regular ice accretion removal from deck superstructure. Deck officers need to be trained and proficient with ice navigation, including identification of ice formations and characteristics; vessel manoeuvrability in ice; understanding of hull stresses from ice pressure; ice escort operations; ice accretion and stability issues; ice breaking operations; and ice indications (OCIMF 2014, 4). Specialised training in polar vessel operations requires personnel with proven polar ship operating expertise. However, there is a lack of such personnel (Baird Maritime, 19 January 2012).

Oil pollution risks

An increase in trans-Arctic commercial shipping will attribute to large vessels carrying millions of tons of heavy fuel. With an estimated 40 million tons of oil and gas forecast to be shipped annually through the region by 2020, oil pollution is one of the most challenging threats faced by the Arctic maritime region (*Huffington Post*, 12 December 2012). Support required for oil spill clean-up activities is starkly limited, and in conjunction with extreme weather; sea ice; equipment icing; prolonged darkness; a fragile ecosystem; and mechanical oil spill recovery rates of only 1–5% possible in icy waters, a significant oil spill would be an environmental catastrophe (Knol and Arbo 2014, 171–176). With the development of the Polar Code, the IMO seeks to manage shipping-related oil pollution risks through amendments to MARPOL Annex I, which introduces mandatory environmental regulations designed to prevent oil pollution, and vessel safety through rules defining ship structure, stability, machinery and operational safety, navigation, fire safety, life-saving appliances, communications, manning and training, and voyage planning criteria (INCE & CO, 17 November 2014).

The Polar Code is seen as a positive step in controlling the safety and environmental risks of shipping in the Arctic. However, despite heavy fuel being identified as the most significant environmental risk through oil pollution by the Arctic Council, and a complete heavy fuel ban in the Antarctic due to the same environmental risks, the Polar Code only makes a non-mandatory recommendation to refrain from carrying heavy fuel oil as cargo or fuel in the Arctic, an aspect which draws continued debate amongst stakeholders, particularly environmental groups which see this as putting the environment at risk (INCE & CO, 17 November 2014).

Recognising the benefits of an oil spill response with coordination and cooperation of member states, the Arctic Council has adopted the 'Agreement of Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic', which permits rapid sharing of communication and resources across borders in the response to an oil spill, collaborative clean-up efforts, and public after action reviews (Scientific America, 30 May 2013). Oil spill response groups in conjunction with scientific research indicate the current best practice cleanup methods are mechanical recovery, *in situ* burning, remote sensing, and the application of dispersants, with the choice of method depending upon the distance from land, depth of water, environmental sensitivity, weather conditions, ice drift, and ice coverage (DNV GL 2014, 1).

While chemical dispersants are less efficient in icy waters, criticised for their marine biota toxicity, relatively untested in Arctic waters, and have limited time frames for application, environmental scientists have identified the bacteria 'Oleispira Antarctica' may hold a biotechnical solution to oil spills in Arctic waters, with its ability to break down oil spills by converting hydrocarbons into fatty acids, with the absence of any toxicity seen as hugely positive (The Pew Charitable Trusts, 1 September 2013; Helmholtz Centre for Environmental Research, 26 September 2013). Technological advances and managerial regulations may lessen the harmful consequences of an oil spill. However, the region's remoteness, lack of infrastructure, and extreme weather conditions continue to be major challenges to be overcome in responding to a significant Arctic oil spill (Muir 2008, 39).

Invasive aquatic species

Commercial shipping causes billions of tons of ballast water to be transferred around the globe annually, resulting in significant ecological and economic damage through the transfer of marine aquatic species such as bacteria, eggs, cysts, small invertebrates, microbes, and larvae in ships ballast water, which often multiply into pest proportions in the new environment, become invasive, and displace native species (IMO 2015b), causing an ecological misbalance. Past research (Mineur et al. 2007, 1300) suggests that introduction of non-indigenous marine species in the marine environment is a major contributor to vessel biofouling. Biofouling causes layers of microbes to form a biofilm on the external hull of the vessel to which bacteria, algae, and barnacles attach themselves creating large growths. Such large growths in commercial vessels can transport large amounts of marine organisms (Winner 2013, 9).

IMO has prepared and provided *Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species* to assist Member States who wish to identify measures to minimise species invasion (IMO 2015d). Countries like Australia (The Department of Agriculture, Fisheries & Forestry (DAFF) 2011) and Canada (Chan et al. 2011) have carried out a risk assessment to identify and determine the risks associated with the spread of marine pest species as biofouling. However, the Arctic region is one of the regions of the world that has not had such significant biological evaluations undertaken of their marine environments (DAFF 2011, 6). The Polar Code also fails to address issues of invasive species associated with ballast water discharge and biofouling (Fernandez et al. 2014, 42).

The fragile Arctic marine environment is seen to be particularly susceptible to invasive aquatic species, which may multiply in the warming, ice receding waters. The IMO has adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) by establishing benchmarks and standards for ships' ballast water discharges. However, it is yet to be ratified. Although the Polar Code recommends all vessels transiting the Arctic region to adopt the standards prescribed in the BWM Convention, it is not mandatory to do so.

Shipping routes through the Panama or Suez Canals involve vessels moving from cold to warm waters, and with the Panama Canal being fresh water, the temperature transition and osmotic shock mean many marine organisms carried in ballast water cannot survive (Smithsonian, 29 May 2014). Northern east–west routes through the Arctic lack the temperature and salinity changes of traditional routes, making survival of ballast water organisms much more likely and requiring more stringent management controls, and highlights the non-mandatory aspect of ballast water management set out in the Polar Code as leaving the environment exposed (Smithsonian, 29 May 2014).

Marine mammal displacement

The Arctic region's ambient noise environment is much more complex than other marine environments. With many Arctic marine areas having extremely limited exposure to underwater noise pollution from commercial shipping, marine mammals which are extremely sensitive to underwater noise are at risk of displacement from their natural environment or feeding grounds, and subject to interference with their ability to communicate, detect prey and predators, and navigate, and may cause hearing loss and even death (IMO 2010). For example, beluga whales have been reported to demonstrate avoidance behaviour 35–50 kilometres from an icebreaker which is detrimental to mothers and calves (IMO 2010; Transport and Environment, 29 November 2014). Despite the Polar Code requiring commercial vessels to keep clear of marine mammals, icebreakers generate significant noise when breaking through ice, and are often louder than most large commercial vessels in open waters due to their large propulsion machinery.

Noise from ships' propellers, machinery, and hull can largely be reduced through design or operational solutions, such as correct matching of propeller to hull form to reduce propeller inefficiencies; hull and propeller attachments to increase flow efficiencies; hull bubble curtains which lubricate the hull and also act to insulate machinery noise; operational speed reduction; increased propeller maintenance to repair damaged blades, and resilient mounting of main and auxiliary machinery; however, many commercial vessel engine sizes make this physically and commercially impossible (WWF 2014b). In response to mounting calls for reducing noise levels of commercial shipping, the Design and Equipment Subcommittee of the IMO has drafted technical advice and voluntary guidelines which recommend consideration of propeller and hull matching, model testing during vessel design phase, careful consideration of vessel machinery selection and installation, and increased maintenance to keep hulls and propellers clean (Wright 2014, 40).

As an example of how maritime nations can implement positive outcomes towards noise reduction strategies, the US government has legislated to address concerns with respect to the consequences of anthropogenic sound on marine mammals through the Endangered Species Act (ESA), the National Environmental Policy Act (NEPA), and the Marine Mammal Protection Act (Clark et al. 2012, 291). These acts specify methods employed to protect marine mammals from noise and include scheduling sound-generating activities to limit co-occurrence, utilisation of the minimum necessary sound source, use of noise attenuating devices such as bubble curtains, pre-sound activity surveys to ascertain the absence of marine mammals before commencing work, and observers or passive acoustic arrays utilised to ensure safety radius around sound source (Clark et al. 2012, 293).

Carbon emissions

Carbon emissions have a significant effect on Arctic climate warming. Although carbon dioxide remains in the atmosphere for hundreds of years, and black carbon remains in the atmosphere for days or weeks, the latter is a more potent climate forcer than carbon dioxide (UNEP 2013, 5). This was supported in a study by the International Geosphere-Biosphere Programme (Global IGBP Change, 15 January 2013), which concluded black carbon as the second most significant climate-warming agent after carbon dioxide with an estimated warming effect of 1.1 Watts per square metre. The study also attributed that the rapid warming of northern hemispherical high latitudes to this key atmospheric pollutant.

UNEP (2013, 5) indicates that rapid reductions in atmospheric pollutants such as black carbon can reduce Arctic warming over the next ten years by two-thirds, reduce global temperature rises below 2°C, prevent millions of respiratory-related deaths, and evade annual crop losses of up to 30 million tons. As Arctic sea ice melts and commercial shipping in the region increases, harmful atmospheric emissions such as carbon dioxide, carbon monoxide, nitrogen oxides, sulphur oxides, and particulate matter including black carbon are anticipated to increase (MarineLink, 14 February 2015). Apart from reduced environmental impacts from accidental oil spill and reduced sludge generation, a ban on heavy fuel would result in a corresponding change to low-sulphur marine distillate or biofuels, would permit more effective emission management technology such as particulate filters, and could result in up to 80% black carbon emissions reduction (Griffith 2014, 15). Another area of consideration is expanding northern latitude Emissions Control Areas (ECA), which come under the IMO MARPOL Annex VI framework, which focuses on fuels and technologies to regulate emissions, such as through low-sulphur distillate fuels, exhaust scrubbers, diesel particulate filters, and liquefied natural gas (The University of Texas, 18 November 2013).

Underwriting considerations

Financial costs are a significant consideration for shipowners intending to operate vessels through the Arctic region. The Northern Sea Route Administration (NSRA) currently requires all vessels transiting the NSR to pay a permit fee and may require escorting by Rosatomflot nuclear icebreakers at a cost of approximately US$200,000 (Marsh 2014, 5). Vessels must also meet the criteria detailed by the NSRA and insurance underwriters, such as ice class, intact stability enhancements, improved communications systems, survival equipment, and the 'winterisation' of vessels. Winterisation is a process which enables vessels to operate in extreme sub-zero temperatures without suffering loss of equipment operability, vessel stability and power, and personnel habitability, and permits crew operations to be performed safely. Class regulations require equipment and systems to be winterised through the use of low-temperature non-brittle grade steel; ice removal equipment such as steam lances; under-deck heating; trace heating for walkways, stairs, and handrails; protective machinery covers; heating arrangements for drain piping and fluid systems; heated cargo and tank vent covers; heated ballast tanks; low temperature working fluids; heated mooring equipment; heated cargo manifolds; low temperature electrical cables and installations; low temperature emergency generators and essential safety systems; internal space heating; low temperature fire-fighting equipment; enclosed and heated lifeboats; and ice navigation radar and dedicated ice searchlights (Hasholt 2011, 20–27).

Protection and Indemnity (P&I), Hull and Machinery (H&M), and Cargo insurance are important and considerable cost items. It is essential for shipowners wishing to engage in Arctic shipping to collaborate carefully with marine insurers, who hold significant concerns over a profusion of safety and navigation issues (The Maritime Executive, 21 August 2014). Minimal historical loss records make it an extremely complex process for marine insurance underwriters to place a cost on premium rates; despite P&I and hull insurers holding an abundance of knowledge and data on the conventional risks associated with shipping, operating in the Arctic presents significant risks which may lead to groundings, machinery breakdowns, stranding, ice damage, severe weather damage, and fire should machinery break down or pumps fail to operate (Marsh 2014, 6).

Arctic nations are bound by the Arctic Search and Rescue Agreement to provide search and rescue services in designated geographical locations (Arctic Council 2011, 5). However, London-based marine insurance underwriters are not persuaded that salvaging of vessels can be achieved successfully, and hold the view that given the extreme remoteness of the region, any collision or grounding is anticipated to result in an actual total loss (Clyde&Co, 18 November 2013). This is supported by Marsh (2014, 6–7), describing small incidents are likely to escalate when the nearest assistance is thousands of nautical miles away – even if the incident occurred within sections of the NSR where the Russian Federation's fleet of nuclear icebreakers operate, they cannot be relied upon to provide salvage operations as the vessels are not designed for this work. Salvage operations must be performed before winter returns with additional potentially catastrophic effects of extreme sub-zero temperatures, darkness, and ice, making salvage operations a considerably more difficult challenge, as it would be almost impossible to perform underwater surveys; the likelihood that pumps and other essential equipment may not be able to be operated in such conditions; the unlikelihood that lightering operations could be performed; non-existent repair facilities; and the sensitivity and importance of time pressures.

NSRA regulations require all vessels transiting the NSR to be constructed to Ice Class 1A standard or be escorted by an icebreaking vessel; however, in January 2013 this regulation was amended as a result of receding sea ice, to permit vessels transiting the NSR without icebreaker assistance when the route is completely free from ice (Clyde&Co, 18 November 2013). Yet regardless of this, insurance underwriters will not usually contemplate insuring vessels transiting the NSR without being assisted by ice-breaking vessels and being suitably ice classed, and in addition, policies may insist the transit be made during specific time frames and weather conditions, which means that one-off journeys would expose the shipowner to exorbitantly priced premiums and contemplate a significantly inflated policy deductable known as the 'ice deductable' (Clyde&Co, 18 November 2013).

Vessels are required to meet more stringent construction standards that meet NSRA and insurance requirements in response to the dangers to hull damage from ice. In an effort to harmonise a number of vessel ice class standards, the International Association of Classification Societies (IACS) developed a standardised global ice classification specification in August 2006 through a document titled the 'Unified Requirements for Polar Ships' which designates the following ice classes: PC1 – year-round operation in all polar waters; PC2 – year-round operation in multi-year ice conditions; PC3 – year-round operation in second-year ice which may include multi-year ice inclusions; PC4 – year-round operation in thick first-year ice which may include old ice inclusions; PC5 – year-round operation in medium first-year ice which may include old ice inclusions; PC6 – summer/autumn operation in medium first-year ice which may include old ice inclusions; and PC7 – summer/autumn operation in thin first-year ice which may include old ice inclusions (Marsh 2014, 6).

While H&M premiums insure the vessel, P&I insurance on the other hand provides coverage for items such as pollution, crew injury, hospitalisation, as well as wreck removal and salvage – both significant considerations under the Nairobi International Convention on the Removal of Wrecks, which requires vessels 300GRT and above which are registered in signatory states or calling at ports in signatory states to be certified as having sufficient insurance cover for wreckage removal, and without adequate search and rescue/salvage infrastructure along the NSR, this could be extremely costly if not an impossible undertaking (Marsh 2014, 8). Oil pollution represents a major consideration for P&I insurance underwriters. Support required for oil spill clean-up activities is severely limited due to issues such as remoteness, extreme weather, sea ice, equipment icing, prolonged darkness, and mechanical oil spill recovery rates of only 1–5%, indicating that any significant oil spill would likely be an environmental and insurance catastrophe (Knol and Arbo 2014, 171–176). National and international standards required by ice navigators and crew members of vessels transiting the Arctic region are insufficient, a factor which represents a significant P&I insurance issue, as vessels are likely to be manned with insufficiently trained and experienced personnel, who are required to operate in arduous conditions, low temperatures, with long periods of intense concentration while searching for ice hazards often in darkness, which requires personnel to be both highly trained and highly experienced (Marsh 2014, 8).

Risk management and the Polar Code

Growing concern over the risks posed from Arctic shipping and related environmental safety has been the catalyst for the Polar Code, which defines minimum benchmark standards for vessel construction safety, which are further detailed and certified on vessels by classification societies, and applies to new vessels constructed after January 2017 and applies to vessels constructed before that date by either the first renewal or intermediate survey after 1 January 2018 (IMO 2015a). The Polar Code goes about managing the risks of Arctic shipping by defining objectives and functional prerequisites relating to watertight and weathertight integrity; ship structure; stability and structural subdivision; operational safety; fire protection and safety; machinery installations; navigational safety; life-saving arrangements and appliances; communications; vessel manning and personnel training; voyage planning; and prevention of pollution by garbage disposal, noxious liquid substances, oil, and sewage (IMO 2015a).

Vessels wishing to operate in polar waters shall be required to apply for a Polar Ship Certificate, which classifies the vessel as either a Category A vessel – designed for polar waters operation in at least medium first-year ice which may include old ice inclusions; Category B vessel – vessel not included in Category A designed for polar waters operation in at least thin first-year ice which may include old ice inclusions; or Category C vessel – designed to operate in open water or in ice conditions less severe than Categories A and B (IMO 2015a). Prior to a certificate being issued, an assessment is required taking into consideration the expected range of hazards and operational conditions the vessel would be likely to encounter, any identified operational constraints, and detailed plans, safety equipment, and procedures that would alleviate safety and environmental incidents, and in addition to this, the vessel is required to hold a Polar Waters Operational Manual, which provides the vessels master, crew, owner, and operator the required information necessary to support operational capabilities and limitations and enhance decision-making processes (IMO 2015a).

Conclusion

Rapidly receding sea ice is paving the way for increased commercial shipping throughout the Arctic region, driven by commercial interests in developing a viable alternative to traditional routes between Asia and Europe, and in exploring opportunities to expand natural resource activities such as fishing and oil and gas exploration. However, increasing commercial shipping throughout the region is also introducing increased risks to the Arctic environment through possibilities of vessel groundings, collisions, oil spills, pollution, and other environmental impacts. In addition to this, the region's remoteness, lack of support, untested search and rescue infrastructure, lack of ports for refuge, lack of accurate well-researched hydrographic charts, and shortage of experienced and well-trained crews further amplify the risks of navigating vessels through these icy waters.

Financial costs are a significant consideration for shipowners intending to operate vessels through the Arctic region. Vessels transiting the NSR must meet the NSRA permit fee, while shipowners must ensure their vessels meet the strict criteria specified by the NSRA and marine insurance underwriters, such as winterisation and structural considerations that improve the safety of the vessel and crew. Marine insurance underwriters have significant challenges in placing a price on the risks of operating a vessel throughout the Arctic due to the lack of historical records. In addition to this, the number of significant risks the region poses such as lack of search and rescue infrastructure, salvage vessels, support bases, and significant ports means any collision or grounding is likely to result in an actual total loss. Further adding to this aspect, the Nairobi International Convention on the Removal of Wrecks requires vessels to be certified as having sufficient insurance cover for wreckage removal; yet in the absence of adequate search, rescue, and salvage infrastructure, this could be extremely costly if not an impossible undertaking.

The Polar Code has been introduced by the IMO to manage the risks of Arctic shipping, by defining standards and operational prerequisites regarding vessel structural integrity, emergency and life-saving requirements, personnel safety and training, navigational planning, and enhanced environmental regulations; however, a revision is required to incorporate or make mandatory essential measures required for safe navigation of vessels. To realise the full commercial benefits of Arctic shipping and to compare traditional shipping routes with Arctic routes for informed decision-making, it is essential for stakeholders to have an in-depth understanding of the risks and hazards. Currently, the associated risks are not understood sufficiently for underwriters to price insurance for Arctic transit with certainty.

Notes on contributor

Samrat Ghosh is currently employed as a lecturer at the Australian Maritime College (University of Tasmania). Christopher Rubly is currently employed as a project engineer with Teekay Shipping (Port Hedland).

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